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SAFETY INVESTIGATION REPORT

Accident to the Airbus EC130 - T2 registered 3A-MVT on 25 November 2022 at Villefranche-sur-Mer (Alpes-Maritimes)

Time	At 12:31[1]
Operator	Monacair
Type of flight	Passenger commercial air transport
Persons on board	Pilot and passenger
Consequences and damage	Pilot and passenger fatally injured, helicopter destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.	

Conducting a flight under the influence of drugs, entry into a cloud layer, loss of visual references and loss of control, collision with terrain

[1] Except where otherwise indicated, the times in this report are in Coordinated Universal Time (UTC). One hour should be added to obtain the legal time applicable in Metropolitan France on the day of the occurrence.

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on statements, the analysis of images recorded by the onboard camera and its built-in GNSS receiver.

On Wednesday 23 November, the operator, Monacair, received a request to fly passengers from Monaco to Lausanne (Switzerland) and back. The next day, in response to this request, the pilot of the helicopter registered 3A-MVT took off from Monaco heliport with two passengers. He spent the night at Lausanne.

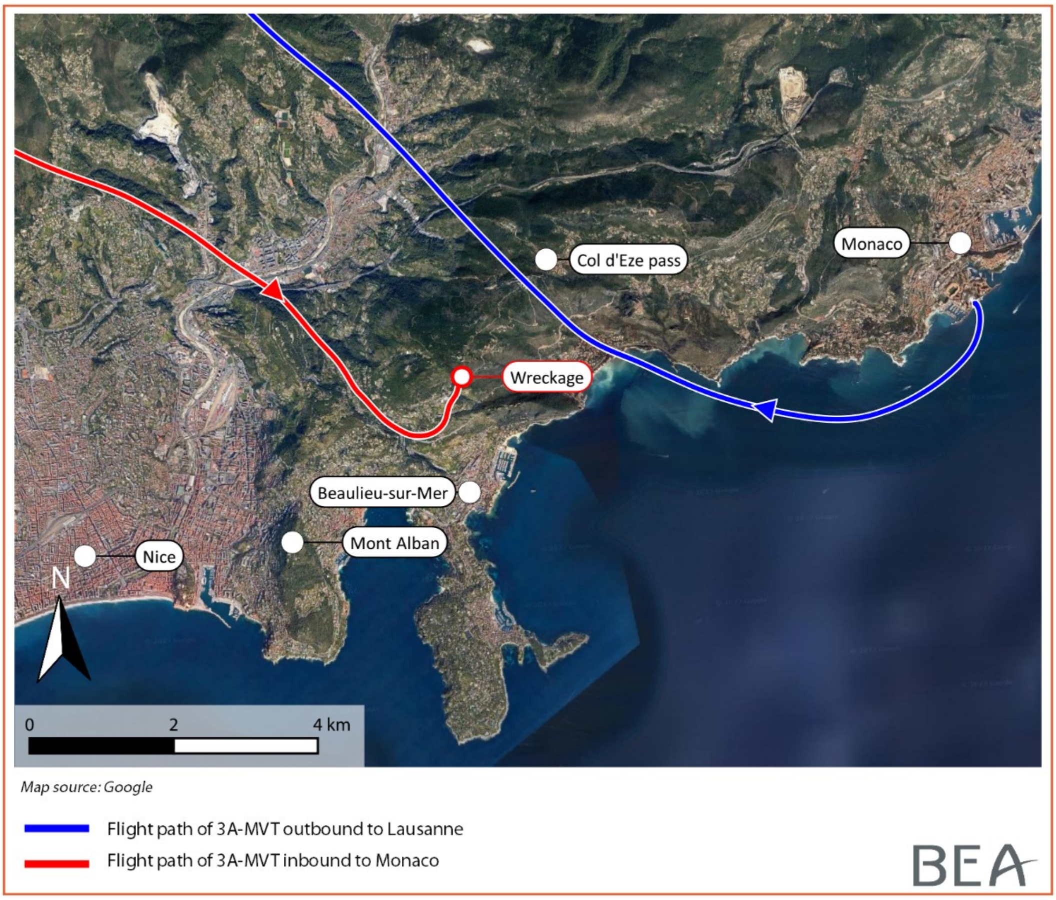


Figure 1: flight paths of outbound flight (24 November) and return flight (accident on 25 November)

On Friday 25 November, the pilot, accompanied by only one passenger, took off from Lausanne airport at 11:02 bound for Monaco under Visual Flight Rules (VFR). He took a southerly route, cruising at an average Indicated AirSpeed (IAS) of 115 kt, at a varying height overhead the terrain while complying with the overflight height rules under VFR.

At around 12:09, at an altitude of 10,000 ft, close to the district of Allos (Alpes-de-Haute-Provence), he turned left onto heading 135° and started the descent towards Nice (Alpes-Maritimes) with an IAS of 130 kt. At 12:27, at a height of 4,000 ft, he headed towards Beaulieu-sur-Mer (Alpes-Maritimes) on a heading of 120°.

