FINAL
KNKT.12.03.06.04

# NATIONAL TRANSPORTATION SAFETY COMMITTEE

Aircraft Accident Investigation Report

**PT. Airfast Indonesia**

**Eurocopter AS 350B3 ; PK–ODA**

**Mt. Zaagkam, Papua**

**Republic of Indonesia**

**17 March 2012**

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2013

This Final report was produced by the National Transportation Safety Committee (NTSC), 3rd Floor Ministry of Transportation, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

The report is based upon the investigation carried out by the NTSC in accordance with Annex 13 to the Convention on International Civil Aviation Organization, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 3/2001).

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# ABBREVIATIONS AND DEFINITIONS

| | | |
|---|---|---|
| AFE | : | Airfast Indonesia call-sign |
| AOC | : | Air Operator Certificate |
| ATS | : | Air Traffic Service |
| BASARNAS | : | *Badan Search and Rescue Nasional* / National search and Rescue Agency |
| BMKG | : | *Badan Meterologi Klimatologi dan Geofisika* / Indonesia Agency Meteorology Climatology & Geophysics |
| CASR | : | Civil Aviation Safety Regulation |
| CFIT | : | Controlled Flight Into Terrain |
| CPL | : | Commercial Pilot License |
| CSN | : | Cycles Since New |
| CVR | : | Cockpit Voice Recorder |
| DGCA | : | Directorate General Civil Aviation |
| ELT | : | Emergency Locator Transmitter |
| FDR | : | Flight Data Recorder |
| GPWS | : | Ground Proximity Warning System |
| ICAO | : | International Civil Aviation Organization |
| IFR | : | Instrument Flight Rules |
| ILS | : | Instrument Landing System |
| Kg | : | Kilogram(s) |
| Km | : | Kilometer(s) |
| Mm | : | Millimeter(s) |
| MP | : | Mile Post |
| KNKT / NTSC | : | *Komite Nasional Keselamatan Transportasi* / National Transportation Safety Committee |
| PIC | : | Pilot in Command |
| CVR | : | Cockpit Voice Recorder |
| FDR | : | Flight Data Recorder |
| TSN | : | Time Since New |
| UTC | : | Universal Time Coordinate |
| VFR | : | Visual Flight Rules |
| VMC | : | Visual Meteorological Conditions |

# INTRODUCTION

## SYNOPSIS

On 16 March 2012 at 0702 LT (2202 UTC[1]) a Eurocopter AS350B3 helicopter registration PK-ODA departed from Timika Airport[2] Papua. The helicopter operated by PT. Airfast Indonesia was on an unscheduled charter flight by Freeport Indonesia Company. The flight was planned from Timika to Utikinagon (helipad) – Mile post (MP) 66 (helipad) – Wanagon (helipad) – MP 66 – Timika.

The helicopter carried four passengers and food supplies to Utikinagon. At Utikinagon the helicopter dropped three passengers and food supplies then picked up another three passengers. The helicopter flew to MP 66 with four passengers on board. At MP 66 the helicopter disembarked three passengers and picked up the food supplies, to be delivered to Wanagon.

At Wanagon the helicopter dropped one passenger and the food supplies and picked up two passengers and returned to MP 66. During the flight to MP 66, the pilot received a radio call to pick up one passenger from West Gully. West Gully is located approximately on radial 100 from Wanagon and on the left side of the track to MP 66 which was approximately 180°. The pilot flew to West Gully and attempted to land twice but unsuccessful due to poor visibility. The pilot then decided to continue to MP 66.

While approaching MP 66 the pilot could not land due to weather and decided to divert to Landville (MP 73). At 23.10 the pilot made radio call to company radio frequency and informed his intention to divert to MP 73. This was the last communication with the pilot.

MP 73 located north east of MP 66 at lower elevation. Normally the ground visibility better than MP 66 and at several times diversion flights successfully land at MP 73. There was no radio room at MP 73 for the crew to make radio communication other than aircraft radio.

At 23.17 Kilangin Tower controller received a phone call from Biak Flight Service Station (Biak FSS) officer informed that BASARNAS received a ELT (Emergency Locater Transmitter) distress signal at coordinate 04 07.9 S 137 04.5 E from PK-ODA at emergency radio frequency 121.5 MHz.

Kilangin Tower controller confirmed the information to the AFE company frequency and exploration radio room, and was informed that PK-ODA has landed at MP 73.

After 30 minutes from the last radio contact, there was no information received from the pilot. The MP 66 Manager contacted Wanagon and was informed that the helicopter was not at Wanagon. The MP 66 manager instructed a team to go to Landville by land vehicle to check the aircraft condition.

At 02.08 Biak FSS officer reconfirmed the status of ELT distress signal to Kilangin Tower controller. Kilangin Tower controller reconfirmed to AFE company frequency and

1 The 24-hour clock used in this report to describe the time of day as specific events occurred, is in Coordinated Universal Time (UTC). Local time, Eastern Indonesian Standard Time (WIT) is UTC+9 hours.

2 Timika Airport, Timika, Papua (TIM/WABP) is referred to as ‘Timika’ in this report.

exploration radio room. Exploration radio room officer informed that after the last communication at 23.10 there was no further information of the aircraft. AFE radio room officer informed that there was no aircraft landed at Landville (MP 73) as informed by the team deployed from MP 66.

The Airfast Operation Base at Timika deployed two helicopters for search operation. The search operation was postponed due to bad weather.

At 2200 on 17 March 2012, the Freeport search team from MP 66 found the helicopter position at coordinate 04° 07.34 S 137° 05.40 E at elevation of 8,000 feet. The helicopter was destroyed and all occupants were fatally injured.

On 17 March 2012, the rescue team successfully evacuated the pilot and transferred to MP 66.

On 19 March 2012 at 0000, the rescue team successfully evacuated the passengers and transported to MP 66.

The evidence of aircraft impact into terrain without any systems malfunction is characteristic of a Controlled Flight IntoTerrain (CFIT).

During the investigation the NTSC issued recommendation to the Directorate General Civil Aviation relating training requirements for pilots operating in remote and mountainous regions such as Papua.

# 1. FACTUAL INFORMATION

## 1.1 History of the Flight

On 16 March 2012 at 0702 LT (2202 UTC) a Eurocopter AS350B3 helicopter registration PK-ODA departed from Timika Airport Papua. The helicopter operated by PT. Airfast Indonesia was on an unscheduled charter flight by Freeport Indonesia Company. The flight was planned from Timika to Utikinagon (helipad) – Mile post (MP) 66 (helipad) – Wanagon (helipad) – MP 66 – Timika.

The helicopter carried four passengers and food supplies to Utikinagon. At Utikinagon the helicopter dropped three passengers and food supplies then picked up another three passengers. The helicopter flew to MP 66 with four passengers on board. At MP 66 the helicopter disembarked three passengers and picked up the food supplies, to be delivered to Wanagon.


**Figure 1: PK-ODA aircraft**

At Wanagon the helicopter dropped one passenger and the food supplies and picked up two passengers and returned to MP 66. During the flight to MP 66, the pilot received a radio call to pick up one passenger from West Gully. West Gully is located approximately on radial 100 from Wanagon and on the left side of the track to MP 66 which was approximately 180°. The pilot flew to West Gully and attempted to land twice, however the approached were discontinued due to poor visibility. The pilot then decided to go to MP 66.

While approaching MP 66 the pilot could not continue to land due to bad weather and decided to divert to Landville (MP 73). At 23.10 the pilot call to company radio frequency and informed his intention to divert to MP 73. This was the last communication with the pilot.

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On 17 March 2012, the rescue team successfully evacuated the pilot and transferred to MP 66.

On 19 March 2012 at 0000, the rescue team successfully evacuated the passengers and transported to MP 66.


**Figure 2: The accident site**

## 1.2 Injuries to Persons

| Injuries | Flight crew | Passengers | Total in Aircraft | Others |
|---|---|---|---|---|
| Fatal | 1 | 2 | 3 | - |
| Serious | - | - | - | - |
| Minor | - | - | - | - |
| Nil Injuries | - | - | - | - |
| **TOTAL** | **1** | **2** | **3** | **-** |

## 1.3 Damage to Aircraft

The helicopter was substantially damage.

## 1.4 Other Damage

There was no other damage reported to property and/or the environment.

## 1.5 Personnel Information

### 1.5.1 Pilot in Command

| | | |
|---|---|---|
| Gender | : | Male |
| Age | : | 42 years |
| Nationality | : | New Zealand |
| License | : | CPL (Helicopter) |
| Date of issue | : | 16 February 2011 |
| Valid to | : | 21 March 2012 |
| Aircraft type rating | : | AS350B3 |
| Medical certificate | : | Class I |
| Date of last medical | : | 26 January 2012 |
| Last proficiency check | : | 20 December 2011 in New Zealand |
| **Flying experience** | | |
| Total hours | : | 3,070 hours 48 minutes |
| Total on type | : | 1,000 hours |
| Last 90 days | : | 86 hours 30 minutes |
| Last 60 days | : | 67 hours |
| Last 30 days | : | 27 hours 18 minutes |
| Last 24 hours | : | 1 hour 15 minutes (approximately) |
| This flight | : | 1 hour 15 minutes (approximately) |

The pilot held a current Commercial Pilot License (CPL) issued by New Zealand aviation authority and validated by Indonesia Directorate General Civil of Aviation which was valid up to 21 March 2012.

There was no evidence that the pilot was not fit for duty, nor was there any evidence of physiological or psychological problems in the day preceding the accident. On 14 March 2012 and 16 March 2012, the pilot did not perform any flight duty due to bad weather.

The pilot completed the flight crew competency check at New Zealand on 20 December 2011.

There was no evidence that the pilot has been trained to flight in instrumental meteorological condition by previous operator or PT Airfast Indonesia.

There was no evidence or information of the training given to the pilot for visual flight operations in mountainous and unpredictable weather conditions, included intensive route and aerodrome familiarization in locations, and over routes, where

aids such as TAWS[3], GPS[4], and Radio Altimeter[5] are not effective nor practical nor available.

