Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

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# Safety Investigation Report

## ACCIDENT
## ROBINSON R44
## AT EBNM AERODROME
## ON 8 OCTOBER 2017

**Ref.:**
AAIU-2017-54

**Issue date:**
21 December 2018

**Status:**
Final

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## FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident.

In accordance with Annex 13 of the Convention on International Civil Aviation and EU Regulation 996/2010, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and to define recommendations in order to prevent future accidents and incidents.

In particular, Article 17-3 of EU regulation EU 996/2010 provides that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

The investigation was conducted by the AAIU(Be). The report was compiled by Henri Metillon and was published under the authority of the Chief Investigator L. Blendeman.

## SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| ’ | Minute |
| ’’ | Second |
| °C | Degrees centigrade |
| AAIU(Be) | Air Accident Investigation Unit (Belgium) |
| AccRep | Accredited Representative of a State Investigation Unit |
| AGL | Above Ground Level |
| AOC | Air Operator Certificate |
| AMSL | Above Mean Sea Level |
| ARC | Airworthiness Review Certificate |
| BCAA | Belgian Civil Aviation Authority |
| CAMO | Continuing Airworthiness Management Organization |
| CAVOK | Ceiling and Visibility OK |
| CG | Centre of Gravity |
| CPL(H) | Commercial Pilot Licence helicopter |
| E | East |
| EASA | European Aviation Safety Agency |
| EU | European Union |
| FAA | Federal Aviation Administration (USA) |
| FH | Flight hour(s) |
| ft | Foot (Feet) |
| lbs | Pounds |
| LH | Left hand |
| LOC-G | Loss of aircraft control while the aircraft is on the ground |
| m | Metre(s) |
| MSN | Manufacture’s serial Number |
| MTOW | Maximum Take-off Weight |
| N | North |
| O/H | Overhaul |
| PIC | Pilot in Command |
| PFM | Pilot’s Flight Manual |
| PPL(H) | Private Pilot Licence helicopter |
| QNH | Pressure setting to indicate elevation above mean sea level |
| RH | Right hand |
| RPM | Revolutions per Minute |
| SN | Serial Number |
| UTC | Universal Time Coordinated[1] |
| VFR | Visual Flight Rules |

[1] Note about the time: For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

## TERMINOLOGY USED IN THIS REPORT

**Safety factor:** an event or condition that increases safety risks. In other words, it is something that, if it occurs in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence.

**Cause:** any act, omission (individual), behaviour or condition (system) that produces an effect; eliminating a cause will eliminate the effect.

> **Direct cause:** the most obvious reason (acts or omissions, so mostly individuals) why an adverse event happens
>
> **Indirect cause:** A less obvious reason (acts, omissions, conditions) for an adverse event happening. The hazard has not been adequately taken into account via a suitable and sufficient risk assessment

**Contributing safety factor:** a condition that influences the effect by increasing its likelihood, accelerating the effect in time, affecting severity of the consequences, etc.; eliminating a contributing factor(s) won't eliminate the effect.

**Other safety factor:** a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

**Safety issue:** a safety factor that
(a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and
(b) is a characteristic of an organization or a system, rather than a characteristic of a specific individual, or a characteristic of an operational environment at a specific point in time.

**Safety action:** the steps taken or proposed to be taken by a person, organization or agency on its own initiative in response to a safety issue.

**Safety recommendation:** A proposal by the accident investigation authority in response to a safety issue and based on information derived from the investigation, made with the intention of preventing accidents or incidents. When AAIU(Be) issues a safety recommendation to a person, organisation, agency or Regulatory Authority, the person, organisation, agency or Regulatory Authority concerned must provide a written response within 90 days. That response must indicate whether the recommendation is accepted, or must state any reasons for not accepting part or all of the recommendation, and must detail any proposed safety action to bring the recommendation into effect.

**Safety message:** A message focussing on the existence of a safety factor and the lessons learned. AAIU(Be) can distribute a safety message to a community (of pilots, instructors, examiners, ATC officers), an organization or an industry sector for it to consider a safety factor and take action where it believes it appropriate. There is no requirement for a formal response to a safety message, although AAIU(Be) will publish any response it receives.

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AAIU-2017-54

## SYNOPSIS

| | | | |
|---|---|---|---|
| **Classification:** | Accident | **Type of operation:** | Non-Commercial[2] |
| **Level of investigation:** | Full investigation | **Phase:** | Take-off |
| **Date and time:** | 8 October 2017<br>10:43 UTC | **Operator:** | Private |
| **Location:** | Airfield of Namur/Suarlée (EBNM) | **Persons on board:** | 4 |
| **Aircraft:** | Robinson Helicopters R44 Raven I | **Aircraft damage:** | Substantial |
| **Occurrence category:** | Loss of control - ground (LOC-G[3]) | **Injuries:** | 4 slightly injured |

**Abstract:**
The helicopter was about to take-off with 3 passengers. Just before the lift-off, the helicopter entered in a rapid counter-clockwise rotation (Nose left). The helicopter banked and the main rotor blades touched the ground. The helicopter ended up on its right side. The occupants climbed out with light injuries and were brought to the hospital.

**Cause(s)**:
The probable cause of the accident is the pilot's inability to properly neutralize the helicopter movement with the cyclic and pedals during the transition from the ground to a stabilized hover before the take-off.

Contributing safety factor:

In this occurrence, the pilot put himself under conditions of stress conducive to human errors.

To achieve an optimal flight safety, the pilot should only focus on the flight preparation and the flight itself. More than experienced pilots, a low experienced pilot should therefore ensure not to be disturbed by external factors and should remain free of any organizational constraints not directly related to the flight.

[2] The pilot considered the flight as being non-commercial, however the investigation concluded that it should have been conducted under the provisions of commercial operations.
[3] LOC-G means "Loss of aircraft control while the aircraft is on the ground". This occurrence category is used for aviation accident and incident reporting systems and defined by the CAST (Commercial Aviation Safety Team)/ICAO (International Civil Aviation Organization) Common Taxonomy Team.

# 1 FACTUAL INFORMATION

## 1.1 History of flight.

### Preamble

The pilot involved in the accident advertised on a dedicated internet website under the trade name 'Lore Hélicoptère'[4] a variety of services involving helicopters (training, short flights, ..).

As the pilot didn't own any aircraft and his organization didn't hold any Air Operator Certificate, the pilot stated that all these services were actually performed by other aviation companies.

This pilot was sponsoring a beauty contest event, called 'Top Women' for which it was part of the sponsorship agreement to reward the winners and the organizers with helicopter rides, free of any charge.

On Sunday 8 October 2017, the winners and the organizers of the beauty contest event were invited by the pilot for their free 40 minutes-long helicopter flights. The pilot, holder of a Private Pilot Licence (PPL(H)), intended to perform these flights by himself, considering that the non-revenue generating character of the flights would eliminate the requirements applicable to Commercial Air Transport (CAT). Two flights were scheduled for the 6 passengers in total.