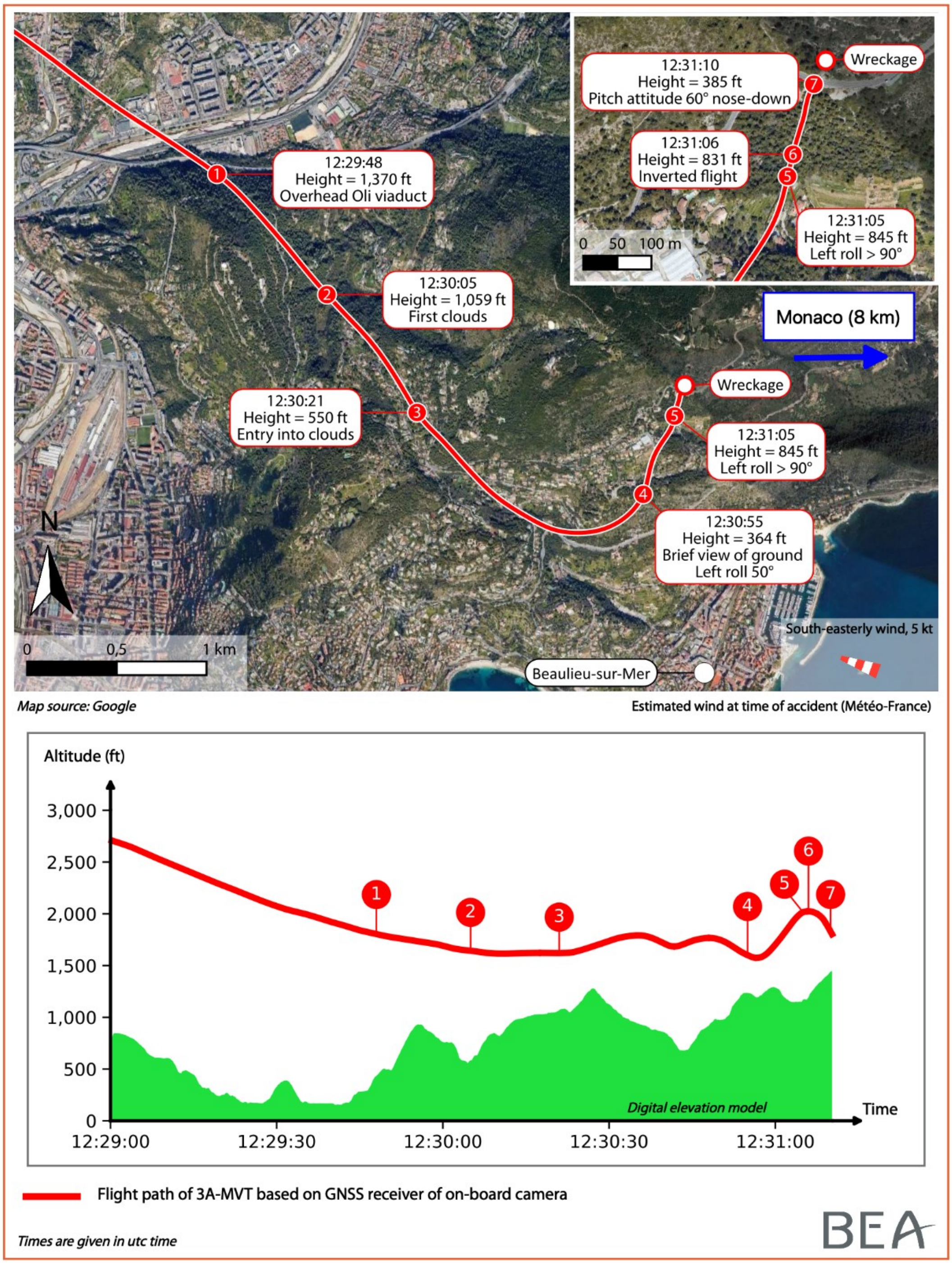


Figure 2: flight path of 3A-MVT approaching clouds and then in clouds

The helicopter flew over Oli viaduct at 12:29:48 (see **Figure 1**, point 1) and slowed down to reach a speed of 105 kt. At 12:30:05, the helicopter encountered the first cumulus fractus (point 2) and at 12:30:21, it entered the cloud layer (point 3). The helicopter's IAS was 100 kt.

At 12:30:55, the ground was visible for a brief instant (point 4), and the helicopter was in a 50° left bank. The pilot then abruptly banked the helicopter 16° to the right. The pilot's abrupt input on the controls caused the LIMIT[2] light to illuminate.

[2] The LIMIT light illuminates notably in the event of a left system failure or during G-force manoeuvres.