## 1.6 Aircraft Information

### 1.6.1 General

| | | |
|---|---|---|
| Registration Mark | : | PK-ODA |
| Manufacturer | : | Eurocopter |
| Country of Manufacturer | : | France |
| Type/ Model | : | AS350B3 |
| Serial Number | : | 4063 |
| Date of manufacture | : | May 2006 |
| Certificate of Airworthiness | | |
| Issued | : | 10 February 2011 |
| Validation | : | 9 February 2013 |
| Certificate of Registration | | |
| Issued | : | 10 February 2011 |
| Validation | : | 9 February 2013 |
| Time Since New | : | 4,437 hours 54 minutes |
| Cycles Since New | : | 25,711 cycles |
| Last Major Inspection | : | Not provided by operator |
| Last Minor Inspection | : | 12 February 2012 (300 hours inspection) |

### 1.6.2 Engines

| | | |
|---|---|---|
| Manufacturer | : | Turbomeca France |
| Engine type | : | Turboshaft engine |
| Type/Model | : | Arriel 2B1 |
| Serial Number | : | 23257 |

3 TAWS – Terrain awareness and warning system. Provides predictive terrain-hazard warnings. See EGPWS.

4 GPS – Global positioning system. Worldwide system in which users derive their location by interrogating four satellites from a total net of 24.

5 Radio altimeter – Instrument giving a readout of height above ground level by time varying frequency and measuring the difference in frequency of received waves, this being proportional to time and hence to height.

| | | |
|---|---|---|
| Installed | : | 13 December 2005 |
| Time Since New | : | 4,436 hours 36 minutes |
| Time since overhaul | : | Not provided by operator |
| Cycles Since New | : | 7,990 cycles |

## 1.7 Meteorological Information

While the helicopter attempted to land at MP 66, the visibility was very low and it was impossible for the helicopter to land as reported by personnel on the ground.

There was no weather information at the accident site.

Based on the daily experiences informed, that the weather were very fast change on that area, and the experienced of the two helicopters of Search and Rescue flight deployed at the dated of accident, they were postponed due to bad weather.

**Figure 3 Evacuation flight**

Sample of weather during evacuation on 19 March 2012 at 0630 AM.

## 1.8 Aids to Navigation

The helicopter was equipped with a Global Positioning System (GPS) receiver and visual chart for that area.

## 1.9 Communications

The communication between the pilot and ground operator was normal. The

communication was not recorded.

## 1.10 Aerodrome Information

MP 66 is sub-base operation of Freeport. It is located at 25,5 Nm radial 030 from Timika, at elevation 7320 feet/ 2220 meter above sea level at coordinate 04°09.24' S; 137° 05,51' E.

MP 66 has a helipad capable to accommodate approximately 6 to 8 helicopters.

## 1.11 Flight Recorders

The aircraft was not equipped with a Flight Data Recorder or a Cockpit Voice Recorder. Neither recorder was required by current Indonesian regulation.

## 1.12 Wreckage and Impact Information

The wreckage was found on a ridge at elevation of 8,000 feet. Some major parts of the wreckage were transported to Timika.

The canopy, parts of the landing skids, and the main gear box (MGB) / engine coupling were not recovered. The main rotor blades had been cut for recovery reason.

### 1.12.1 Main structure Examination

The details of the examination of main structure are as follows:

**Landing Skid**

The front cross tubes of the left landing skid was found bent backward and twisted while the aft cross tube was bent backward (as showed on figure 6). These types of damages were resulted by horizontal and lateral forces.

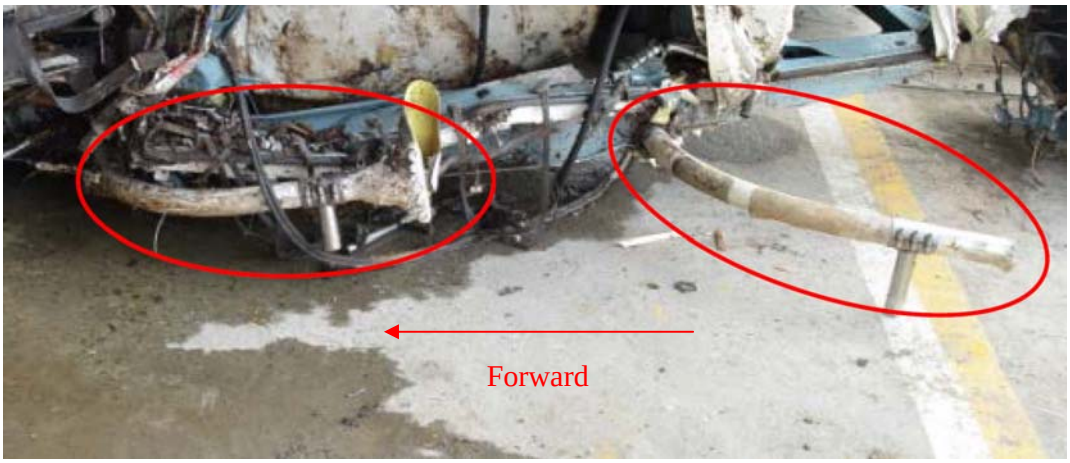


**Figure 4: damages of the landing skid cross tube.**

**Fuselage**

The upward bending of the forward cabin floor, deformation of the lateral cross bulkhead, and the skin buckling on the intermediate fuselage and the tail boom

indicated a significant forward force.

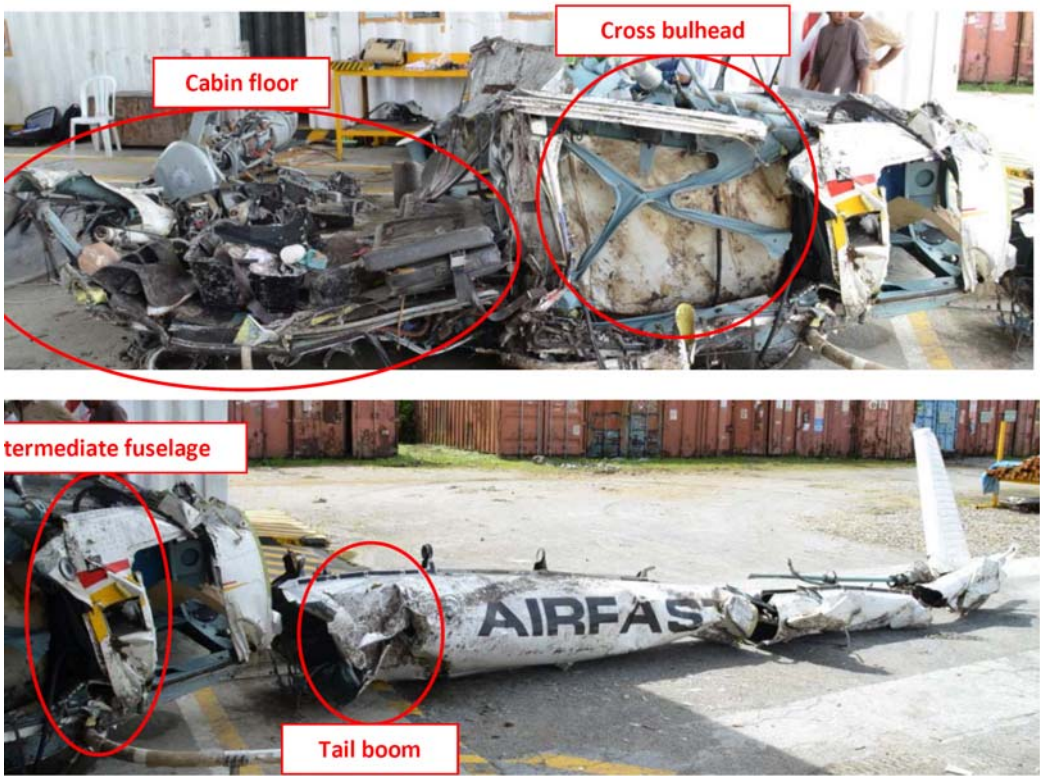


**Figure 5: The damage of the main structure**

### 1.12.2 Blades examination

#### Main Rotor Blades

The main rotor blades were severely damaged on the leading edges near the blade tips. These damages were typical of high speed impact damage. High speed impact on the main rotor blades indicated that the engine was still operating prior to impact.

**Figure 6: General condition of the Main Rotor Blades**

### Tail rotor (TR) blades

The tail rotor blades were severely damaged due to impact. This was indication of significant rotor speed during the impact.

**Figure 7: The tail rotor blades conditions**

### 1.12.3 Engine examination

The “twist grip” handle on the collective pitch lever was in the “Flight” position. This is the normal position during flight

The fuel shut-off switch was not activated and was in the open position (red guarded). This is the normal position during flight.

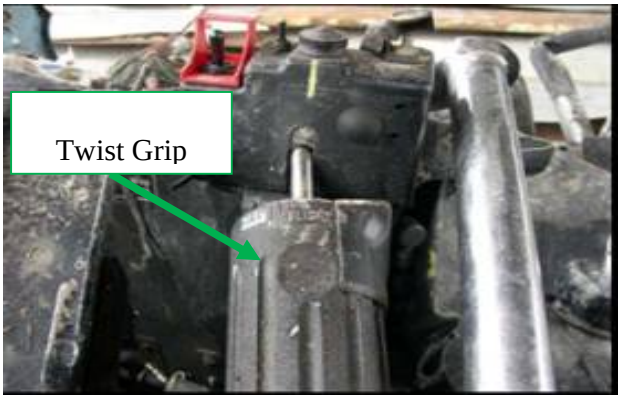


**Figure 8: Twist Grip**

The engine start switch was in the "On" position with the guard in the folded down position. This is the normal position during flight.

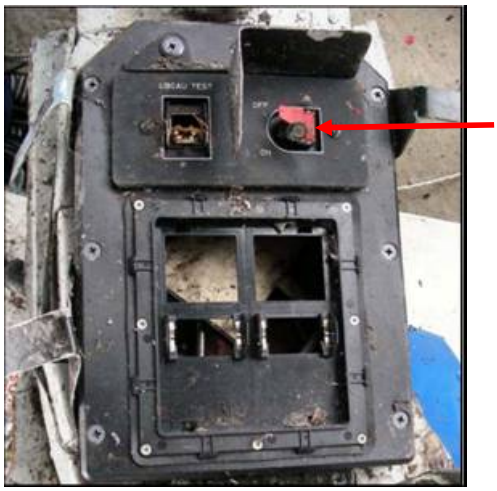

**Figure 9: The engine start switch position "ON"**

The whole engine was recovered and had retained its integrity after impact.

