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INVESTIGATION REPORT

Accident to the MAGNI - M16 identified 48BU

on 18 January 2021
at Valmeinier (Savoie)

Time	Around 14:45[1]
Operator	Private
Type of flight	Local
Persons on board	Pilot
Consequences and damage	Pilot fatally injured, gyroplane destroyed

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in September 2021. As accurate as the translation may be, the original text in French is the work of reference.

[1] Except where otherwise indicated, the times in this report are in local time.

Interference of rotor with tailplane, loss of control, collision with ground

1 - HISTORY OF THE FLIGHT

Note: the following information is principally based on statements, observations of the site, and data from the aircraft's engine computer.

The pilot took off at around 14:30 from Valloire Bonnenuit mountain airstrip[2] (Savoie) for a local flight of around 30 minutes. Witnesses saw him fly near Valloire heading for Mont Fourchon, then Valmeinier heading south towards Roche Château Mountain and Mont Thabor. The pilot's body and the wreckage of the gyroplane were found the next day on a snowy plateau north of the Terre Rouge refuge.

[2] LF7332 Paved runway 18-36, altitude 5,600 ft.

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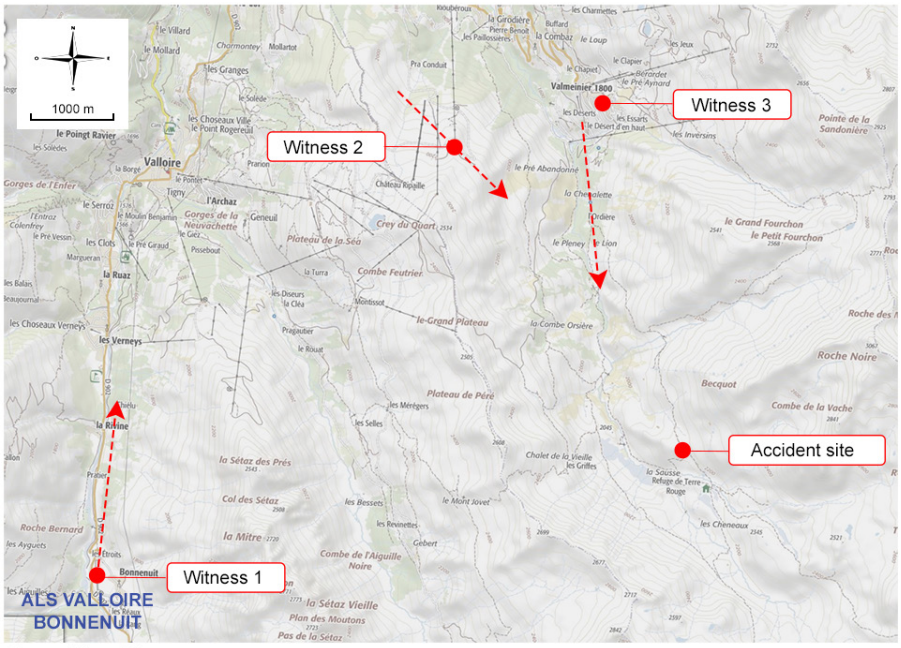