On the same day, the pilot organized a 'First flight' event on the aerodrome of Namur/Suarlée. In order to do that, he agreed with 'Best in Sky', a helicopter company, to carry the fare-paying passengers for short 6 minutes First flights.

The pilot and his son, arrived early in the morning at the airfield to prepare the 'First flight' event that was scheduled to begin in the late morning. During the morning, the pilot was given the opportunity to participate as passenger/observer to a pipe line survey flight performed by 'Best in Sky'. When the survey part of the flight was completed, the 'Best in Sky' pilot, who is also an instructor, proposed the passenger/observer to act as pilot during the return flight, which he accepted. This flight was uneventful.

A little later, 'Best in Sky' started with the 'First flights' at about 9:00 UTC with a pilot holding a Commercial Pilot Licence (CPL(H)) in command. The pilot's son was in charge of the administrative work of welcoming the customers, registration, payment, etc.

### The accident flight

The pilot postponed his own flights somewhat due to the meteorological conditions south of the Namur airfield. At about 10:00, the meteorological conditions improved and the pilot decided they were adequate for the intended flight. He performed the pre-flight, checked the fuel quantity (about 45 litres in each tank), the weight and balance and invited three passengers to board the helicopter. He did not give a formal pre-flight briefing to the

[4] The legal base of this organization was unclear and its website is now offline.

passengers but checked that the safety belt of each passenger was fastened and that the doors were properly closed.

The pilot stated that after the boarding he found out that the intercom wasn't working. This gave him some stress as this would prevent him to easily communicate with the passengers during the flight.

He experienced difficulties when starting the engine. It took him six attempts to finally start the engine. He engaged the clutch and warmed the engine in accordance with the starting and run-up check list.

The group of people accompanying the winners and organizers of the beauty contest – 9 people in total - gathered outside to watch the take-off and take pictures and videos. They were standing between the hangars and the helicopter, at a short distance.

The helicopter was ready for take-off when the pilot of another helicopter made a radio call to announce that he was taxiing towards the parking area and was about to pass on the right side. The pilot acknowledged the information and waited until the landing of the other helicopter before initiating the take-off.

**Figure 1: people gathered near the helicopter ready for take-off**

About 12 seconds after the landing of the other helicopter, when initiating lift off, the helicopter was suddenly taken in a violent counter-clockwise rotation. The pilot stated that he had the impression that his actions on the pedals were ineffective just as if the tail rotor controls were failing. A video shows the helicopter still on the ground turning about 45° to the left in about one second just before lift-off.

**Figure 2: Stills from the smartphone footage showing the helicopter ready for take-off (left) and the helicopter having turned 45° to the left one second later (right)**

The pilot stated that he reacted by pulling on the collective control in order to increase the lift off in an attempt to recover control. As the counter-clockwise (CC) rotation did not stop, he had the impression that the controls were no longer responding and he fully lowered the collective control to put the helicopter on the ground. The main rotor blades hit the ground and the helicopter crashed on its right side.

Several detached parts of the main rotor blades flew in the directions of the runways and a car parking area. By chance, no bystander was impacted by the helicopter or by detached parts of the helicopter.

**Figure 3 : 2 seconds after lift-off – 180° CC turn**

**Figure 4 : 3 seconds after lift-off – 300° CC turn**

**Figure 5 : Rotor blade hits the ground**

**Figure 6 : Final rest after 5 seconds (1 turn ¾)**

As soon as the helicopter stopped, bystanders ran to help the occupants to evacuate the wreckage and provide them with first aid. The first passenger climbed out after 30'' and the last one after 1 minute 45''. The pilot secured the controls and evacuated the helicopter as last, after 2 minutes 35''.

Although there was a small continuous fuel leak coming from the area located above the auxiliary (right) fuel tank, the helicopter did not catch fire. A plastic container was placed to collect the fuel leak.

The rescue services came rapidly on site, sprayed fire suppression foam and evacuated the occupants to a nearby hospital. Thereafter, the remaining fuel contained in the main (left) fuel tank was removed.

**Figure 7: Wreckage with a collecting pan avoiding the fuel leak to flow on the ground**

## 1.2 Injuries to persons.

| Injuries | Crew | Passenger | Others | Total |
|---|---|---|---|---|
| Fatal | | | | |
| Serious | | | | |
| Minor | 1 | 3 | | 4 |
| None | | | | |
| Total | 1 | 3 | | 4 |

## 1.3 Damage to aircraft.

The helicopter was damaged beyond repair.

## 1.4 Other damage.

The asphalt parking area was slightly damaged by the impact with the rotor blades.

## 1.5 Personnel information.

**Pilot:**

| | | | |
|---|---|---|---|
| **Age:** | 51 years - Male | **Medical:** | Class II, Valid up to 25 August 2018 |
| **Nationality:** | Italian | | |
| **License:** | PPL(H) | **Language proficiency:** | French VFR Level 6 |
| **Ratings:** | R44, valid until 31 January 2018 | **Restraints used:** | 3-Points |
| **Flight experience:** | Private Pilot Helicopter license delivered by DGAC (France) on 9 August 2011. Total flight time: 154:31 FH. Total as PIC: 60:51 FH. Last 6 Months: 4:36 FH Last Month: 1 FH. | | |

## 1.6 Aircraft information.

The Robinson R44 is a four-place light helicopter produced in the United States by the Robinson Helicopter Company since 1992. It is a single-engine helicopter with a semi-rigid two-bladed main rotor, a two-bladed tail rotor and a skid landing gear. It has an enclosed cabin with two rows of side-by-side seating for a pilot and three passengers. This helicopter is type-certificated by EASA under the reference EASA.IM.R.121, issue 3 dated 21 April 2010.

### General characteristics

- Crew: one or two pilots
- Capacity: four, including the pilot
- Length: 21 ft 5 in (9.0 m)
- Rotor diameters: 33 ft (10.06 m) – Counter-clockwise rotation
- Tail rotor diameters: 4 ft 10 in (1.47 m)
- Height: 10 ft 9 in (3.3 m)
- Basic empty weight: 1,460 lb (663 kg)
- Max gross weight: 2,400 lb (1,089 kg)
- Fuel tanks capacity (bladder-type fuel cell installed):
  - Main (L/H): 115 litres, 112 litres usable
  - Aux. (R/H): 65 litres, 64 litres usable