**Figure 10: The fuel shut-off valve handle**

**Figure 11: Accessories Gearbox**

It was found misalignment of the mark on the drive nut with respect to the mark on the drive gear's shaft. This misalignment occurred when the engine encountered an important sudden increase in resistant torque whilst delivering power. The torque increase was likely to have occurred when the main rotor (blades or rotor head) hit the solid obstacles (trees or ground).

The misalignment indicates that the engine was delivering power at the time of the impact.

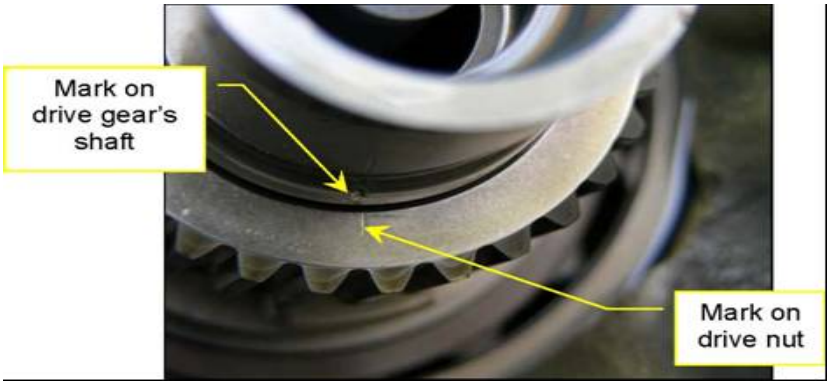


**Figure 12: The misalignment marks**

There were no particular findings to report regarding the MO3. The gas generator spool could be rotated by hand. The rotation was silent and smooth. The starter could be seen rotating in conjunction with the rotation of the spool, thus confirming the operational condition of the accessories gearbox gear chain.

There were no particular findings to report regarding the MO4 casings. All the Free Turbine's blades were present and appeared in nominal condition. The free turbine wheel could be rotated by hand. The rotation was silent and smooth.

**Figure 13: Turbine blades**

All three magnetic plugs were checked. One filament like particle was found on the MO1 (accessories gear box) magnetic plug. Such an isolated particle does not represent any advanced stage of damage and it may have been released as a consequence of the accident. No other particle was found on the other magnetic plugs.


**Figure 14: Magnetic plugs**

The examination of the significant components available of the aircraft wreckage indicated that the helicopter was on level flight with a significant longitudinal speed at the first impact. It was also concluded that the engine was operating prior to impact. The examination did not reveal evidence of any system malfunction prior to impact.

## 1.13 Medical and Pathological Information

No medical or pathological investigation was conducted following this occurrence.

## 1.14 Fire

There was no evidence of pre or post impact fire during the occurrence.

## 1.15 Survival Aspects

On 16 March 2012 at 2317, Kilangin Tower controller aware of accident PK-ODA after received a phone call from Biak Flight Service Station (Biak FSS) officer. BASARNAS received a ELT (Emergency Locater Transmitter) distress signal on emergency radio frequency 121.5 MHz at coordinate 04 07.9 S 137 04.5 E.

PK-ODA was equipped with ELT 406 that capable to transmit in three different frequencies: 406 MHz, 121.5 MHz, 243 MHz.

The evacuation process terminated on 19 March 2012 after all occupants has been evacuated.

All occupants were fatally injured due to the magnitude impact forces.

## 1.16 Tests and Research

Not relevant to this accident.

## 1.17 Organizational and Management Information

| | |
|---|---|
| Aircraft Owner and Operator | : PT. Airfast Indonesia |
| Address | : Jalan Marsekal Suryadarma No. 8, Tangerang, Republic of Indonesia |
| Operator Certificate Number | : AOC/135-002 |

## 1.18 Additional Information

There was no other factual information that was relevant to the circumstances leading up to the occurrence.

## 1.19 Useful or Effective Investigation Techniques

The investigation was conducted in accordance with the NTSC approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

# 2. ANALYSIS

The examination of the main structure, blades and engine indicated that the aircraft was on level flight with a significant longitudinal speed during impact. The examination did not reveal any evidence of system malfunction prior to impact and the engine was operating prior to impact.

The last communication revealed that the pilot intended to divert to MP 73 after found the destination of MP 66 was not possible for landing. This decision was commonly chosen as sudden changes of weather very often occur on that area. Based on experiences, the weather at MP 73 normally better than MP 66, as it is located at lower elevation. There was no information from the pilot of any aircraft system malfunction.

The impact point was found at 8000 feet. It indicated that the aircraft was on cruise on route to the alternate helipad at MP 73.

The evidence of aircraft impact into terrain without any systems malfunction is characteristic of a Controlled Flight IntoTerrain (CFIT).

# 3. CONCLUSIONS

## 3.1 Findings

a. The aircraft was certified as being airworthy at the time of accident.

b. The pilot was appropriately licensed and qualified to operate Eurocopter AS350.

c. There was no evidence that the pilot was not medically fit.

d. The pilot complied with the Directorate General Civil Aviation (DGCA) and company flight.

e. The aircraft was being operated within the approved weight and balance limitations.

f. The detailed examination of the all the available components of the aircraft wreckage has no revealed any evidence of pre-crash failure.

g. The observation on the crash site and on different wreckages parts seems to indicate that the first contact with the trees and ground was at level flight with an aircraft with a significant longitudinal speed and power on the dynamic components.

h. No pre-crash failure has been observed.

i. The weather was  very fast changes it most likely in a very low visibility

## 3.2 Causes/Factors[6]

The above findings showed that this is a controlled flight into terrain (CFIT).

6 "Factors" is defined as events that might cause the occurrence. In the case that the event did not occur then the accident might not happen or result in a less severe occurrence.

# 4. SAFETY ACTION

At the time of issuing this draft final investigation report, the National Transportation Safety Committee had not been informed of any safety actions resulting from this occurrence.

# 5. SAFETY RECOMMENDATIONS

As a result of this investigation, the National Transportation Safety Committee issued safety recommendations to address safety issues identified in this report.

## 5.1 Directorate General of Civil Aviation

The National Transportation Safety Committee recommends to the Directorate General of Civil Aviation to review the training and checking requirements for pilots operating in remote and mountainous regions such as Papua such as:

Particular attention to the training given to the pilot for visual flight operations in mountainous and unpredictable weather conditions, included intensive route and aerodrome familiarization in locations, and over routes, where aids such as TAWS[7], GPS[8], and Radio Altimeter[9] are not effective nor practical nor available.

## 5.2 PT. Airfast Indonesia

The National Transportation Safety Committee recommends to the PT Airfast Indonesia review the training and checking requirements for pilots operating in remote and mountainous regions such as Papua.

7 TAWS – Terrain awareness and warning system. Provides predictive terrain-hazard warnings. See EGPWS.

8 GPS – Global positioning system. Worldwide system in which users derive their location by interrogating four satellites from a total net of 24.

9 Radio altimeter – Instrument giving a readout of height above ground level by time varying frequency and measuring the difference in frequency of received waves, this being proportional to time and hence to height.

# 6. APPENDICES

## 6.1Appendix A : Eurocopter On site Wreckage Examination Report

EUROCOPTER
AN EADS COMPANY

FLEET SAFETY
INVESTIGATIONS AND PRODUCT INTEGRITY

Marignane, the 15/11/2012
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### ON SITE WRECKAGE EXAMINATION REPORT

**Report EAI n°:** 62/2012
**Date of examination:** 10-11 September 2012, Timika, Indonesia

#### AIRCRAFT

**Type of helicopter:** AS350 B3
**S/N and registration:** S/N4063 PK-ODA
**Customer:** PT Airfast Indonesia
**Date of the accident:** 17 March 2012, Mt Zaagkam, Indonesia

#### EQUIPMENT EXAMINED

**Designation:** Wreckage Examination (H/C without CVFDR)
On site pictures and information done by Jacques Trabut, Eurocopter Indonesia, Technical Advisor for BEA

#### REASON FOR EXAMINATION

Examination of the recovered parts of the wreckage to determine if there are any evidences of pre-crash failure and identify any evidences of power/torque installed on dynamic assemblies.

## 1. CIRCUMSTANCES:

The helicopter took off from Wanagon to MP66 with the pilot and two passengers. During the flight, the radio called to pick up a passenger at West Gully. The pilot encountered some bad weather condition at West Gully and decided to turn back at MP66 then at Landfill by radio at 8h10am as last contact.
The distress call has been received at 9h02am.
The wreckage was found in a very mountainous area: Zangkam Mount at 8000ft.

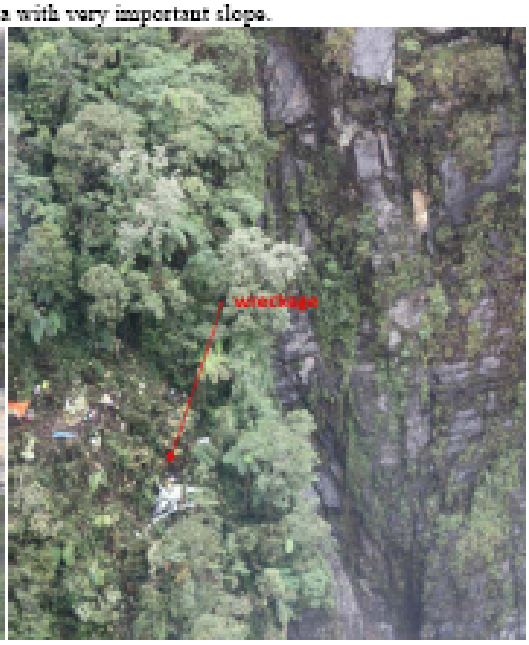
## 2. WEATHER CONDITIONS:

The weather was very bad with many clouds.

## 3. CRASH SITE MAPS:

## 4. CRASH SITE OBSERVATIONS:

The wreckage was found in a very mountainous area with very important slope.