Figure 1: General situation map

2 - ADDITIONAL INFORMATION

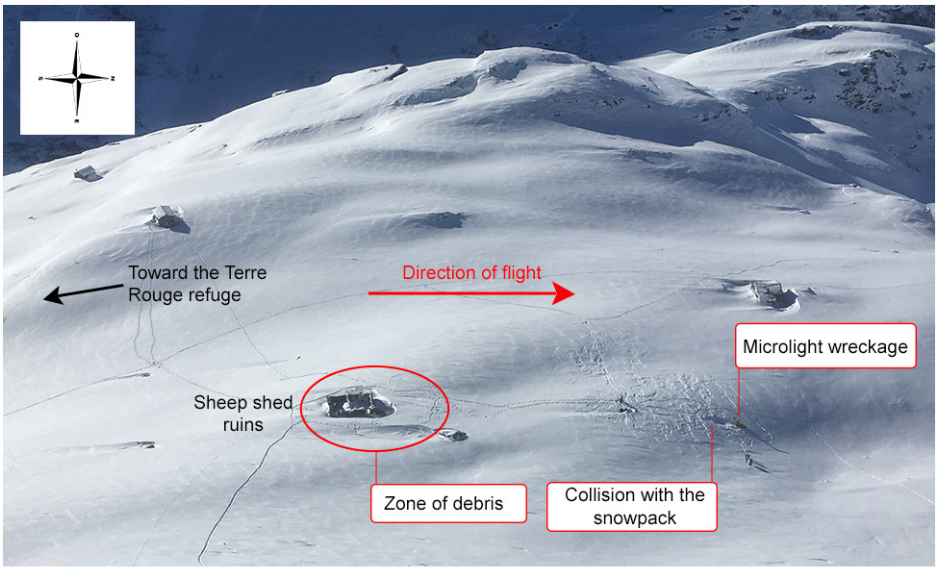
2.1 Examination of site and wreckage

The accident site was located at an altitude of around 2,190 m on a snowy plateau. The wreckage was found around 100 metres north of a dilapidated former sheep shed. The Terre Rouge refuge is located south of the sheep shed. The terrain slopes steeply from the refuge up to the accident site (average slope of around 16%).

Some debris from the gyroplane was found around this sheep shed, within a 20-metre radius. The debris corresponded to the vertical and upper sections of the tailplane, as well as glass fibre fragments from the pusher-propeller blades. The propeller cone was also found in this zone with the lightest debris found after the sheep shed.

The small spread of debris around the sheep shed would indicate a separation in flight at low height when flying over the sheep shed.

No sign of contact of the gyroplane with the sheep shed was detected and no debris was found between this zone and the wreckage.



Source: BEA

Figure 2: Aerial view of the accident site

The only contact with the snowpack occurred several metres before the wreckage. The wreckage was lying on its right side. All of the distortion observed on the gyroplane's structure was consistent with the collision with the ground.

Several interference marks were found on the lower surface and the leading edge of the main rotor blades:

- on the tip of the blades, traces of yellow similar to that of the tailplane;
- approximately one third from the blade root, signs of impact corresponding to contact with the pusher-propeller blades.

Only one of the pusher-propeller blades was still in place on the hub and the end of it was damaged. The second blade, found near the wreckage and fractured at its root, had similar damage at its tip. The third blade, which was fractured at its root, was not found due to the snow coverage at the site. The fracture surface of the roots of the two fractured blades were visibly similar and compatible with bending failures caused by the impact.

2.2 Data from the Rotax computer

The gyroplane was equipped with a Rotax engine computer that was removed for analysis. This computer recorded eight parameters:

- temperature of the exhaust gases of the four cylinders;
- oil pressure and temperature;
- temperature of the water cooling system;
- engine speed.