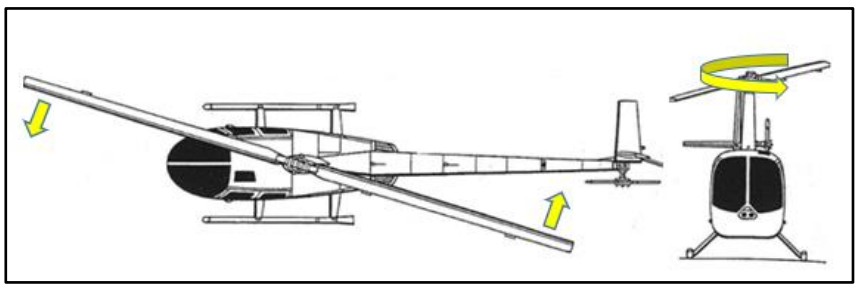


**Figure 8 : Drawing showing the counter-clockwise direction of rotation of the main rotor.**

## Accident helicopter:

| | | | |
|---|---|---|---|
| **Type** | Helicopter | **Certificate of Airworthiness:** | EASA Form 25 issued by BCAA on 6 May 2008 |
| **Manufacturer:** | Robinson Helicopter Company | **Airworthiness Review Certificate:** | EASA Form 15B last issued on 8 May 2017, valid until 13 May 2018 |
| **Model:** | R44 Raven I | **State of registry:** | Belgium |
| **Built year:** | 2008 | **Total airframe time:** | 1784.5 Flight Hours |
| **Serial number:** | 1857 | **Number and type of engine(s):** | 1 reciprocating |
| **Airworthiness:** | EASA Aircraft | **Engine:** | Lycoming engine O-540-F1B5 |

## Weight and balance:

The calculated weight and balance, based on the load figures provided by the pilot, was within limits.

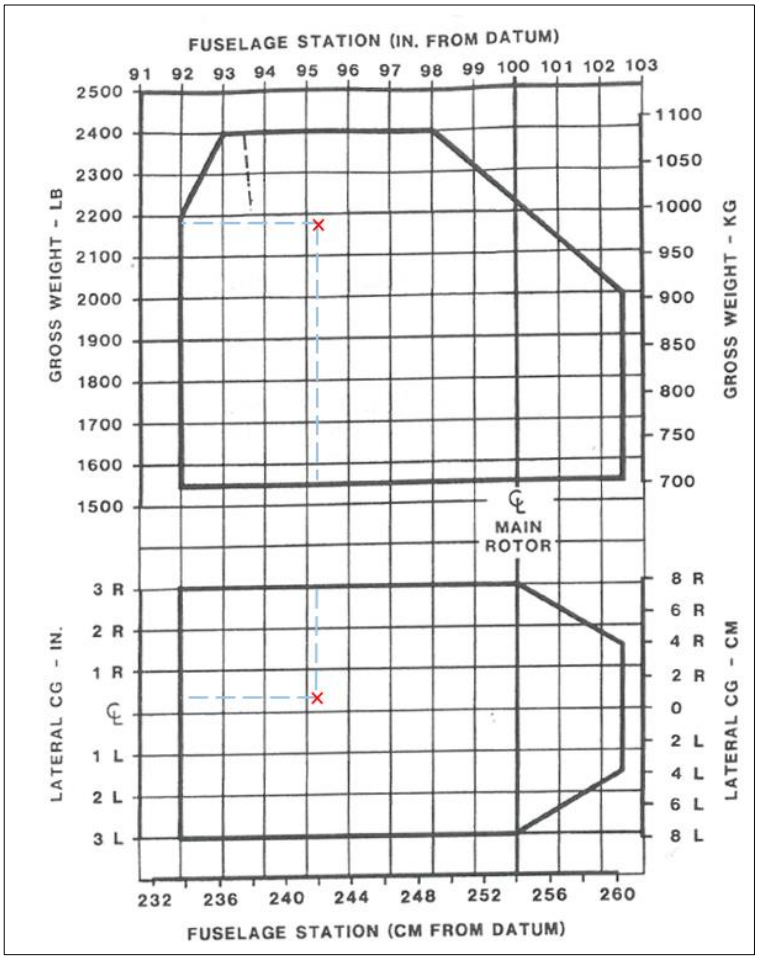



**Figure 9 : Showing that both lateral and longitudinal CG (red X) were within limits**

## 1.7 Meteorological conditions.

METAR at EBNM airfield:
Visibility: 8000 m, Wind: 280° - 7kt, Temperature: 12°C, QNH: 1018 hPa. Clouds: scattered at 1400 ft – broken at 2000 ft.

## 1.8 Aids to navigation.

Not applicable.

## 1.9 Communication.

The R44 in approach reported on the airfield frequency 118.000 Mhz ('Namur Radio') that he was about to land. The pilot of the other helicopter acknowledged the information and waited until the landing of the other helicopter before initiating the take-off.

## 1.10 Aerodrome information.

EBNM Namur airfield is located 7 km west-northwest of Namur. Geographical coordinates are 50°29'17" N – 4°46'08" E and elevation is 594 ft (181 m). The airfield is equipped with two grass[5] 06/24 bi-directional runways.

The use of the aerodrome is subject to prior permission from the operator. A mix of aeroplanes, helicopters and gliders are operating from the airfield along with parachuting activities. Basic Information is provided on 'Namur Radio' and radio equipment is mandatory for all aircraft.

Extract of the aerodrome Manual regarding pedestrian access to the airside of the aerodrome (Translation from French):

> *Only pedestrians holding a pilot license have free access to the internal zones of the airfield. The pilot's license shall be presented at each request of the Airfield Commander, or his delegates. The pedestrians access is restricted to the boundaries of the aerodrome. In no case shall pedestrians cross runways, taxiways or runway threshold.*

## 1.11 Flight recorders.

Not applicable.

[5] Condition at the time of the accident. At the publication date of this report, runway 06R/24L has been converted to an asphalt runway

## 1.12 Wreckage and impact information.

**Sequence:**

When still on the ground, the helicopter suddenly turned counter-clockwise. The helicopter then lifted off and did not stop turning, making almost twice a 360-degree turn. The detail of the sequence is:

- The helicopter started to rotate counter clockwise with both skids on the ground;
- The helicopter lifted off and made a 360-degree turn;
- The helicopter hit the ground violently with the right-hand skid;
- The helicopter turned further counter-clockwise with a bank to the right;
- The tail struck the ground with its RH side (tail rotor up). The tail and the tail rotor drive shaft broke off;
- One main rotor blade tip hit the ground with high energy. A piece of the blade (1a) was torn off and was projected horizontally towards the runway, more than 160 m away;
- The other blade hit the ground with lower energy and was subsequently bent. Several pieces of this blade (2a, 2b, 2c, 2d) broke off and were also projected. They fell close to the main wreckage.