Ten seconds later, at 12:31:05, the pilot banked the helicopter by more than 90° to the left and entered a steep climb (point 5). At the top of the climb (point 6), the amber SERVO[3], HYD 1 and HYD 2 lights and then the red MGB P and ENG P lights illuminated; the helicopter was inverted and rotated 180° around its yaw axis. At point 7, the helicopter was upright again with a nose-down attitude of 60°.

The video and GNSS recording stopped at 12:31:11. The helicopter collided with the ground between one and two seconds later.

2 HELICOPTER INFORMATION

2.1 Examination of site and wreckage

Accident site

The accident site was located on steeply-sloping rocky scrubland at an altitude of 464 m (1,522 ft) above sea level. The ground marks from the accident were concentrated in a limited perimeter around the wreckage.

Several trees (conifers) between 10 and 15 m tall surrounded the accident site. Several branches of the tree closest to the wreckage were broken and/or cut, the largest of these branches had a diameter of 10 to 12 cm. The main part of the helicopter was roughly oriented on a heading of 100°.

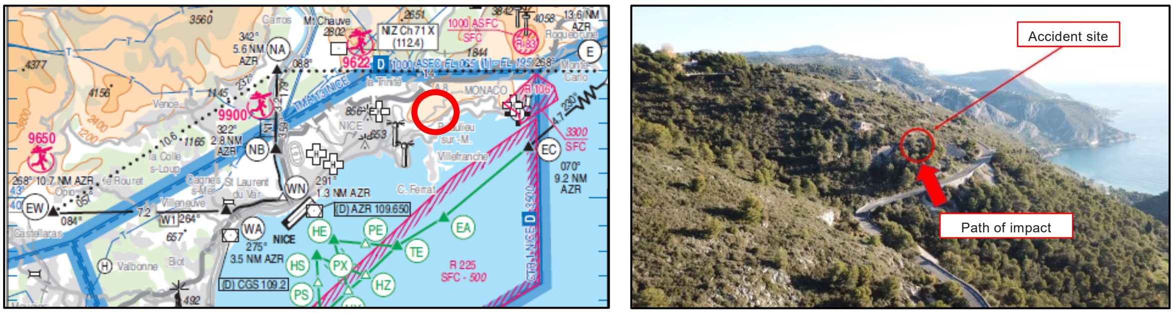


Figure 3: accident side in Nice airport controlled airspace (source: SIA for LH image – SRTA for RH image)

Examinations of helicopter wreckage

The helicopter had a single control system. Its cabin had a three front seat and four rear seat configuration. The pilot was sat in the front left seat and the passenger in the front right seat.

Each seat was equipped with a four-point harness composed of a lap belt and two shoulder straps. The lap belt and shoulder straps were fastened together by a central buckle. All the ruptures observed on the seats had a fracture face characteristic of a sudden rupture. The pilot was wearing the lap belt and the two shoulder straps. The passenger was wearing the lap belt. The investigation was unable to determine if the passenger had been wearing the shoulder straps.

The helicopter cabin was destroyed, the nose and lower fuselage were substantially crushed. The cabin floor was greatly deformed and had multiple ruptures.

[3] The SERVO light indicated the loss of hydraulic pressure in one of the hydraulic systems.

The tail boom had broken off and was lying on the right side of the main part of the helicopter.

The landing gear was no longer integral with the structure. It had broken in several places. All the breaks had a fracture face characteristic of a sudden rupture.

The damage observed on the landing gear was consistent with the nose of the helicopter hitting the rocky ground with high energy.

The two front bars of the Main GearBox (MGB) had suddenly ruptured. The two rear bars of the MGB were complete and attached to both the MGB and the transmission deck.

The emergency locator transmitter was attached inside the middle section of the helicopter.

The three main rotor blades were found nominally attached to the rotor head. The blades were substantially damaged.

Observations of the engine and drive system found that the engine was providing power and that this power was being transmitted to the main and tail rotors at the time of contact with the ground.

The helicopter was equipped with an emergency flotation gear. The emergency flotation gear had not been activated and the float assembles had been torn off during the accident. The two cylinders, still pressurised, were neutralised on the accident site.