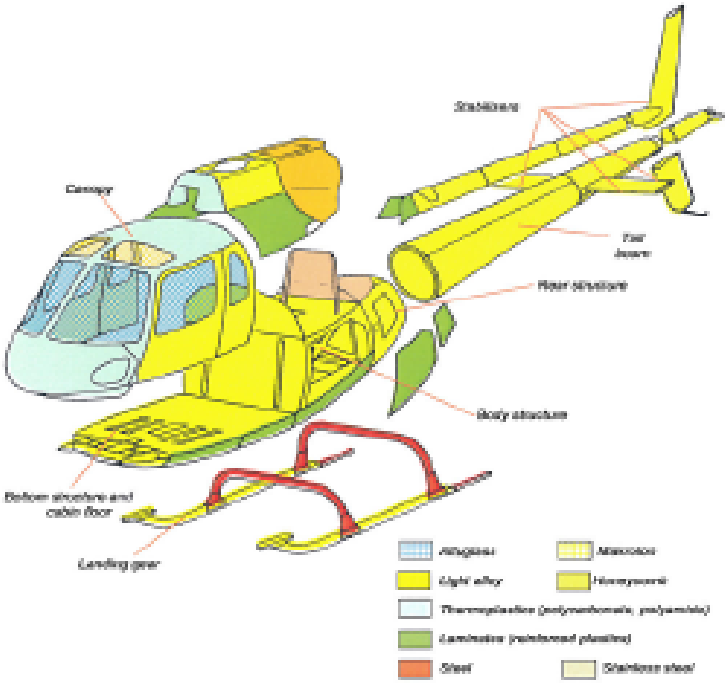

Due to the area of the crash (forest, high slope...etc), the examination of the wreckage has been performed in a hangar in Timika after the recovery.

## 4. CRASH SITE OBSERVATIONS:

The wreckage was found in a very mountainous area with very important slope.


Due to the area of the crash (forest, high slope...etc), the examination of the wreckage has been performed in a hangar in Timika after the recovery.

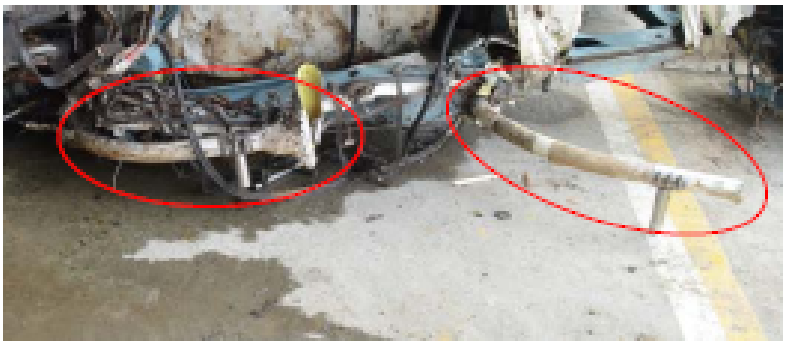
## 5. GENERAL WRECKAGE EXAMINATION:




The wreckage examination took place at Timika where the main parts of the wreckage have been transported.
The canopy, parts of the landing skids and the main gear box (MGB) / engine coupling are missing.
The blades have been cut for recovery reason.

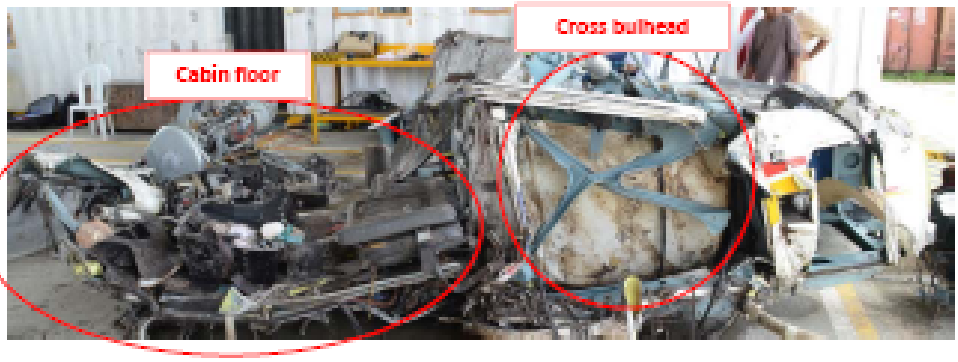
## 5.1. Landing Gear:

The skid landing gear exhibits some damages which are consistent with a significant longitudinal velocity. Indeed, both cross tubes don't present deformation due to vertical load but have swiveled backward conducting to the failure at the junction with the horizontal tubes which are missing.



## 5.2. Fuselage:

Main structure is highly damaged but exhibits some evidences of a significant longitudinal speed like deformation of the cabin floor, the lateral cross bulkhead deformation of the fuel surrounding structure, the lateral skin buckling of the intermediate fuselage and the tail boom



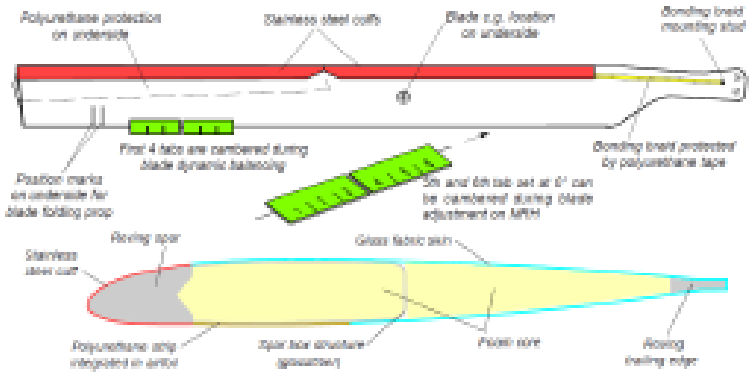

5.3. **General Conclusion for General Wreckage Examination:**

The only conclusion which can be given concerning the general wreckage examination is that the aircraft seems to have impacted with a significant horizontal speed.
No evidence of pre-crash failure has been observed on the recovered part.

## 6. DYNAMIC COMPONENTS EXAMINATION:

### 6.1. Main Rotor (MR) Blades:

**Principle schema of the Main Rotor Blades**




**General Conditions of the Main Rotor Blades:**

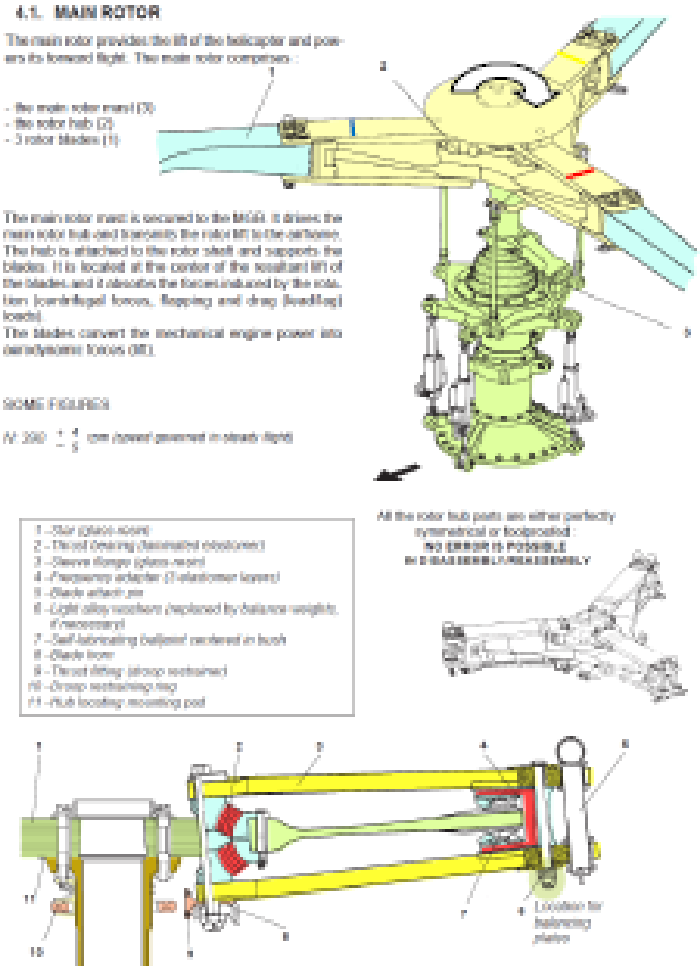
Blades cut for wreckage recovery

**Conclusion concerning the Main Rotor Blades examination**

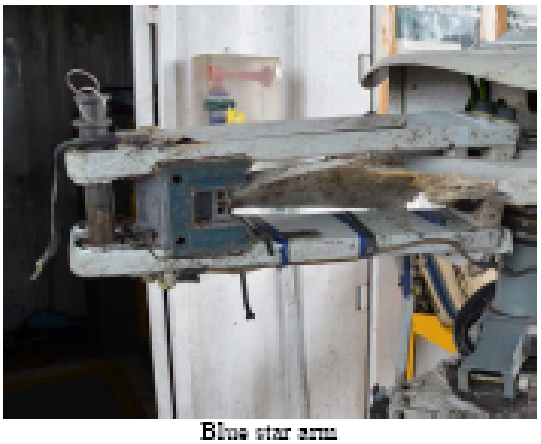
The main rotor blades are severly damaged due to the contact with the trees & the ground. These findings are consistent with a presence of significant rotor speed during the impact.

## 6.2. Main Rotor Head (MRH) Assembly:

**Principle schema of the Main Rotor Head**



**General Conditions of the Main Rotor Head**



Blue star arm

Red star arm

Yellow star arm

Drop restrainer/restraining ring

**Conclusion concerning the Main Rotor Head examination**

The Main Rotor Head exhibits significant damages resulting from the crash.

The three Star arms (rep 1) are broken with an angle of about 45° which is representative of a significant drag resulting from the ground contact.

The star arms exhibits also damages resulting from flapping.
Moreover, the drop restrainer/restraining ring exhibits high contact and deformation which is also consistent with the flapping damages observed on the star arms.

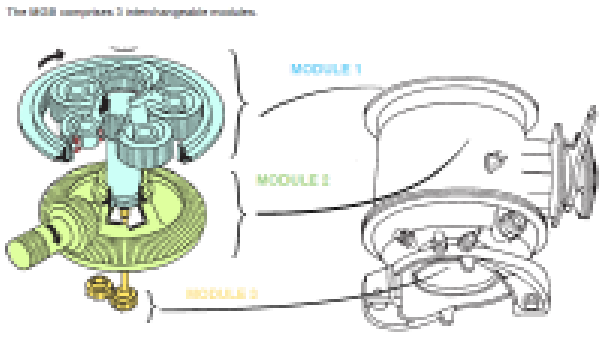
These observations indicate a high energy torque (RPM and power) installed on the MRH during the crash sequence.