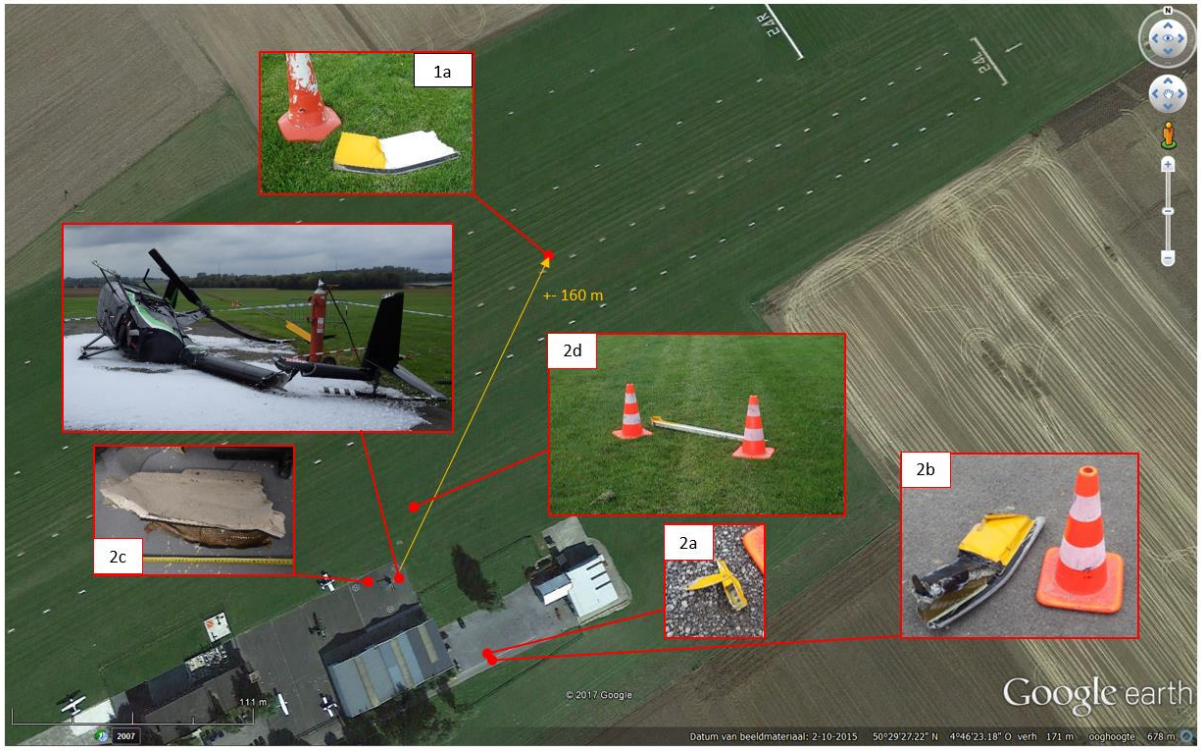



**Figure 10: Aerial view showing the scattered parts of the helicopter**

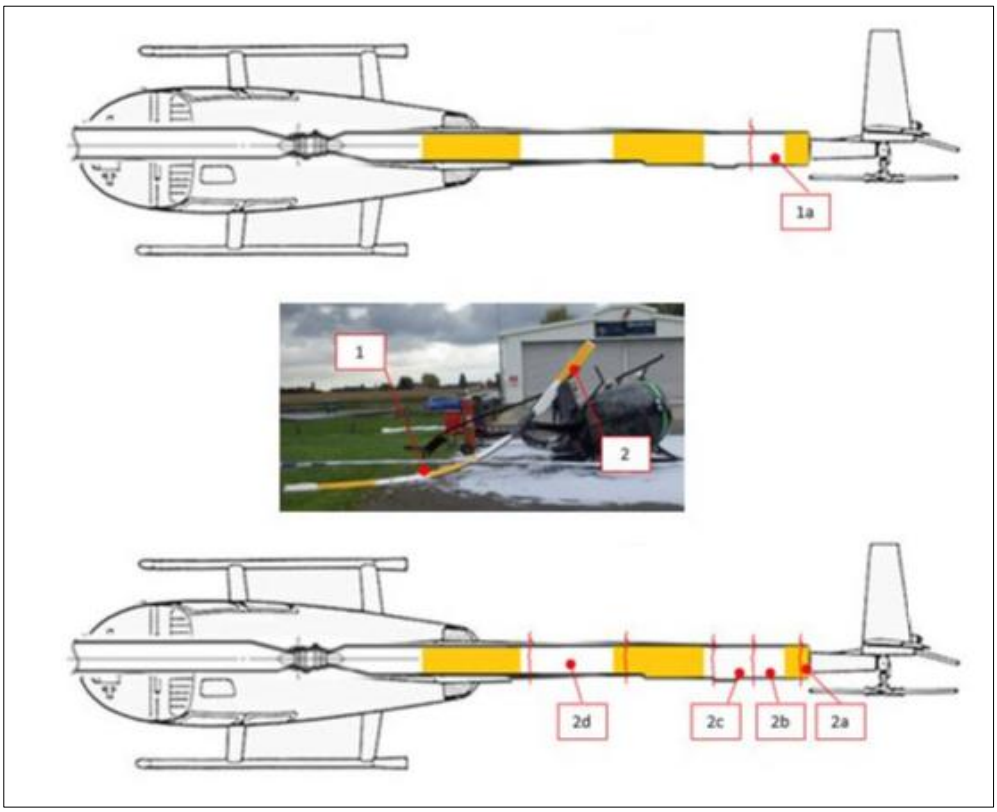



**Figure 11 : Sketch identifying the different severed parts of the main rotor blades**

### Position of the controls and switches

Little time after the accident, the pilot of the 'Best in Sky' helicopter that had just landed prior to the accident rushed to rescue the pilot and to help securing the wreckage. He could identify the initial position of the different controls and switches and the controls that were moved to secure the wreckage before the evacuation of the pilot.

- Mixture: full rich with the plastic protection installed;
- Hydraulic switch: ON (this switch is installed at the end of the cyclic control);
- Governor switch: ON (this switch is installed at the end of the collective control);
- Master switch: OFF (Set in this position after the accident);
- Fuel Shut-off valve: Closed (Set in this position after the accident);
- Friction of the collective control: Adjusted in an intermediate position with a moderate friction;
- Friction of the cyclic control: Completely released (no friction);
- Position of the collective control: Fully UP (placed in this position after the accident to gain access to the shut-off valve);
- NAV lights and Strobe Lights: ON;
- Clutch: ON;
- Carburettor heat: slightly ON (pulled about 18mm);
- Rudder pedals: both pedals on pilot side adjusted on a similar manner, for people with long legs;
- Rudder pedals: passenger side: removed;
- Hobbs meter: 1784.5h.

**Inspection of the wreckage**

The flight controls system was inspected for continuity and freedom of movement. In particular, the yaw controls were carefully inspected from the pilot's pedals to the tail rotor. Broken flight controls linkages were examined and they all show a typical form of failure in overload resulting from the accident. All other damages found resulted from the impact with the ground; no pre-impact anomaly was found.

The damage to the tail rotor drive shaft resulted from the movements of the tail structure when the tail skid violently hit the ground. The tail structure was almost severed. The tail rotor blades did not touch the ground during the loss of control; the drive shaft was bent and there was no sign of damage to the drive shaft under torque.

The damages to the main rotor blades, the main skids and the fuselage structure were caused by the impact with the ground during the loss of control of the helicopter. At the time of the accident, the main rotor mast and its associated fairings moved forward causing an approximative 20 cm permanent deformation to the cabin roof.

The aluminium structure of the fuselage was torn open at the front face of the fuel tanks. The bladder-type fuel tanks were visible through openings in the structure. Despite the damages to the surrounding structure, the bladder cells were undamaged and remained fuel tight.