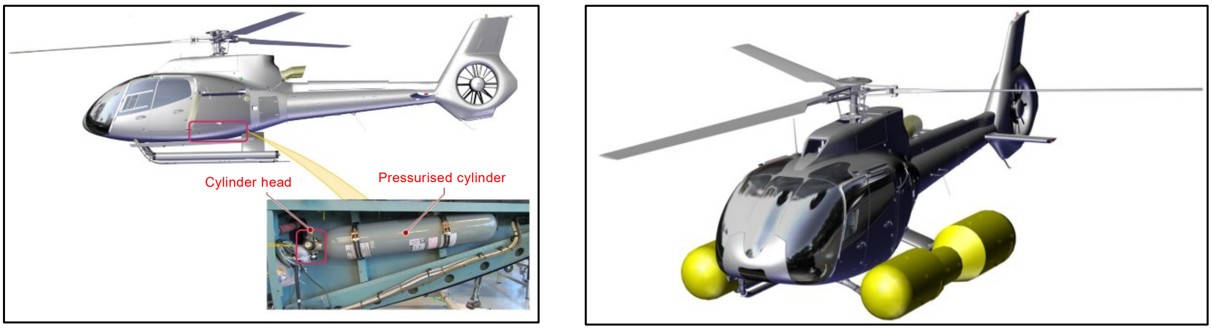


Figure 4: emergency flotation gear (source: Airbus, annotated by the BEA)

Conclusion of observations made at accident site and on wreckage

The damage observed on the structure of the helicopter bore witness to the aircraft's high forward speed when its nose and lower fuselage hit the ground. When it hit the ground, the helicopter was in a nose-up attitude. The engine was providing power.

2.2 Characteristics of helicopter

The Airbus EC130 T2 registered 3A-MVT was a single-engine, seven-seat helicopter with a Maximum Take-Off Weight (MTOW) of 2,500 kg. It belonged to the operator, Monacair.

The helicopter was equipped with flight controls on the left side only. There was no autopilot. Only day VFR flights were authorised on 3A-MVT for passenger transport organised by Monacair.

The airframe and ARRIEL 2D engine had logged 3,020 flight hours.

The helicopter registered 3A-MVT had the minimum equipment for VFR flights required by the regulations in force. It was also equipped with an onboard Vision 1000 type camera. The analysis of the recorded images made it possible to reconstruct the flight from take-off from Lausanne to nearly up to the impact with the ground (see paragraph 3.2).

1.	Airspeed indicator
2.	Gyro-horizon
3.	Altimeter
4.	Variable speed indicator
5.	Chronometer
6.	Gyro-horizon

Figure 5: view of cockpit of 3A-MVT (source: Monacair, annotated by the BEA)

Figure 6: warning panel (source: Airbus)

The flight manual states that the helicopter is approved for day and night VFR operations, that aerobatic manoeuvres are prohibited and that the maximum positive G-force triggering the illumination of the amber LIMIT light must not be exceeded.

3 OPERATIONAL INFORMATION

3.1 Meteorological information

The French met office, Météo-France, described the conditions around the accident site as being calm, slightly anticyclonic (QNH of 1016 hPa). Below high cirrus clouds, low sea cloud formations were observed after 12 noon. There was a light easterly to south-easterly wind at the surface and in the lower layers, with surface gusts of 10 to 15 kt. There was no turbulence.

Readings from the Météo-France automatic weather station at Mont Alban (Alpes-Maritimes) (altitude 223 m / 731 ft), located 3.5 km south-west of the accident site, indicated:

- the presence of low cloud between 12:10 and 13:00, with the cloud base at a varying altitude of between 1,300 ft (400 m) and 2,000 ft (600 m), except at 12:31 when the base was at 4,200 ft (1,300 m);
- quickly-passing low clouds after 13:00 with the cloud base at a varying altitude of between 1,600 ft (500 m) and 2,000 ft (600 m).