All the other damages (failures/ruptures, deformation,…) observed on the MRH are the consequence of the overloads resulting from the crash sequence.

No pre-crash failure has been observed.

## 6.3. Main Gear Box (MGB):

### Principle schema of the Main Gear Box




### General Conditions of the Main Gear Box

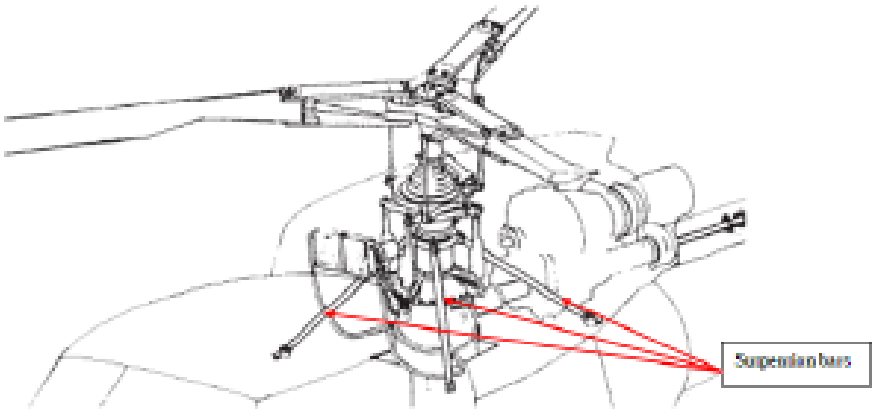
### Conclusion concerning the Main Gear Box examination

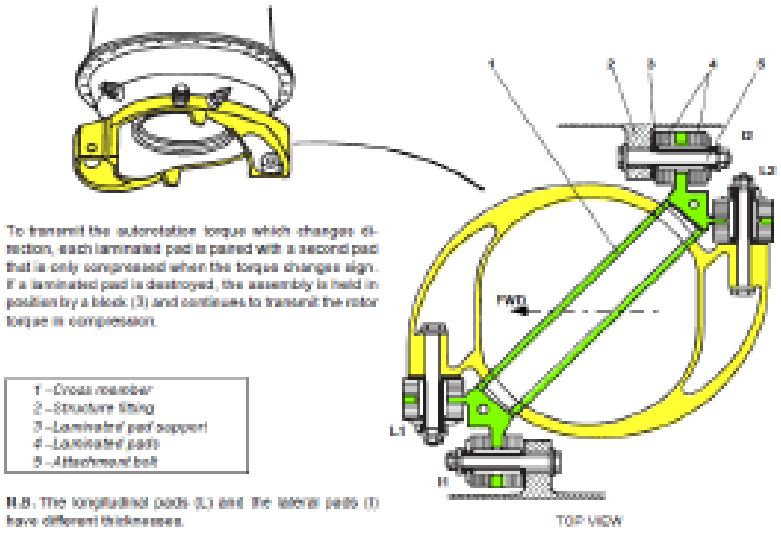
It was not possible to confirm the free rotation of the main rotor head likely due to the post-crash mechanical damage and deformation but no pre-crash damage or failure has been identified on this assembly (no overheating or distress evidence) and no particle has been found on the magnetic plug.

No pre-crash failure has been observed.

## 6.4. Suspension:

**Principle schema of the Suspension**




To transmit the autorotation torque which changes direction, each laminated pad is paired with a second pad that is only compressed when the torque changes sign. If a laminated pad is destroyed, the assembly is held in position by a block (3) and continues to transmit the rotor torque in compression.

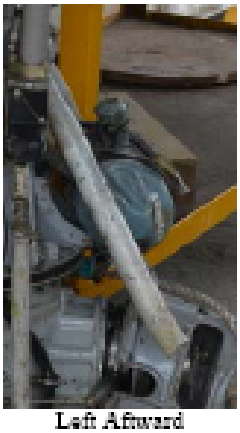
1 - *Cross member*
2 - *Structure fitting*
3 - *Laminated pad support*
4 - *Laminated pads*
5 - *Attachment bolt*

N.B. The longitudinal pads (L) and the lateral pads (T) have different thicknesses.

TOP VIEW

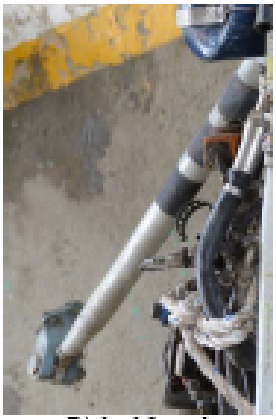
**General Conditions of the Suspension**

Left Forward



Left Afward

Right Forward



Right Afward

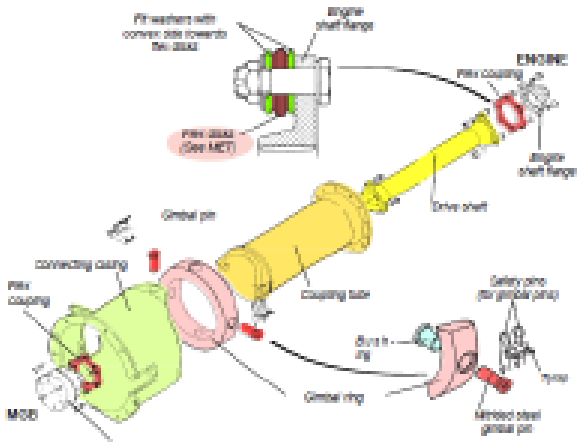
**Conclusion concerning the Suspension examination**

The main gearbox suspension exhibits overload failures and damages which are consistent with the result of the crash sequence.

No pre-crash failure has been observed.

## 6.5. Engine To Main Gear Box (MGB) Coupling Assembly:

### Principle schema of the Engine/MGB Coupling




### General Conditions of the Engine/MGB Coupling

The Engine to MGB drive shaft and the Gimbal ring are missing.

Connecting casing junction with MGB failure

Connecting casing junction with missing Gimbal ring

Failure of the drive shaft to MGB input flange Flexible coupling


Coupling tube (interference)

**Conclusion concerning the Engine to MGB Coupling examination**

The Engine to MGB coupling tube to Connecting casing coupling is broken due to overload at the gimbal ring area with evidence of mechanical interference with the rotating coupling shaft.
The drive shaft to MGB input flexible coupling is broken at the MGB side.
One coupling bolt is missing, one coupling bolt exhibits significant shearing/bending deformation with elongation of the coupling hole and one is in position with part of flexible coupling destroyed due to overloads.
The coupling tube exhibits evidence of mechanical interferences with the rotating drive shaft flange which indicates that the drive shaft was still turning after the overload flexible coupling failure. The gimbal ring is missing.

All these damages are consistent with the consequence of the damages resulting from the overload resulting from the crash sequence (overtorque and deformation) with evidence of significant rotational speed and power during this sequence.

No pre-crash failure has been observed.

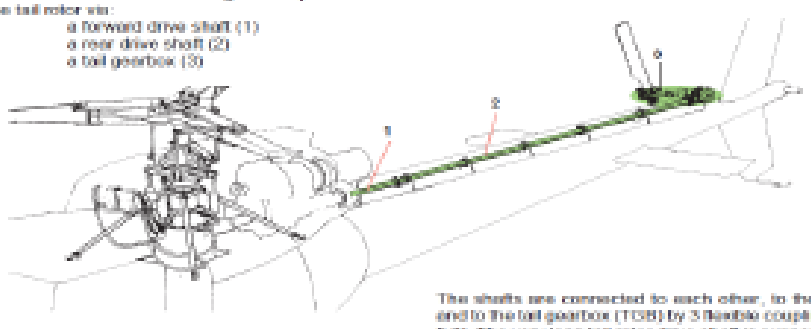
## 6.6. Engine:

The engine examination has been subjected to the "On Site Investigation Report" N°Rap_Sit 2012/067-1 from Turbomeca.

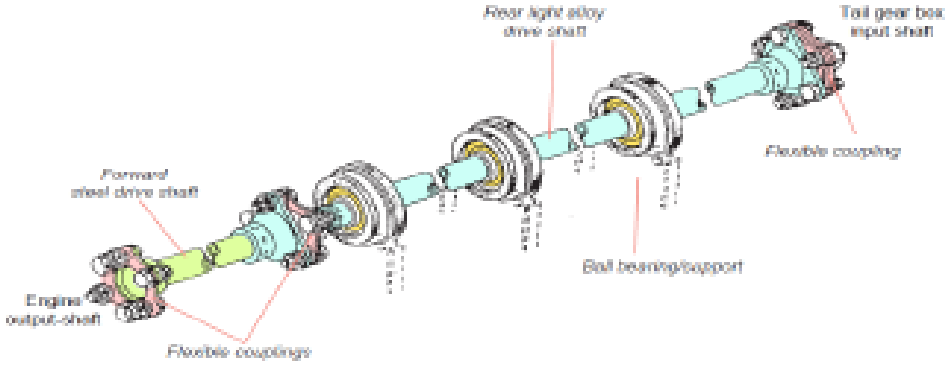
## 6.7. Tail Rotor Drive (TRD) Shaft Assemblies:

**Principle schema of the Tail Rotor Drive Shafts:**

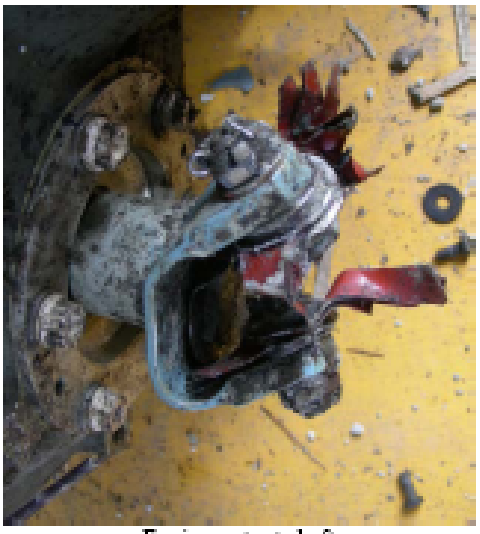
Power is transmitted from the engine rear power takeoff to the tail rotor via:
- a forward drive shaft (1)
- a rear drive shaft (2)
- a tail gearbox (3)




The shafts are connected to each other, to the engine and to the tail gearbox (TGB) by 3 flexible couplings (see § 3). The very long tail rotor drive shaft is supported by 5 ball bearing/support assemblies mounted on elastomer bushes that damp out the system vibration (viscoelastic "deflection and torsion" dampers).