The interconnecting vent line, made of a rubber tubing forming a vertical loop, connecting together the left (main) to the right (auxiliary) fuel tanks, was found severed at about 6 cm from the connection to the left fuel tank. The tie-wrap holding the loop of the tubing in up position on a rib of the mast fairing was also elongated and cut.
In the same area, the vent line of each fuel tank was found disconnected at the vent rollover valve.

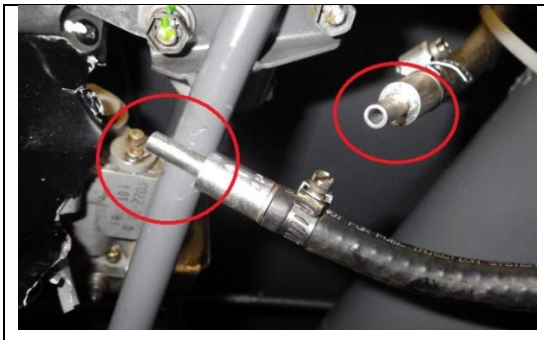


**Figure 12 : Disconnected fuel vent lines.**

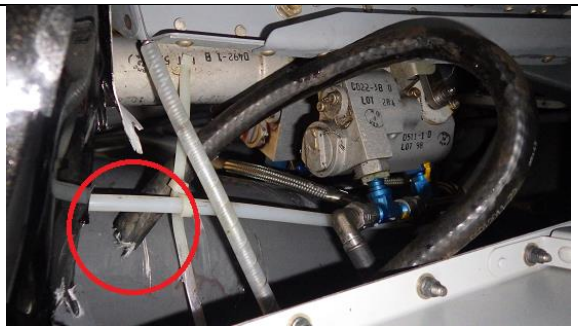


**Figure 13 : Severed interconnecting vent line**

## 1.13 Medical and pathological information.

The 3 passengers were shocked and slightly injured. The front seat passenger suffered head injuries. They were sent to a hospital for medical examination. After the examination, none was further hospitalized.

**1.14 Fire.**

There was no fire although there was a fuel leak close to the engine compartment.

**1.15 Survival aspects.**

The severity of the shock was survivable and the structure of the cabin remained relatively intact except for the deformation of the roof above the rear seats. However, in case of fire, the probability of survival would have been reduced.

**1.16 Tests and research.**

Not applicable.

**1.17 Organizational and management information.**

Regulation on Air Operations

Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 (consolidated version) has the following definition for commercial operations: *'commercial operation' shall mean any operation of an aircraft, in return for remuneration or other valuable consideration, which is available to the public or, when not made available to the public, which is performed under a contract between an operator and a customer, where the latter has no control over the operator;*

The requirements and procedures for Air Operations are further laid down in Commission Regulation (EU) No 965/2012. In this Regulation commercial air transport (CAT) operation is defined as *an aircraft operation to transport passengers, cargo or mail for remuneration or other valuable consideration.*

Article 5 (1) states that Operators shall only operate an aeroplane, a helicopter or a sailplane for the purpose of CAT operations in accordance with the requirements specified in Annexes III – 'PART-ORO' (Organization Requirements for Air Operations) and IV – 'PART-CAT' (Commercial Air Transport Operations)

Article 6 specifies some derogations from Article 5(1). Some operations with other-than complex motor-powered aeroplanes and helicopters, and with sailplanes may be conducted in accordance with Annex VII – 'Part NCO'. These operations are:

- Cost-shared flights
- Competition flights or flying displays
- Introductory flights, parachute dropping, sailplane towing or aerobatic flights performed either by a training organization or by an organization created with the aim of promoting aerial sport or leisure aviation, on the condition that the aircraft is operated by the organization on the basis of ownership or dry lease, that the flight does not generate

profits distributed outside of the organization, and that whenever non-members of the organization are involved, such flights represent only a marginal activity of the organization.

## 1.18 Additional information.

Not applicable.

## 1.19 Useful or effective investigation techniques

Video camera.

For this investigation, as for many other investigations, the availability of images of the accident proved invaluable.
During the investigation the following sources of images were used:

- Airfield surveillance video camera.
- Pictures taken in the helicopter cabin.
- Pictures and videos from the outside of the helicopter, taken by people watching the take-off.

# 2 ANALYSIS

## 2.1 The loss of control

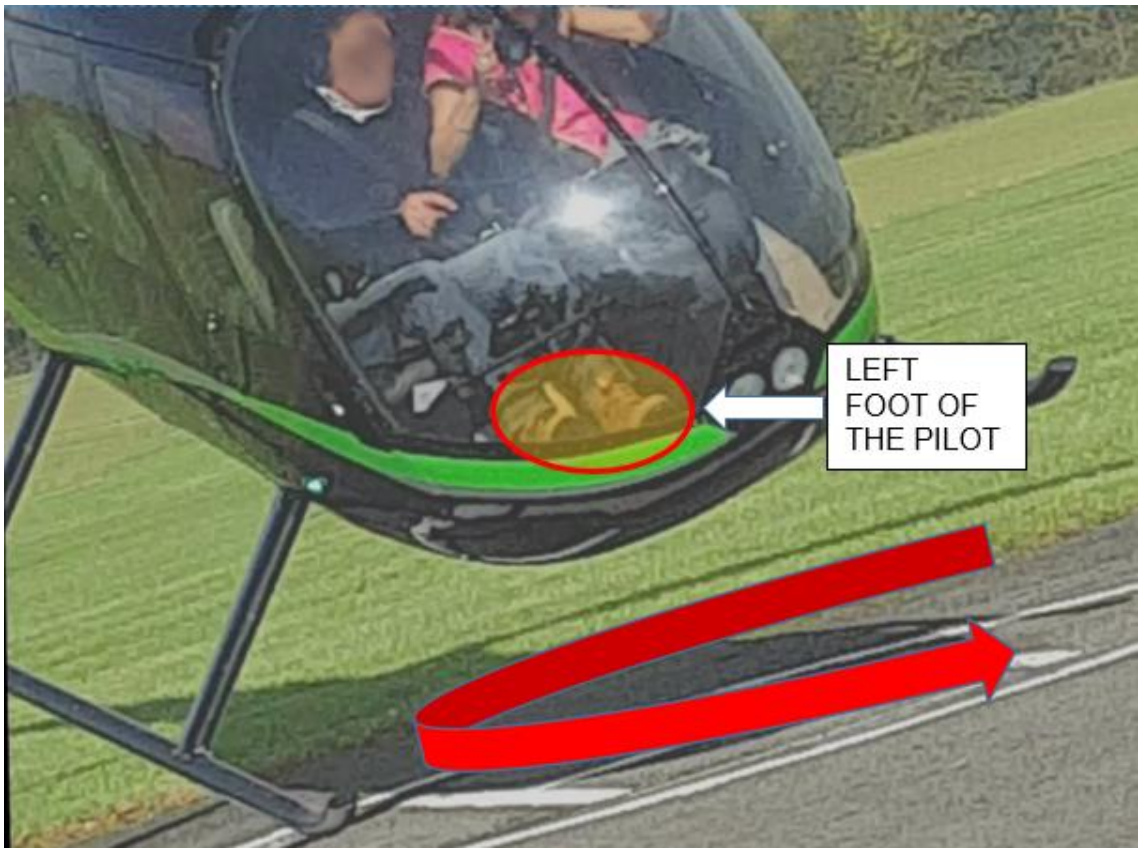



**Figure 14 : The helicopter after ¼ counter-clockwise turn, showing that the pilot is pushing on the left pedal**

When the helicopter became light on the skids, just before the lift off, with the two skids still touching the ground, it started to turn rapidly 45 degrees counter-clockwise. A still of the video footage, just after lift-off when the helicopter reached a 90 degrees turn, clearly shows the left foot of the pilot pushing on the left yaw pedal.