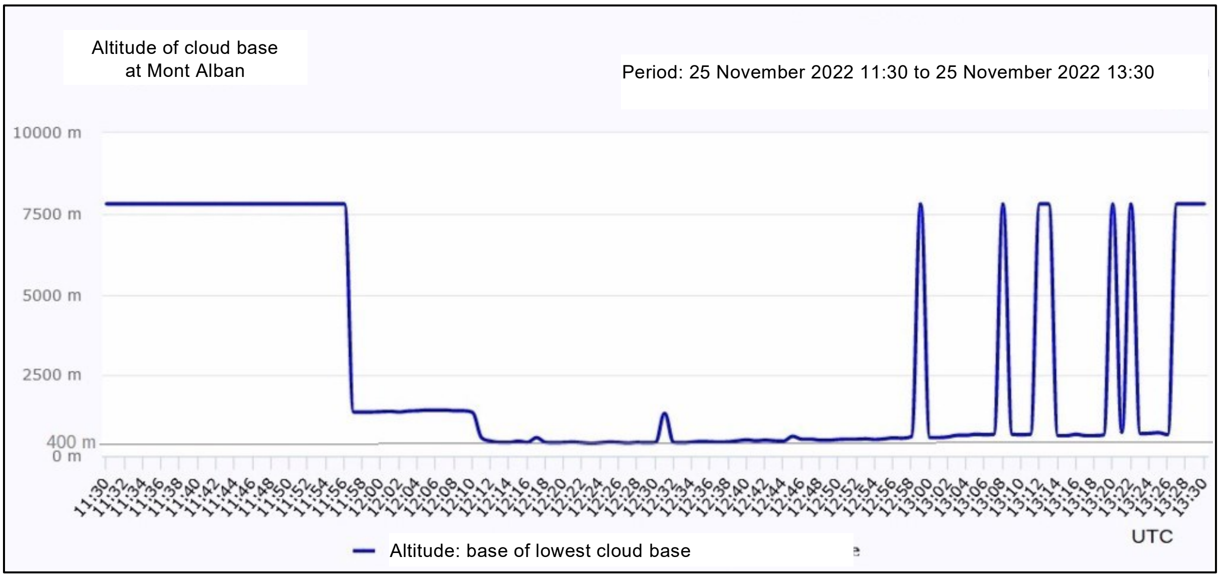


Figure 7: altitude of cloud base at Météo-France automatic weather station at Mont Alban (source: Météo-France, annotated by the BEA)

Nice airport aeronautic reports (LFMN)

The Nice airport meteorological forecasts, available before the take-off from Lausanne, indicated between 25 November 09:00 and 26 November 15:00:

- wind from 330° of 10 kt;
- visibility of 10 km or more;
- no clouds below 5,000 ft with respect to the airport, no significant phenomenon, no cumulonimbus or towering cumulus clouds;
- becoming on 25 November between 10:00 and noon, wind from 90° of 12 kt.

The SIGWX chart, published at 10:00 on 25 November and valid at noon of the same day indicated no clouds over the Côte d’Azur coast and over the Pre-Alps nor a reduction in visibility.

The Nice airport TAF and METAR weather reports did not mention the appearance of mist, fog or sea haze. The 12:00 SIGWX chart did not mention these phenomena either.

The VAC chart for Monaco heliport mentioned in the paragraph, Air navigation hazards, that the heliport can be covered by sea haze in a few minutes. There is no mention of sea haze in the information section of the Nice airport VAC chart.

Météo-France synthesis
Between 12:00 and 12:30, the low clouds which were already over the sea had spread to the coast and had quickly thickened when they reached the near relief of the coast between Villefranche-sur-Mer and Monaco. This situation is frequent in this area, notably around the Col d'Eze pass and La Turbie (situated three kilometres north-west of Monaco). The moist air is blocked by a relatively high terrain, very close to the sea.

Low clouds, present from 12:30, between 1,300 ft and 2,000 ft, became thicker and rapidly formed fog over the terrain, in particular on the south facing slope and at the altitude of the accident site.

The 12:30 Nice METAR indicated:
- wind from 100° of 12 kt;
- visibility greater than 10 km;
- few clouds at 4,000 ft, scattered clouds at 23,000 ft;
- temperature 17°C and dew point 12°C;
- QNH 1016;
- no significant change expected in the following two hours.

3.2 Flight path before accident

The analysis of the images and data recorded by the Appareo Vision 1000 computer made it possible to reconstruct and plot the flight path of 3A-MVT during the accident flight.

3.2.1 Flight path between Lausanne and Beaulieu-sur-Mer

The flight was carried out under VFR, the flight conditions being suitable for this type of flight. The pilot was wearing tinted glasses.

The flight path taken by the pilot on taking off at Lausanne airport showed no particularities. It complied with helicopter flight practices under VFR, i.e. a straight path southwards, following the major valleys of the Alps and maintaining a ground height compatible with the rules of VFR flight, at an average ground speed of 130 kt (air speed of 115 kt).

During the flight over the Alps, the helicopter flew at an altitude of over 10,000 ft for a maximum of 15 minutes. The maximum altitude reached by the helicopter was approximately 11,180 ft.

After passing Allos, the pilot turned south-east and left the high ground of the Alps. He was at this point east of the Nice aerodrome CTR, heading towards Beaulieu-sur-Mer, towards the sea. The ground speed increased to 145 kt (airspeed around 130 kt), a normal descent speed for this helicopter. The aiming point of this flight path appears to be the pass just beyond the hills to the east of Nice, in the Nice CTR, which is consistent with a flight path to approach the Monaco heliport which is accessible only by sea.

At 12:29, approximately 3.5 NM north-west of Beaulieu-sur-Mer, the pilot continued the descent at a ground speed of 130 kt (air speed 105 kt). It is very likely that at this point the pilot could see the sea and could observe the weather conditions and how they were evolving.