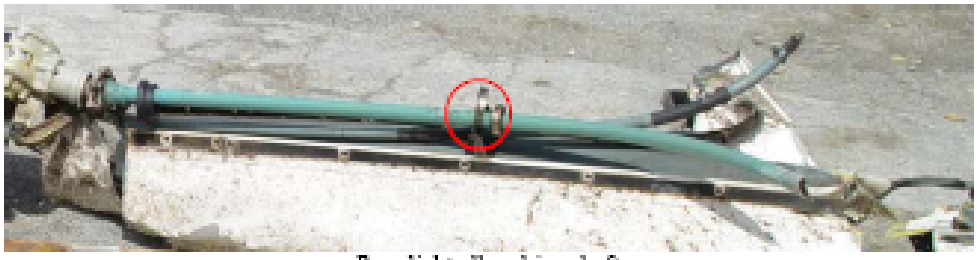
General Conditions of the Tail Rotor Drive Shafts



Engine output shaft

The forward steel drive shaft is missing.

Only the aftward part of the rear light alloy drive shaft is available



Rear light alloy drive shaft

Rear light alloy drive shaft (missing parts)

Tail Gear Box input shaft

**Conclusion concerning the Tail Rotor Drive Shafts examination**

The engine output flexible coupling is destroyed due to overload (torque and traction) which are consistent with a disconnection under power.

The forward steel drive shaft is missing.

The rear light alloy drive shaft is significantly deformed and broken between the bearing number 3 and 4 due to overload and deformation which are consistent with a damage/failure consequence resulting from the crash sequence.
The forward part of the rear light alloy drive shaft is missing.

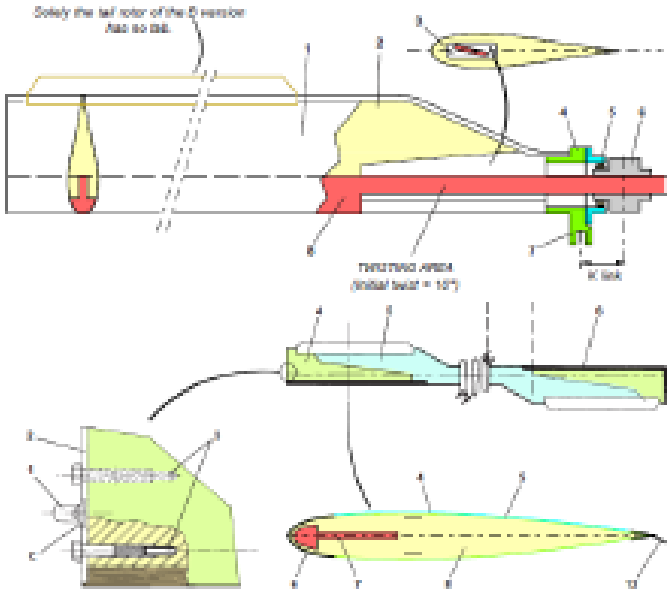
The engine output flexible coupling is significantly deformed which is representative of damage resulting from the crash sequence.

All these observations indicate that this tail rotor drive shaft was rotating with power during the crash sequence and that this coupling has been disconnected during this sequence due to the significant airframe deformation/failure.

No pre-crash failure has been observed.

## 6.8. Tail Rotor (TR) Blades:

### Principle schema of the Tail Rotor Blades



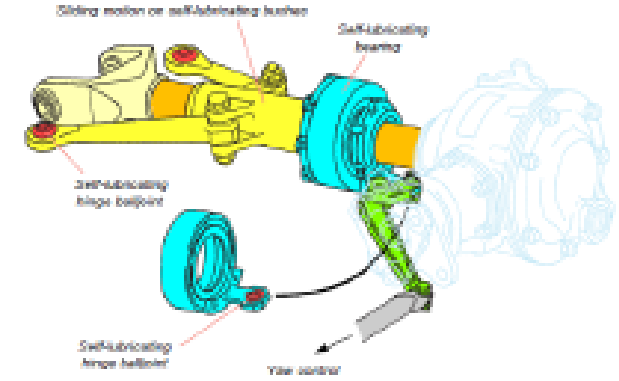
### General Conditions of the Tail Rotor Blades

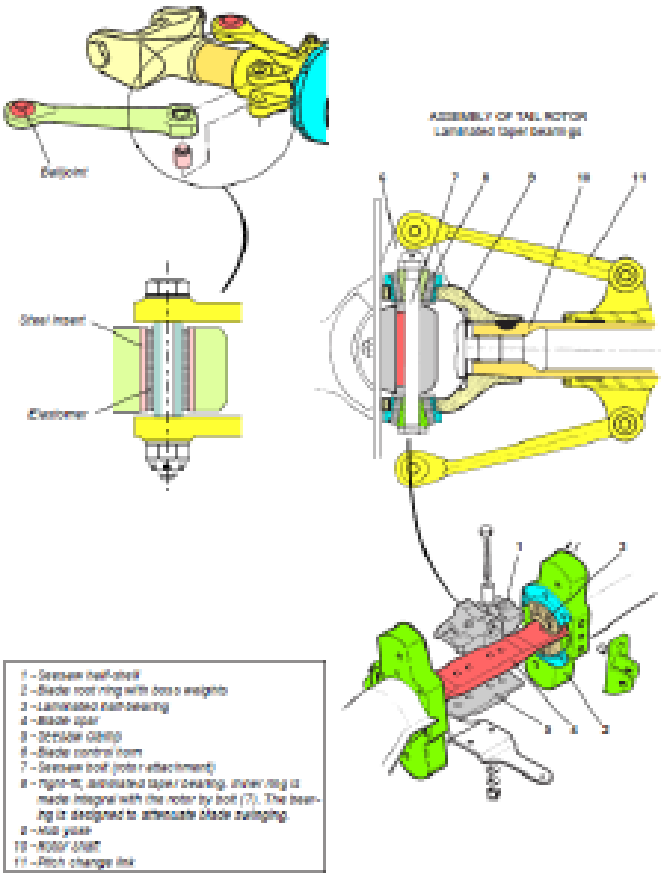
### Conclusion concerning the Tail Rotor Blades examination

The tail rotor blades are severely damaged due to the contact with the trees & the ground.
These findings are consistent with a presence of significant rotor speed during the impact.

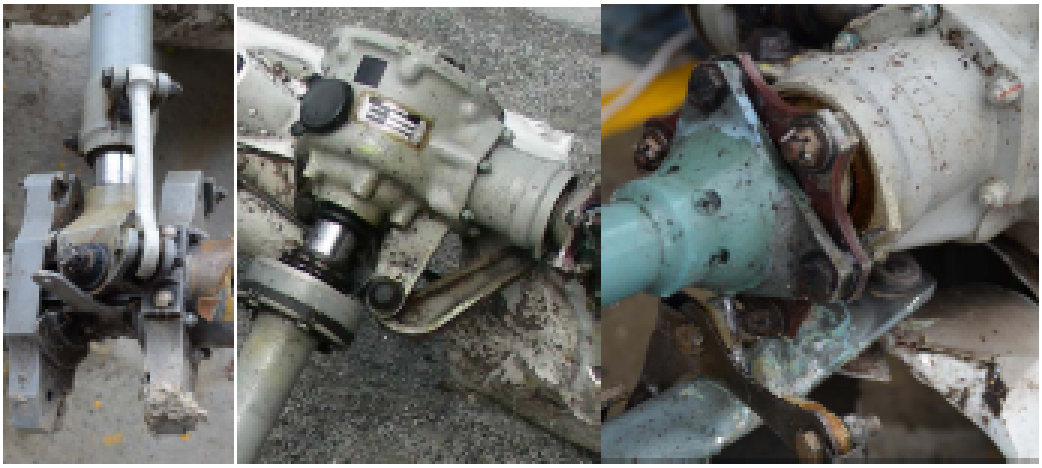
## 6.9. Tail Gear Box (TGB) and Tail Rotor Head (TRH):

### Principle schema of the Tail Gear Box and Tail Rotor Head



**General Conditions of the Tail Gear Box and Tail Rotor Head**



**Conclusion concerning the Tail Gear Box and Tail Rotor Head examination**

No damage observed on the pitch change control system (pitch change bellcrank, pitch change spider, pitch links,…).

The Tail Gear Box input supports are broken due to overloads probably due to the structure deformation/failure resulting from the crash sequence.
The Tail Gear Box turns freely, the magnetic plug is free from particle.

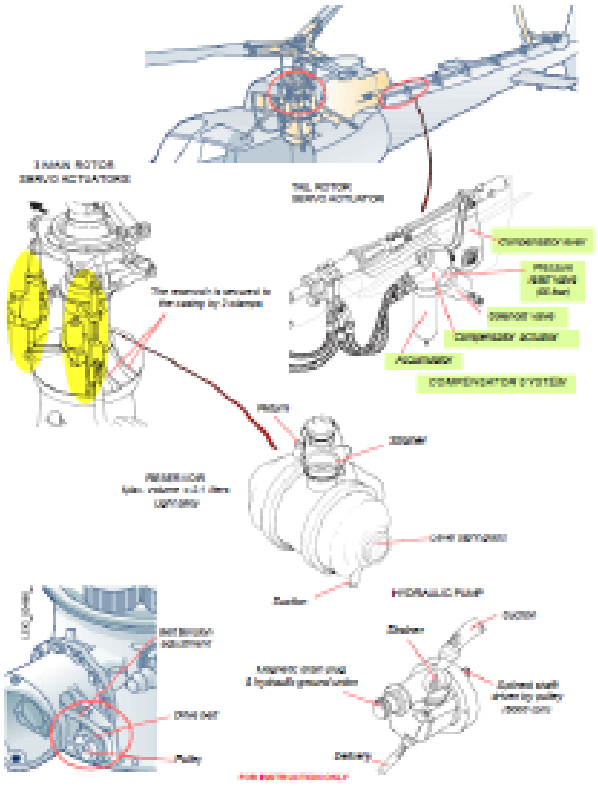
No pre-crash failure has been observed.