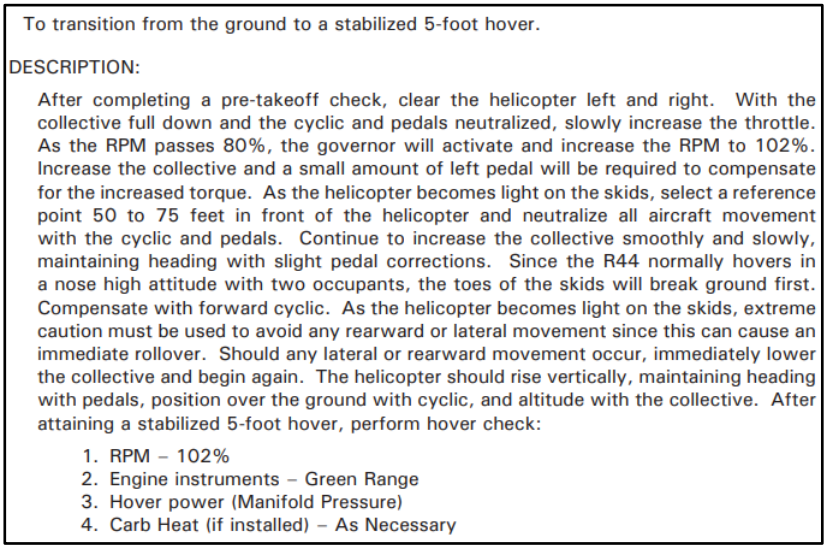
There was no interference from the front passenger to the controls of the helicopter. The pedals at the left seat were not installed in the helicopter and the still clearly shows that the front passenger was holding her hands up during the turn.

The helicopter has a normal tendency to turn clockwise (nose right), due to the counter-clockwise rotation of the main rotor. Normally, the pilot should have neutralized this tendency by pushing slightly on the left pedal. An excessive left pedal input would result in a counter-clockwise (nose left) rotation. This is described in the R44 maneuver guide (see extract on figure 15).

It is likely that the pilot initially applied too much left pedal when increasing the collective for the lift off. He was then surprised by the sudden turn to the left that occurred when the helicopter became light on the skids, leaving him no time to think about what happened.

The pilot had the impression that his actions on the pedals were ineffective to stop the helicopter rotation. He likely did not realize the helicopter was rotating left instead of right.

The factual elements (video and inspection of the wreckage) do not reveal any anomaly in the flight controls of the helicopter.



To transition from the ground to a stabilized 5-foot hover.

DESCRIPTION:

After completing a pre-takeoff check, clear the helicopter left and right. With the collective full down and the cyclic and pedals neutralized, slowly increase the throttle. As the RPM passes 80%, the governor will activate and increase the RPM to 102%. Increase the collective and a small amount of left pedal will be required to compensate for the increased torque. As the helicopter becomes light on the skids, select a reference point 50 to 75 feet in front of the helicopter and neutralize all aircraft movement with the cyclic and pedals. Continue to increase the collective smoothly and slowly, maintaining heading with slight pedal corrections. Since the R44 normally hovers in a nose high attitude with two occupants, the toes of the skids will break ground first. Compensate with forward cyclic. As the helicopter becomes light on the skids, extreme caution must be used to avoid any rearward or lateral movement since this can cause an immediate rollover. Should any lateral or rearward movement occur, immediately lower the collective and begin again. The helicopter should rise vertically, maintaining heading with pedals, position over the ground with cyclic, and altitude with the collective. After attaining a stabilized 5-foot hover, perform hover check:

1. RPM – 102%
2. Engine instruments – Green Range
3. Hover power (Manifold Pressure)
4. Carb Heat (if installed) – As Necessary

**Figure 15 : Extract of R44 manoeuvre guide**

## 2.2 Human factors – Placing oneself under pressure

As stated previously, the pilot was involved in different activities on that morning. He was actively involved in;

- The organization of a 'First flight' event including welcoming, registering, briefing, accompanying interested people, assisted by his son. The flying activity itself was, except for 2 planned flights, subcontracted to another company.
- A pipe-line survey mission, for which he performed the return flight as a pilot.
- The preparation of the 2 flights for the 6 people of the beauty contest, including some concern about the changing weather.

When he took place in the helicopter with the three first passengers at least 9 other persons, the 3 other passengers and friends and relatives, were observing the operations, standing at a short distance. Shortly after, he realised that the intercom was not working which upset him as he expected difficulties to communicate with his passengers during the flight.

All abovementioned activities are sources of pressure that might have contributed to stress the pilot. This likely resulted in a non-adequate starting procedure of the engine leading to difficulties to start it. The pilot made several unsuccessful attempts to start the engine. It is only on the sixth attempt that the engine started.
Trying to start the engine several times while being observed and filmed likely caused an additional stress that contributed to reduce the pilot's concentration to properly control the take-off.

In summary, on this morning, the pilot did a lot of different things and exposed himself to an excessive stress.

### 2.3 Unnecessary presence of people close to the helicopter at take-off.

When the accident occurred, 9 people were gathered at a distance of about 15 meters from the helicopter. Luckily, none of them was hit by rotating or flying parts.

The internal rule of the airfield states that only people holding a pilot license are authorized to enter the airside of the airfield. However, although not specified in the airfield manual, it is assumed that this authorization is extended to passengers under the supervision of their pilot and people otherwise duly authorized by the airfield commander.
In this event, with several persons gathering so close to the helicopter without authorization and supervision from anyone, it is obvious that the internal rule for the airfield airside access was not complied with.

The pilot, in charge of the organization of the event, let it happen without reaction. This situation could also be seen from the office of the airfield commander, having a good field of vision of the apron. The duties of the airfield commander include the monitoring of airfield activities and the enforcement of the airfield internal rule. There was no reaction noted from the airfield commander following the gathering of people around a helicopter on the airside.

The investigation could not determine whether this gathering of people happened suddenly and why the airfield commander did not take action. However, this gathering of people reflects shortcomings in the preparation of the event.