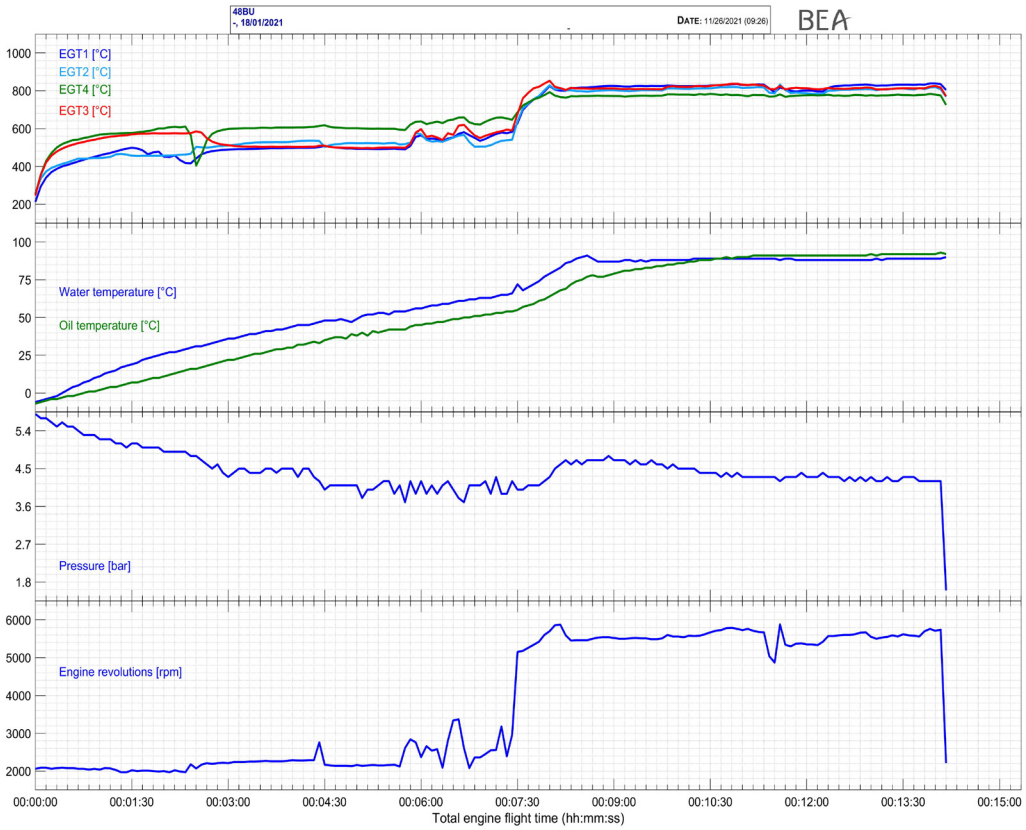


Figure 3: Accident flight engine parameters

The analysis of these parameters showed that:

- the engine had operated for 22 minutes from start-up;
- 5 mins 40 seconds after engine start-up, a period during which the engine warmed up, the pilot performed engine tests (lasting one minute);
- take-off took place 7 mins 20 seconds after start-up;
- the duration of the flight up to the accident was 6 mins 40 seconds;
- during the flight, no anomaly on the parameters that could indicate an engine failure was visible;
- at the time of the accident, the engine speed was close to its maximum.

2.3 Pilot information

The 70-year-old pilot held a microlight pilot licence with flex-wing (issued in 2000), fixed wing (issued in 2004) and gyroplane (issued in 2018) ratings.

The pilot, who owned the gyroplane (since 2018) and another fixed wing microlight, travelled from the Vendée to Valloire by road for a few days' holiday. He transported his gyroplane on a trailer. He had already made two flights from Valloire Bonnenuit mountain landing area on the previous days.

Without the flight log, it was not possible to determine the pilot's experience. Nevertheless, according to the statements collected, the pilot had regularly flown in his microlights. He had logged around 200 flight hours per year and had made several flights to Italy, Croatia, Senegal and Tunisia.

Manager of a microlight company for 10 years, he also made introductory flights with his microlights from a private microlight strip in the Vendée.

2.4 Statements

During the flight, the microlight was seen by three witnesses.

The first witness, also a microlight pilot, stated that he had been on holiday with the pilot and his wife. He stated that the pilot, who had arrived the week before, had made two flights from Valloire Bonnenuit mountain landing area prior to the accident flight. On the day of the accident, he helped the pilot to take the gyroplane out of the hangar in which it was parked. According to him, the pilot had planned to make a flight lasting around 30 minutes and had not planned to land elsewhere during the flight. He stated that the pilot had taken off at 14:30 and had headed north in the direction of Valloire before he had lost sight of him.

The second witness stated that at around 14:30 to 15:00, when he was at the top of the Grandes Drozes cable car at 2,200 m, he had seen the gyroplane headed towards Mont Thabor, then fly over him in the direction of Fourchon Peak.

The third witness, who was a paragliding instructor and who lived in Valmeinier 1800, saw the microlight as he was leaving home at around 14:30 - 14:45. He stated that he had seen the gyroplane head south in level flight towards Roche Château Peak along the valley line. According to him, the microlight was approximately 50 m above him (altitude of 1,850 m) and 300 m horizontally to the west of his position. He estimated the microlight's height to be around 150 m in relation to the bottom of the valley.

He stated that the meteorological conditions at this time had been CAVOK.

The pilot's wife said that they had regularly holidayed in the region for more than 15 years. She stated that her husband had undergone mountain training in a gyroplane with a local instructor a few years ago, and that once he had acquired mountain experience, he had flown with his gyroplane and always alone on board.

2.5 Aircraft information

2.5.1 Gyroplane involved in the accident

Figure 4: Gyroplane 48BU

This MAGNI M16 Tandem Trainer R914 gyroplane entered into service in November 2016. It was powered by a ROTAX type 914 UL engine and a composite three-blade propeller. The main rotor comprises two composite blades. Its empty weight was 260 kg and the maximum permissible take-off weight was 450 kg.

The gyroplane was maintained by its owner.