## 6.10. General Conclusion for Dynamic Components examination:

All the observed damages, failures/ruptures and deformation observed on the available part of the dynamic assemblies are the consequence of the overloads resulting from the crash sequence.
The detailed examination of theses damages (deformation and type of ruptures) have also permitted to determine that the mechanical continuity from the engine to the main rotor and tail rotor blades was present before the first tree impact and that some high rotational speed and torque so power were installed on the dynamic Assemblies during the crash sequence.
This examination has no evidenced any pre-crash failure.

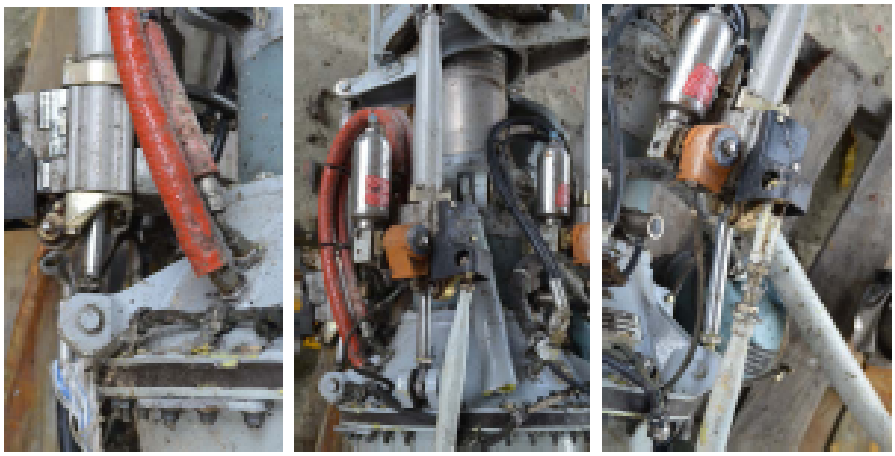
## 7. FLIGHT CONTROL/HYDRAULIC CIRCUIT:

### Principle schema of the Flight Control/Hydraulic Circuit



General Conditions of the Flight Control/Hydraulic Circuit

Main Rotor Channel:

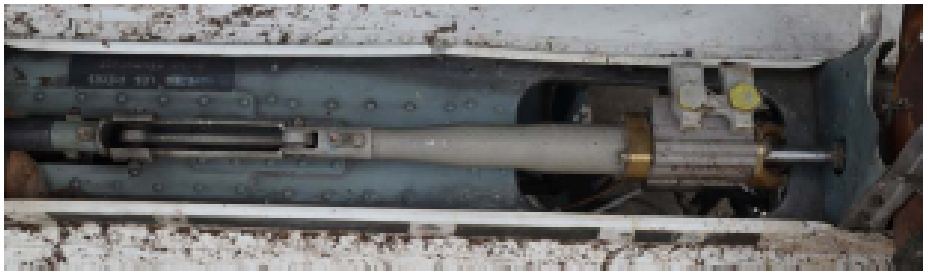


Forward

Left

Right

Tail Rotor Channel:



Hydraulic circuit:

**Conclusion concerning the Flight Control/Hydraulic Circuit examination**

All the damage, deformation, failure observed on the available components (control rod, bellcrank, main and tail rotor servocontrols, pitch links, ball bearing cable,…) were consistent with the consequence of the overload resulting from the crash sequence.

The hydraulic oil pump is still connected from the MGB input pinion pulley flange driving and the belt is not well positioned on the pulleys anymore but is still present.
The magnetic plug is free from particles and the coupling pulley the main oil pump connecting splines are in good condition.

No pre-crash failure has been observed on the remaining available component of the hydraulic circuit.

No pre-crash failure has been evidenced.

## 8. ELECTRICAL AND NAVIGATION SYSTEMS:

### Comments for the Electrical and Navigation Systems:


### Conclusion concerning the Electrical and Navigation Systems examination

The cockpit has been completely destroyed by the energy of the impact.
However, the instrument panel was available but the instrument can't give information for the crash sequence except the VEMD.

## 9. GENERAL CONCLUSION:

The detailed examination of the all the available components of the aircraft wreckage has no revealed any evidence of pre-crash failure.
The observation on the crash site and on different wreckages parts seems to indicate that the first contact with the trees and ground was at level flight with an aircraft with a significant longitudinal speed and power installed on the dynamic components.
No technical problem which should explain this event has been evidenced.

LASSUS Vincent
Fleet Safety
Investigation and Product Integrity
Accident Investigations Manager

## 6.2 Appendix B : Safran Turbomeca On Site Examination Report

SAFRAN Turbomeca

**ON SITE EXAMINATION REPORT**
**Timika, Papua, Indonesia**

| | |
|---|---|
| Event date : | **17th March 2012** |
| Event location : | **Mt Zaagkam, Papua, Indonesia** |
| Operator : | **PT Airfast** |
| Aircraft : | **AS350B3+** |
| Serial number : | **4063** |
| Registration : | **PK-ODA** |
| Engine : | **Arriel 2B1** |
| Serial number : | **23257** |

**Reference:** Rap_Sit 2012/067-1

| VALIDATION | | APPROBATION | |
|---|---|---|---|
| DATE | validated by DVS/TEA | DATE | Approved by DJJ/TEA |
| 27 Sept 2012 | | 29th Sept 2012 | |

## Table of Contents

# 1. Introduction

The purpose of this document is to provide a factual account and subsequent discussion regarding the inspection carried out on the wreckage of the helicopter mentioned here-above.

Turbomeca attended the investigation as technical advisor to the Bureau d'Enquêtes et Analyses pour la Sécurité de l'Aviation Civile (BEA), French investigation board.

## 1.1 Date and Location of the Investigation

Date : 10th & 11th September 2012

Location : Timika, Papua, Indonesia

## 1.2 Attendees

The following organisations were present during the investigation :

- KNKT, National Transportation Safety Committee, Ministry of Transportation, Indonesia
- Airfast
- Eurocopter Indonesia
- Turbomeca

# 2. Circumstances

## 2.1 Circumstances reported to Turbomeca prior to the Investigation

During a flight to a mining site in a mountainous area, the pilot announced that he intended to turn back to his departure point due to the weather conditions. 18 minutes after he left, the control tower lost contact with the aircraft.
The wreckage of the aircraft was spotted the following day in a steep place.

## 2.2 Additional circumstances reported to Turbomeca

None

## 2.3 Additional Information

Estimated altitude of the accident: 8000 ft

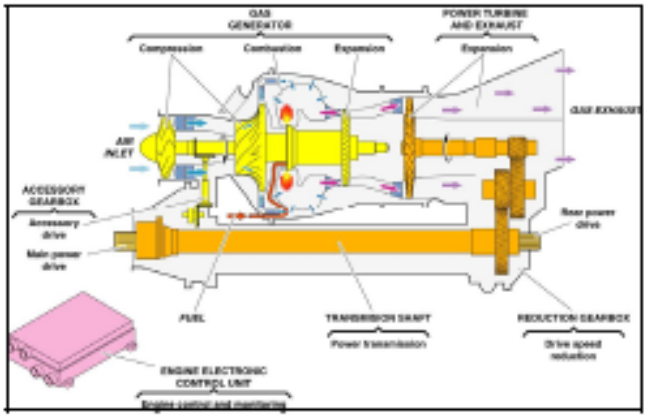
# 3. Conclusion

The examination of the wreckage revealed that the engine was on DECU automatic control mode and was delivering power at the time of the accident.

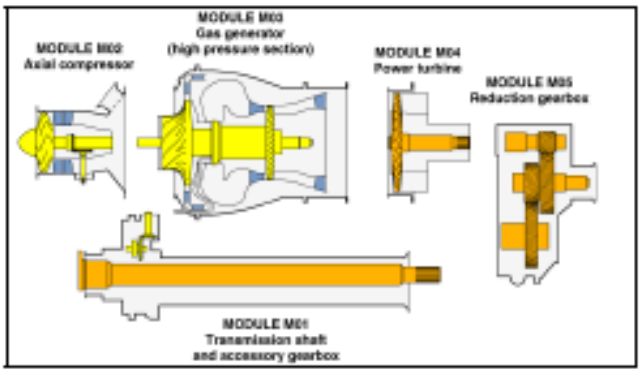
# 4. Engines Description

## 4.1 General description

The Arriel 2B1 engine is a turboshaft engine with a single-stage axial compressor, a single-stage centrifugal compressor, an annular combustion chamber, a single stage high pressure turbine, a single stage power turbine, and a reduction gearbox with a nominal output at 6000 rpm.




The engine is composed of 5 modules :




The engine is rated at 746 shp (557 kW) at takeoff power and 728 shp (543 kW) at maximum continuous power.

The dimensions of the engine are 1.14 m long, 0.491 m wide, and 0.616 m tall. Its dry weight is 132 kg.

The ignition system is one of low tension, high energy, and includes one high-energy generator, two injectors, and two igniters. Engine start is via an electrovalve.

### 4.2 Engine's Technical Data

| Engine | TSN | TSO | Remarks |
|---|---|---|---|
| Arriel 2B1 – S/N 23257 | 4436 | Unknown | |
| **Modules** | **P/N** | **S/N** | **Remarks** |
| M01 – Accessories Gearbox | 70BM012010 | 1976 | |
| M02 – Axial Compressor | 70BM022010 | 625 | |
| M03 – Gas Generator | 70BM032000 | 1789 | |
| M04 – Power turbine | 70BM041720 | 718 | |
| M05 – Reduction Gearbox | 70BM052000 | 540 | |
| **Equipments** | **P/N** | **S/N** | **Remarks** |
| DECU | 70BMF01010 | 2206 | |
| HMU | 0292861000 | 5045 | |

Log book was not available.

## 5. Wreckage Examination

### 5.1 Airframe

- The airframe was severely damaged. The helicopter's tail rotor, engine, Main Gearbox and dashboard had separated from the main body. The canopy was missing.