3.2.2 Entry into cloud layer and loss of visual references

Figure 8: end of flight path of 3A-MVT (source: Google, annotated by the BEA)

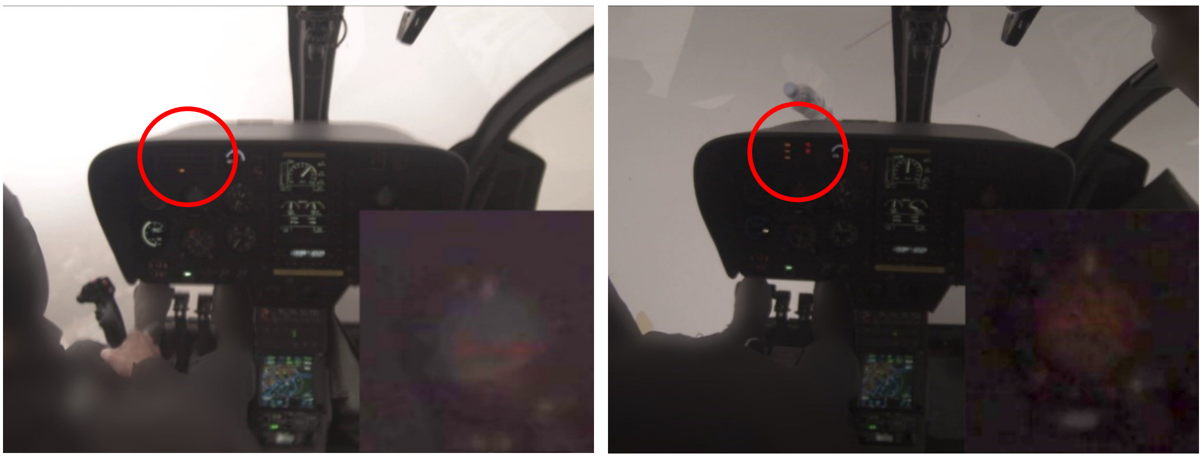
- At point 1 (see **Figure 1** and **Figure 8**): at 5 NM from the seashore, after flying over the motorway and before crossing the pass, the pilot decreased the speed to below 100 kt probably in reaction to the changing weather conditions with a reduction in visibility and the presence of low clouds. At this point, the pilot was able to observe the weather conditions over Nice and the airport that still allowed him to envisage without difficulty, a flight path in that direction to avoid the clouds ahead of him.
- At point 2: 17 s later, at 1.25 NM from the seashore, when flying over the pass, the pilot flew close to low clouds. Sixteen seconds later, the helicopter entered the cloud mass and started to take unusual pitch, roll and yaw attitudes.
- At point 4 : visual references (vegetation/house) were briefly visible. The pilot's inputs seem to indicate an unsuccessful attempt to correct the helicopter's attitude.
- At point 7: this is the last recorded image. The impact occurred around 50 m further on, very probably one or two seconds later.

3.2.3 Reconstruction of helicopter's flight path and attitudes

The analysis of the images downloaded from Vision 1000 was used to determine the helicopter's attitudes from when it entered the cloud mass to less than two seconds before the collision with the ground.

These two images show the helicopter flying (LH photo) outside the clouds and then approaching the first cloud banks (RH image).

The LH image shows the absence of visual references, the helicopter is horizontal in level flight. The RH image corresponding to point 4 of **Figure 8**, shows that the external references are briefly visible (ground and houses on bottom left of image). At this point, the helicopter is in a left bank of around 50°.



In the LH image, it can be seen that the LIMIT light is illuminated, the pilot is banking the helicopter by around 20° to the right and is raising the collective pitch lever. In the RH image, the lights for the hydraulic systems (SERVO, HYD 1 and HYD 2), the engine pressure (ENG P) and the MGB pressure (MGB P) are illuminated, the helicopter is inverted (top of the climb, between points 4 and 7).

In this image, the helicopter's pitch attitude is 60° nose down towards the road visible on the bottom left side of the photo (near point 7). After a pull-out, the helicopter re-entered the clouds during the climb.

It collided with the terrain in steep climb, very probably during a pull-out. The helicopter and the rotor were nearly parallel with the slope of the terrain.

Between the helicopter entering the clouds and the last recorded image, the flight lasted around 50 s, in which time the external references were only visible twice, for 1 s each time.

3.2.4 Evolution of brightness and contrast

When the pilot entered the cloud layer, he went from a bright environment to a dark environment.

The rapid formation of the clouds, the transition from a bright to dark environment on entering the cloud layer and then the continuation of the flight with a low light contrast in the layer required the pilot to promptly react to any path deviation by solely relying on the instrument panel instruments. The darkening effect was amplified by the helicopter's wide, high windshield, which offered a wide field of vision and plenty of light before entering the layer (see images in paragraph 3.2.3). The investigation was not able to determine the setting of the instrument panel lighting potentiometers before taking off. However, the pilot did not modify the brightness of the instrument lighting during the flight.

The pilot was wearing sunglasses; the investigation was not able to determine the protection index or the lens correction. Despite his capacity of adaptation to changes in luminance due to his young age, it is probable that the pilot experienced difficulties in reading the flight instruments in a low-contrast environment, under sudden and substantial time pressure. It is possible that he had difficulties in interpreting the information displayed which made the adoption of the correct actions to hold a safe flight path difficult.