### 2.4 Determination of type of operation.

After the event, the pilot stated that the flights with the winners and organizers of the beauty contest were, in his eyes, not commercial, and therefore he decided, as private pilot to perform the flights himself. The reason given was that these flights were not paid by the passengers and made out of a personal interest in supporting the beauty contest event.

However:
- The website of the pilot (‘Lore Hélicoptère’) had a clearly commercial character (offers of services against a fee, bank account details,..), and
- The pilot’s organization name and logo were clearly identified on the website of ‘Top Women’ along other commercial sponsors and,
- The First flights that were organized for the general public on the same day as the flight with the ‘Top Women’ competition winners were advertised with a clear reference to the ‘Top Women’ event.

The above shows that there was a commercial relation between ‘Lore Hélicoptère’, ‘Top Women’, the First flights generating revenues organized the same day, and the accident flight with the beauty contest winners.

Furthermore the offering of free flights with the winners in return for advertisement as sponsor of the event can be considered as a kind of 'valuable consideration', which is a term with a very wide meaning, including the provision of goods and services.

As a reminder 'commercial air transport' (CAT) means an aircraft operation to transport passengers, cargo or mail for remuneration or other valuable consideration. For CAT, the regulation is designed such to ensure the highest level of safety for the passengers.

As the accident flight operation doesn't fall under the derogations of Article (6) of Commission Regulation (EU) No 965/2012 (see chapter 1.17 of this report), the flight should have been considered as commercial operation and operated under the requirements of Annex IV (PART-CAT) and Annex III (PART-ORO), which requires amongst others an Air Operator Certificate (AOC) for the operator.

All the above (website, logo, the organization of the 'First flight' event) also gave the impression to the passengers that the accident flight was within the framework of commercial operation and hence in accordance with higher standards, expecting a higher level of safety than a private helicopter flight.

## 2.5 Fuel leak

Witnesses stated that the fuel leak did not originate from the tanks or from the tank caps and the examination of both rollover valves showed that their disconnection occurred at the correct location. It was also determined that these rollover valves were in good condition and that they properly blocked the vent to minimize fuel spillage.

As the helicopter was lying on its right side, the ruptured vent line interconnecting the fuel tanks was located at a lower height than the fuel level in the tank. This caused the fuel spillage observed when the helicopter was lying on its right side.

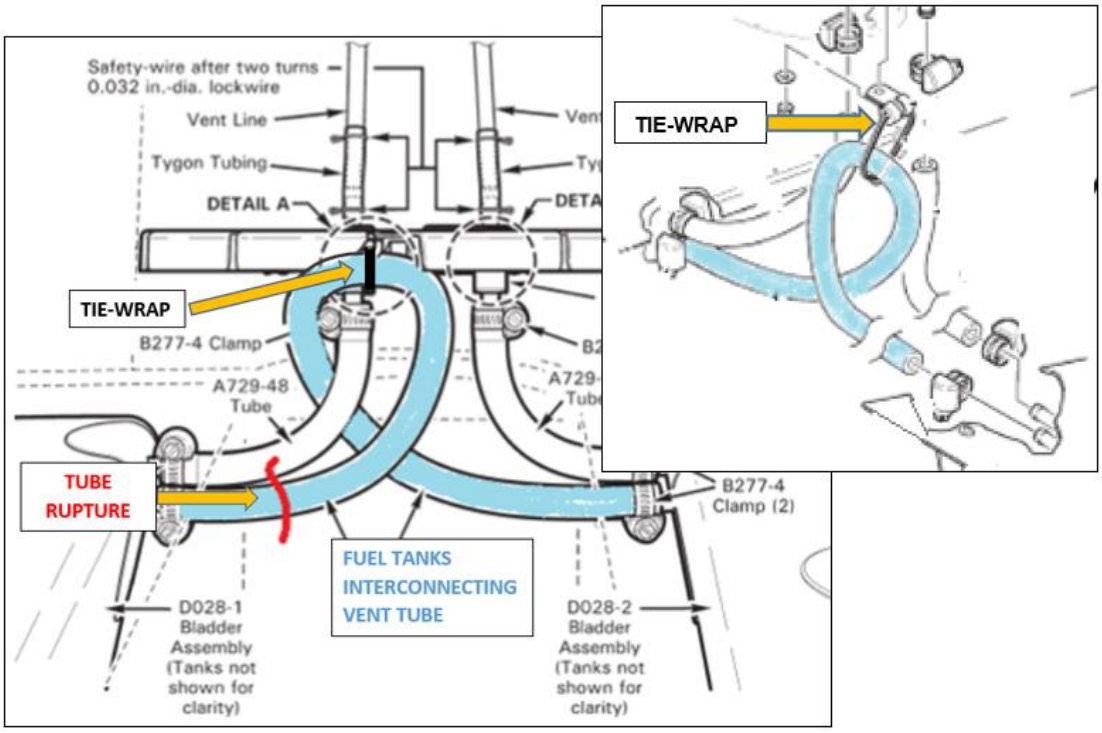



Figure 17 : Drawing of the interconnecting vent line and its tie-wrap (view looking aft)

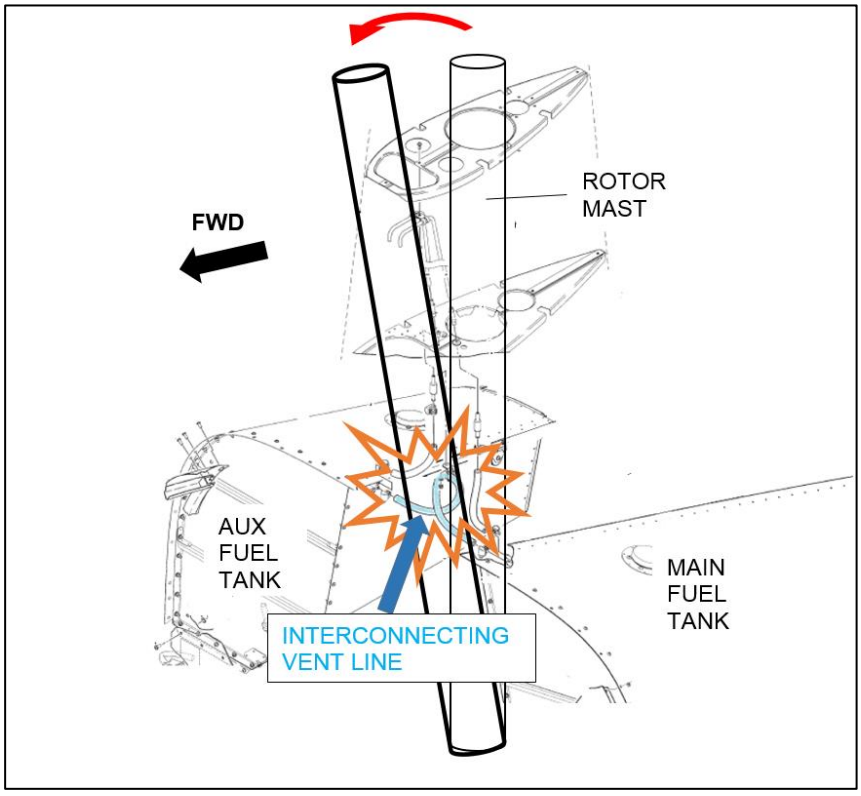



Figure 18 : Rocking of the main rotor mast causing the rupture of the rubber line.