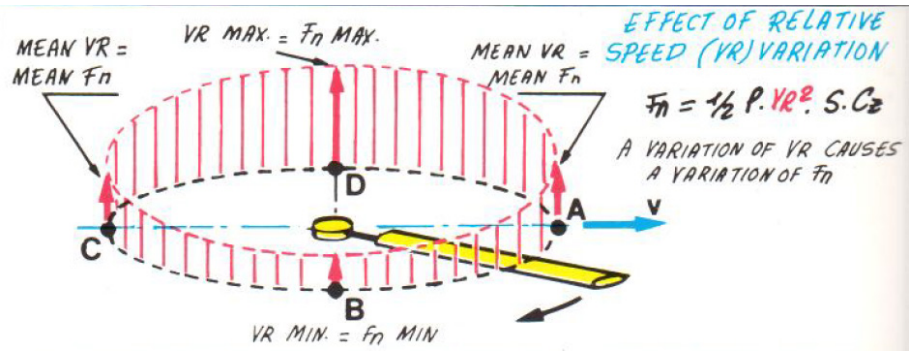
2.5.2 General information about microlight gyroplanes

A gyroplane is an aircraft whose lift is assured by a free rotor. In forward flight, the free rotor is driven by the relative wind (wind turbine principle). The power unit provides the power required for the gyroplane to fly forward and does not drive the rotor. The tailplane is used to control the gyroplane in yaw and to stabilize it in pitch. The cyclic stick tilts the aerodynamic resultant of the rotor and thus enables the gyroplane to climb, descend, turn left and turn right.

The rotor equipping gyroplanes classified as microlights comprises a twin-blade teetering rotor. Both blades are integral and non-articulated. However, they can deform by elasticity.

2.5.3 Rotor flapping[3]

During a rotor revolution, the blades flap due to the combination of forces to which they are subjected, in particular the lift force and the centrifugal force. On the teetering rotor, the balance of each blade is influenced by its own forces but also by the forces of the other blade.



Source: Théorie élémentaire de l'hélicoptère, published by Cépaduès

Figure 5: Variation of lift as a function of speed

When the pilot moves the lever to modify the orientation of the rotor plane, the lift force on each blade changes, which causes flapping. In the same way, when the centrifugal force of the rotor blades changes following a change in forward speed of the gyroplane or due to an aerological phenomenon, the blades flap to find a new balance. For gyroplanes, it is essential to maintain a forward speed to ensure lift. This way, the air speed on the advancing blade is higher than the air speed on the retreating blade. In these conditions, the flapping of the blades causes the rotor plane to tilt backwards. The pilot must continually adjust the load on the lever to control his forward speed and to maintain a sufficient number of rotor revolutions to ensure lift, in particular during path changes. When the flapping phenomenon is significant, the retreating blade can strike the tailplane and the pusher propeller. The strike risk is heightened by the pendulum movement of the carriage under the rotor[4].

[3] The BEA's report into the accident to 31-HK on 7 June 2008 https://www.bea.aero/fileadmin/user_upload/31-k080607_web.pdf includes an appendix which explains the principles of gyroplane rotor dynamics. Available in French only. The flapping phenomenon is also described in the report of the accident to 31LI on 5 July 2020 https://www.bea.aero/fileadmin/user_upload/BEA2020-0241.en.pdf

[4] For rotary wings, rotor forces are transmitted to the airframe by the hinge on the mast. This can cause a delay in the airframe's response following an input on the lever. The gyroplane's carriage is free to swing longitudinally or laterally like a pendulum. This phenomenon can be exacerbated by over-control.

3 - CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation. They are not intended to apportion blame or liability.

Scenario

After taking off from Valloire Bonnenuit mountain airstrip, the pilot headed north towards Valloire then Valmeinier, then south towards the Terre Rouge refuge and Mont Thabor. At the end of the valley probably near the refuge, the pilot turned around. He headed north and climbed following the terrain at low height.

When he arrived at the plateau, near the dilapidated sheep shed, for an unknown reason, the pilot made a sudden action (possibly by instinct in the light of an immediate danger) on the cyclic stick. This action caused a rotor blade flapping phenomenon, which destroyed a section of the vertical tailplane and damaged the pusher-propeller blades. This damage rendered the microlight uncontrollable and the pilot was unable to avoid the collision with the snow-covered ground.