3.3 Pilot information

3.3.1 Experience

The 35-year-old pilot held a French helicopter Commercial Pilot Licence (CPL (H)) obtained on 20 July 2015 and a Monegasque CPL obtained on 2 August 2017, both of which were valid.

He held a valid class 1 medical certificate without any limitations indicated. The last medical fitness examination had given rise to the VDL limitation which had not been recorded on the medical certificate. This limitation required him to wear suitable optical correction in flight to correct defective distance vision and to carry a spare set of spectacles in the cockpit.

Total experience	2,360 flight hours of which approximately 670 hours on the EC130
Experience in last 30 days	21 flight hours, all on type
Experience in last 72 hours	2.3 flight hours, all on type

The pilot held the AS350 type rating obtained on 7 November 2016 and the EC130 type rating obtained on 18 October 2019, both of which were valid. He was also qualified for night VFR flights. He joined Monacair on 5 June 2021. He carried out commercial transport flights by day.

Entries in the pilot's logbook stopped on 30 October 2022 and there was no record of the total number of flight hours carried out on the EC130.

Based on other documents belonging to the pilot and Monacair's records, the pilot's experience on the date of the accident was estimated as being:

- 2,360 flight hours including 2,109 hours as pilot-in-command, of which around 550 flight hours on the AS350 and EC130 in the previous 12 months;
- around 670 flight hours in total on the EC130;
- 13.7 night flight hours;
- 10.2 flight hours under Instrument Flight Rules (IFR). All of these IFR hours were carried out in instruction in 2015 during his CPL (H) training. The pilot did not hold the IFR rating.

The 13.7 night flight hours can be broken down as follows:

- the first night flight hours were performed on 16 October 2014 during a CPL (H) basic training module;
- on obtaining his CPL (H), the pilot carried out 5.1 night flight hours;
- the 4.4 night flight hours carried out in 2022 are recorded in the table below:

Dates in descending order from the accident	Hours on the EC130	Hours on the AS350
8 September 2022	0.6	
26 April 2022	0.5	
14 April 2022	1.5	
10 April 2022	0.2	
20 March 2022		0.4
08 March 2022	0.5	
15 February 2022	0.2	
12 February 2022	0.2	
11 February 2022		0.2
1 January 2022	0.1	

3.3.2 Last flight and proficiency checks

The pilot followed the operator conversion course between 5 and 12 June 2021.
The table below sets out the checks completed by the pilot from the renewal of his EC130 rating on 28 May 2021.

	Operator proficiency check CHL	**Line check CEL**	**TR test**	**Recovery from unusual attitudes**
Dates	12 June 2021	12 June 2021		12 June 2021 Blind navigation in return flight
Dates	7 December 2021			7 December 2021
Dates	16 April 2022	16 April 2022	16 April 2022	16 April 2022 Blind navigation in return flight
Dates	19 October 2022			19 October 2022

3.3.3 Toxicological tests

The post-mortem toxicological tests on the pilot showed recent cocaine consumption a few hours before the accident and possibly the same morning. The presence of cocaethylene in a blood alcohol level of zero confirmed that alcohol and cocaine had been consumed several hours before the accident.

The analyses also revealed the presence of cannabidiol (CBD, a non-narcotic cannabinoid) and an inactive metabolite of tetrahydrocannabinol (THC).

The analysis of the pilot's hair found the presence of cannabidiol and benzoylecgonine (a cocaine metabolite) in the three hair segments analysed, between one and three centimetres long[4], at the root, in the middle and at the tip. This indicates regular cocaine use.

When he was recruited in June 2021, the pilot was tested for narcotics using two saliva drug test means. The BEA had one of the means used[5] checked by a specialist laboratory, using liquid chromatography analysis with QTOF mass spectrometry detection: no narcotics were found in the sample taken at the time of recruitment.

The pilot passed two prevention medical examinations in Monaco, one in 2017 and the other in 2021. In the second examination, the urine screening test for cannabis was negative. The urine samples taken during these medical examinations were no longer available at the time of the investigation.

[4] Average hair growth is one centimetre per month. The total length of the pilot's hair was around five centimetres. The hair was divided into two segments each of around one centimetre, the third segment being the rest of the hair to the tip.
[5] All the results obtained by analytical techniques and means, particularly semi-quantitative ones, are subject to errors, however small. The error most detrimental to safety concerns "false negatives", a situation where the pilot's consumption of the product sought is not detected by the test.

3.4 Monacair information

Founded in 1987, Monacair is a Monegasque helicopter company specialising in commercial air transport and helicopter management for third parties.

Monacair complies with European regulations in its compliance with Ministerial Order No 2014-480 of 11 August 2014 concerning the technical regulations applicable to aircraft registered in Monaco or operated by a Monegasque operator.

In particular, Article 1 of the Order specifies that aircraft registered in Monaco or operated by a Monegasque operator, as well as associated products, parts and equipment, shall be certified, operated and maintained in accordance with the European regulations listed in Annex 1 to this Order.