Examination of the rubber vent line and the tie-wrap holding it upright to the rotor mast determined they failed upon impact.

Both the rubber vent line and the tie-wrap ruptured because they were pulled away by the deformation of the surrounding structure caused by the rocking movement (moving in the lateral and longitudinal direction) of the rotor mast at impact.

By design, in case of deformation of the surrounding structure, the tie-wrap should fail first in order to release the vertical loop of the rubber vent line. This would give the rubber vent line a better freedom of movement and allow for a reduced risk of rupture.

However, in this case, both the tie-wrap and the rubber vent line ruptured. This suggests that both ruptures occurred exactly at the same time because the strength of the tie-wrap was equivalent to the rubber vent line strength.

# 3 CONCLUSIONS

## 3.1 Findings.

- The pilot was duly qualified and licenced for piloting the helicopter in non-commercial operation.
- The pilot total flying experience as well as his last 6 months experience were relatively low.
- On a website, the pilot presents himself as the manager of an organization focused on aviation activities, 'Lore Hélicoptère'. This company didn't hold a 'Air Operator Certificate' and its legal base was unclear.
- On the day of the accident, this organization organized fare paying First flights outsourced to another company, 'Best in sky'.
- It was planned that 2 flights were offered by 'Lore Hélicoptère' without remuneration to a beauty contest organizer, with the pilot of 'Lore Hélicoptère' as PIC. The accident occurred during the take-off of this first flight.
- The pilot lost the control of the helicopter during the transition between the ground and a stabilized hover.
- A video of the accident shows the left foot of the pilot pushing hard on the left pedal while the helicopter is already turning counter-clockwise.
- There are indications that the pilot was under an excessive stress upon take-off.
- The helicopter was in an airworthy condition which means registered, covered by a valid airworthiness certificate and a valid Airworthiness Review Certificate.
- The inspection of the damaged helicopter did not reveal any technical anomaly that could explain the loss of control.
- Although the helicopter structure in the area of the fuel tanks suffered severe damage, the installed bladder-type fuel cells did not leak. However, a fuel leak occurred close to the fuel tanks due to the rupture of a rubber vent line interconnecting both tanks. The helicopter did not catch fire.
- When the accident occurred, at least 9 persons were present on the aircraft parking, close to the helicopter. By chance, none of them were hit by rotating and flying parts.

## 3.2 Causes.

The cause of the accident is probably the inability of the pilot to properly neutralize the helicopter movement with the cyclic and pedals during the transition from the ground to a stabilized hover before take-off.

Contributing safety factor:

In this event, the pilot put himself under conditions of stress conducive to human errors.

To achieve an optimal flight safety, the pilot should only focus on the flight preparation and the flight itself. More than experienced pilots, a low experienced pilot should therefore ensure not to be disturbed by external factors and should remain free of any organizational constraints not directly related to the flight.

# 4 SAFETY ACTIONS AND RECOMMENDATIONS

## 4.1 Safety issue: Insufficient preparation of the event.

The presence of unnecessary people in the immediate surroundings of the helicopter indicates that the preparation of the event was insufficient and was not safety-minded. AAIU(Be) is of the opinion that the safety of such an event begins with a good preparation from the organizer, where the airfield commander / operator can play an important supervision role. The airfield commander has the authority to reject the event if he is not fully satisfied with the safety measures taken by the organizer. Therefore:

**Safety Recommendation BE-2018-0008:**

It is recommended, that, in case of organization of similar events, the operator of the airfield of Namur adopts a proactive approach requesting beforehand the organizer of the event to demonstrate that all the necessary safety measures are in place before authorizing the event.

## 4.2 Safety issue: Rupture of the rubber vent line interconnecting the fuel tanks and fuel leak in case of accident.

A fuel leak, with the potential of causing a fire, occurred at the rubber vent line interconnecting the fuel tanks. Should a fire have occurred, this accident could have caused severe injuries, or worse, because of the time necessary to evacuate the occupants. In this case, the evacuation was not easy and was only possible through the left side doors whereas the rear door was located approximately above the fuel leak. The last passenger, helped by witnesses, climbed out after 1 minute 45'' and the pilot evacuated the helicopter after this last passenger.
AAIU(Be) is of the opinion that the system of rubber vent line interconnecting the fuel tanks should be improved to reduce the likelihood of a fuel leak when a movement of the rotor mast occurs during a survivable accident. Therefore, the following recommendation was addressed to the Robinson Helicopter Company on 7 November 2018.

**Safety Recommendation BE-2018-0009:**

It is recommended that Robinson Helicopter Company improves the design of the vent line interconnecting the fuel tanks to further mitigate the risk of fuel leak in case of survivable accident, by reviewing the routing of the vent line, its length and the fixture of the vertical loop.

Safety actions performed by Robinson Helicopter Company

On 22 November 2018, Robinson Helicopter Company responded to the recommendation letter and provided information about the safety actions already performed:

*Based on the information we received shortly after the accident, the fuel vent hose installation was revised to use a lighter tie-wrap (MS3367-4-9 replaced MS3367-5-9, revised). The blueprint revision was approved on 17 November 2017, it was likely 2-3 weeks later when the assembly line began installing the -4-9 ty-raps on all new production and overhaul aircraft.*

Thereafter, on 19 December 2018, Robinson Helicopter Company also stated that:

*The United States Congress has recently passed legislation requiring modifications to general aviation fuel systems that do not meet current certification regulations. After reviewing the information from this accident, our engineers have decided to redesign the fuel vent system, deleting the crossover hose (and the tie-wrap).*
*Once the revision is approved, we will provide an update on the changes and any decisions on retrofitting the fleet.*

### 4.3 Safety issue: 'First flights' organised by organizations not holding an 'Air Operator Certificate'

Today, a lot of organizations offer so called 'First flights' (Baptême de l'air in French – Luchtdopen in Dutch) with helicopters, aeroplanes, hot air balloons... to the public in return for payment. These flights should be operated under the requirements of Regulation (EU) No 965/2012 Annex IV (PART-CAT) and Annex III (PART-ORO), including the obligation for the operator to hold an Air Operator Certificate (AOC). However, currently not all of these organizations comply with the rules, giving a false impression of safety to the public. Therefore :

**Safety Recommendation BE-2018-0010:**

It is recommended that the Belgian Civil Aviation Authority (BCAA) actively controls organizations offering so-called 'First flights' and also sets up a promotion campaign to inform the public of the rules and to make the public aware of the existence of an Air Operator Certificate (AOC), which is a guarantee of a certain level of safety.

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