### 5.2 Cockpit

- The cockpit was separated from the main structure. No engine information could be read on the engine parameter indicator.

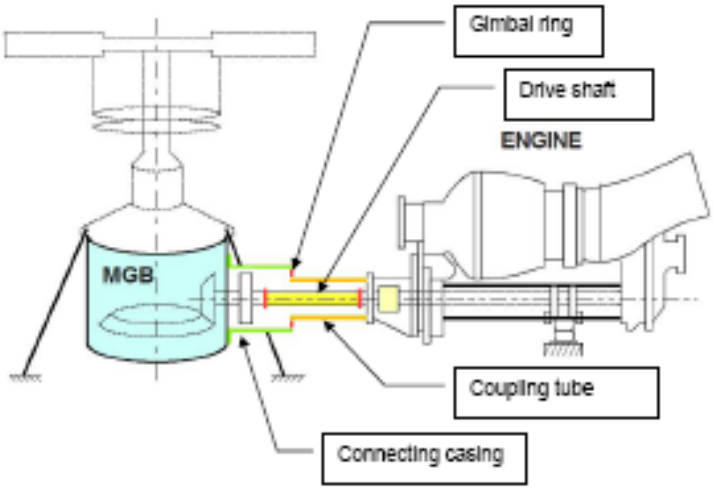
- The "twist grip" handle on the collective pitch lever was in the "Flight" position. This is the normal position during flight.

- The fuel shut-off valve was not activated and was in the open position (red handle). This is the normal position during flight.
- The rotor brake handle (yellow handle) was in the activated position although this is not coherent with the damaged condition of the main rotor blades. Therefore, the handle may have been pushed back during the crash or during the recovery efforts.

- The engine start switch was in the "On" position with the guard in the folded down position. This is the normal position during flight.

### 5.3 Power transmissions

- The Main Gearbox (MGB) was separated from the helicopter and the engine was separated from the MGB. The gimbal ring and the drive shaft were not recovered from the crash site.




- The MGB's flange that holds the connecting casing was sheared all around its base resulting in the connecting casing hanging loose. Rubbing marks on the connecting casing indicated that the rupture probably occurred as a consequence of the crash.

- Damage to the MGB and its supports indicate that it rotated counter-clockwise at the time of the crash. This was a result of the resistant effort generated by the blades hitting solid obstacles. This indicates that the engine was delivering power at the time of the crash.
- The outer flange of the MGB input pinion was in place. The flector coupling normally connected to it was missing with only a small portion of it remaining around one of the fixing screws. This may have resulted from a combination of high torque levels and misalignment between the MGB and the engine at the time of the crash..

### 5.4 Rotor blades

- All rotor blades sustained significant damages thus indicating the presence of power at the time they impacted obstacles (ground and/or trees).

### 5.5 Engine Cowlings

- The engine cowling was mainly intact and did not reveal any pre-crash damage. It was still attached to the engine compartment front fire wall.
- The air intake was fitted with a sand barrier filter that did not present any anomaly.

### 5.6 Engine's air intake

- The air intake was fixed to the engine and exhibited several impact marks resulting from the crash including one area punched inwards near its front flange.
- The removal of the air intake revealed that the punched area had come to rub against the compressor's axial wheel.

### 5.7 Engine installation

- The rear engine support was in place. The cradle was slightly twisted as a consequence of the crash. The two clamps that fix the engine to the cradle were not recovered.

## 6. Engine Examination

### 6.1 Visual examination

- *Whole engine*

The whole engine was recovered and had retained its integrity during the crash.

- *Accessories Gearbox (MO1)*

There were no particular findings to report regarding the MO1 gearbox and link tube.

- *Axial Compressor module (MO2)*

There were no particular findings to report regarding the MO2 casings.

The axial compressor blades were present and were free of impact marks.

The nose cone exhibited circular rubbing marks that are coherent with the punched area noticed on the air intake (see § 5.5 above).

- *Gas Generator module (MO3)*

There were no particular findings to report regarding the MO3.

The gas generator spool could be rotated by hand. The rotation was silent and smooth. The starter could be seen rotating in conjunction with the rotation of the spool, thus confirming the operational condition of the accessories gearbox gear chain.

- *Power Turbine module (MO4)*

There were no particular findings to report regarding the MO4 casings.

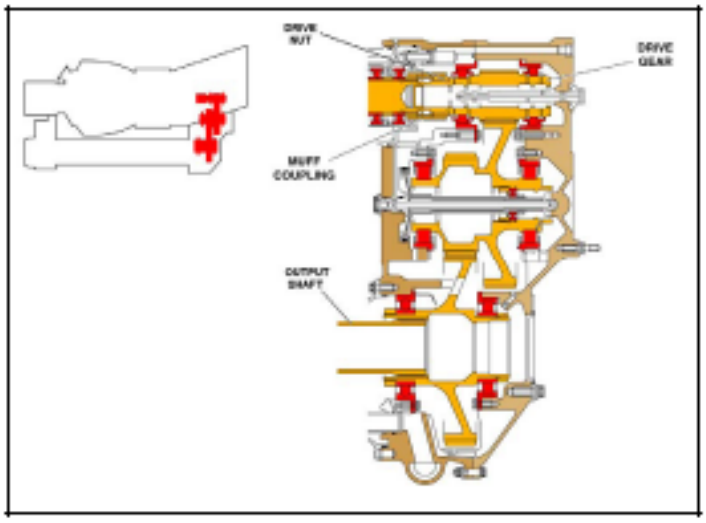
All the Free Turbine's blades were present and appeared in nominal condition.

The free turbine wheel could be rotated by hand. The rotation was silent and smooth.

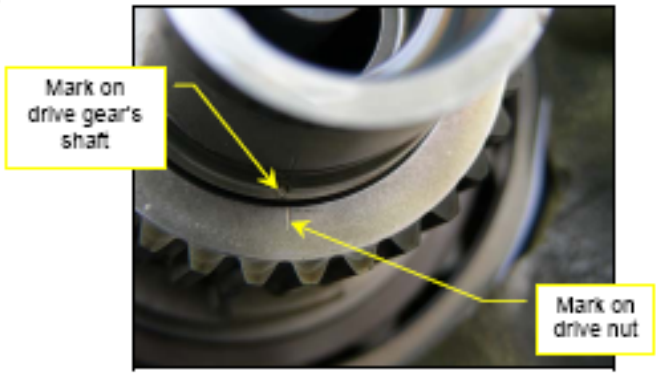
- *Reduction Gearbox module (MO5)*

There were no particular findings to report regarding the MO5.

The reduction gear module was separated from the free turbine module. The muff coupling was then removed to reveal the splined drive nut on the drive gear's shaft.




A close examination revealed that the nut had rotated on its shaft by approximately 0.5mm to 1mm.




The misalignment of the mark on the drive nut with respect to the mark on the drive gear's shaft occurred when the engine encountered an important sudden increase in resistant torque whilst delivering power. The torque increase is likely to have occurred when the main rotor (blades or rotor head) hit the solid obstacles (trees or ground).

The misalignment indicates that the engine was delivering power at the time of the accident.

- *Output drive shaft & free wheel*

The coupling tube was removed to reveal the free wheel assembly.

The free wheel could be rotated by hand. Its rotation could be locked or unlocked by rotating the output shaft in opposite directions thus confirming the nominal operation of the free wheeling function.

The splines of the output shaft were in good condition and did not present any surface marks especially at their front ends. This indicates that the torque level was low when the drive shaft disengaged and that the drive shaft was no longer connected to the MGB when that happened. The thin metallic strips at the front end could have been produced by the rubbing of the drive shaft inner diameter on the free wheel shaft's locking washer upon disengagement.

The three wings of the rear output shaft's flange were bent and twisted away from the engine and indicate that it was subjected to a high longitudinal force at the time of the crash. The drive shaft that links the engine to the tail gear box was not recovered.

- *Dressing*

The examination of the engine's pipes and harnesses did not reveal any pre crash damage.

### 6.2 Check of magnetic plugs

The magnetic plugs were checked. One filament like particle was found on the MO1 magnetic plug. Such an isolated particle does not represent any advanced stage of damage and it may have been released as a consequence of the accident. No other particle was found on the other magnetic plugs.


### 6.3 Equipment Examination

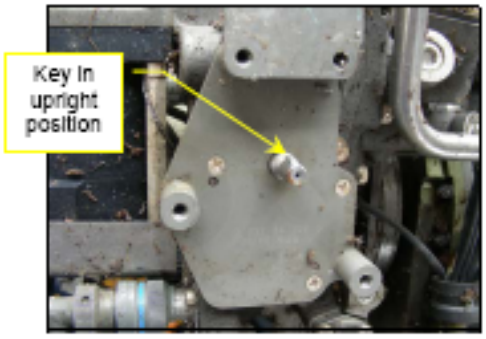
*6.3.1 Digital Engine Control Unit (DECU)*

There were no particular findings to report regarding the DECU.

*6.3.2 Other equipment*

There were no particular findings to report regarding the HMU, the valve assembly and the bleed valve.

The EBCAU auxiliary control drive unit was removed to reveal that the key on the HMU's auxiliary input drive shaft was in the upright position. Therefore, the auxiliary mode was not used during the last flight and consequently the DECU did not experience any loss of automatic control. This is the normal position of the shaft in DECU controlled automatic mode.



The bleed valve was in the open position which corresponds to the normal position once the engine has slowed down.

## 7. Summary and Discussion

The examination of the recovered components of the helicopter showed that the engine control systems were in their nominal flight position : twist grip on "Flight", engine start switch "On", fuel shut off valve opened, and fuel flow under automatic DECU control (EBCAU auxiliary control unused).

The rotor brake was activated. However, it happened as either a consequence of the crash or during the recovery effort because the damage sustained by the rotor blades indicates that they were rotating under power at the time of the accident.

Moreover, the swerving movement of the MGB and the rupture of the drive shaft indicate that the engine was delivering power at the time of the crash.

No significant findings were found on the engine: both the gas generator and the free turbine spools could be rotated silently and smoothly by hand. Both the accessories and the reduction gearboxes displayed continuity in the gear chain. The free wheel assembly performed its locked / unlocked drive functions.

The control of the position of the MO5 input gear nut revealed that it had rotated thus indicating that the engine was delivering power at the time of the accident.