Monacair holds a Monegasque air transport certificate and an EASA TCO[6] approval allowing it to operate aircraft in Europe. Since 2016, Monacair has held an operating licence for the scheduled service between Nice and Monaco. Monacair also carries out on-demand passenger commercial transport flights.

The fleet is composed of three twin-engine helicopters: a H155, a H135 and an AW109 and three H130 single-engine helicopters (formerly called EC130 T2), which included the 3A-MVT.

Monacair had published a code of conduct and ethics for the managers and employees of the Monacair group. This code was intended to encourage, among other things, a culture of honesty and responsibility, and compliance with laws and regulations.

3.5 Blind navigation

3.5.1 Monacair rules concerning weather minima for flights

The Monacair Operations Manual (OM) stated that en-route flight conditions must be such that:
- the pilot is certain of maintaining sight of the ground or of the body of water overflown in CP3[7] at all times, and makes sure that it is possible to divert in sight of the ground and with safety areas in the event of the weather deteriorating;
- visual flight conditions are maintained;
- VMC minima are complied with.

The OM specifies in particular that:
- in order for a flight to be completed, each portion of the VFR route must present visibility and ceiling conditions at least equal to the following values:
  - ceiling .... not below 600 ft,
  - visibility .... at least 2 000 m;
- the horizontal visibility of 2,000 m used by the company in uncontrolled airspace corresponds to the distance covered in 30 s at a cruising speed of 130 kt.

[6] Third Country Operators.

[7] CP3 designates operations in performance class 3 where in the event of a power plant failure during flight, a forced landing may be necessary. Single-engine helicopter operations are necessarily in CP3.

In the OM, it is accepted that the horizontal visibility may be reduced en-route for short periods when the ground is in sight and the helicopter is manoeuvred at a speed that allows obstacles to be detected in sufficient time to avoid a collision. To this end, the pilot-in-command can reduce his forward speed in order to maintain a distance ahead of him of at least 30 s of flight, but this speed must not be less than Vy[8].

The values adopted for an EC130 are a distance of 1,080 m for a Vy of 70 kt.

Concerning the deterioration in weather conditions, in controlled airspace when it is not possible to continue the VFR flight in VMC in accordance with the current flight plan, the pilot-in-command must:

- request a new clearance allowing him:
  - either to continue the flight to destination,
  - or to divert to an alternate aerodrome,
  - or to leave controlled airspace,
- request a special VFR clearance.

In uncontrolled airspace, when it is not possible to continue the VFR flight in VMC, the pilot-in-command must divert to an alternate aerodrome.

3.5.2 Blind navigation training

3.5.2.1 At Monacair

The declared blind navigation experience of the pilot of 3A-MVT was limited to training flight hours (approximately 10 h) in 2015 during his CPL (H) training.

At Monacair, he had completed all the checks required by the regulations in force, as shown in the table in paragraph 3.3.2 of this report. The reports include ticked boxes certifying that the flights had been completed, including certain exercises such as “recovery from unusual attitudes”, and were sometimes completed with the comment, blind navigation return flight.

As far as the practical flight test programmes were concerned, they did not indicate the time to be spent performing the various exercises; this was not required by the regulations. The duration was left to the discretion of the instructors and examiners. The results of the examinations were limited to *Satisfactory* or *Unsatisfactory*. The examiners could add comments if they so wished. In the case of the pilot of 3A-MVT, no specific comments were recorded, all the examinations were deemed to be satisfactory.

Only the emergency procedures module contained exercises during which the pilot must, by sole reference to the instruments:

- in level flight, control the heading, speed and altitude;
- carry out a rate-one left then right level turn on defined headings from 180° to 360°;
- climb and descend including rate-one-turns on specific headings;
- recover from unusual altitudes;
- turn with a bank angle of 30°, up to 90° to the left and to the right.

[8] Best rate-of-climb speed.

Monacair VFR pilots who carry out commercial operations at night benefited from information on inadvertent entry into IMC. The pilot of 3A-MVT had not received this training as it was not planned that he would carry out commercial flights at night.

Night flight/blind navigation refreshment training material enabled pilots to familiarise themselves with the particularities of night flying. This training material was designed solely to refresh the pilot's general knowledge of night flying, with a reminder about blind navigation and the procedures associated with the operations manual and regulations. Among other things, it dealt with human factors, sensory illusions and spatial disorientation. It also dealt with instrument flight, instrument scanning and pre-display of flight parameters.

The same document referred to flight exercises to be carried out and stated that unusual attitudes were generally the result of incorrect piloting, distraction or severe turbulence. In this case, the pilot must return to normal flight conditions, and the manoeuvres to be carried out urgently and in the following order were:

- exit bank;
- bring the nose onto the horizontal bar;
- display 80% power and try to ensure continuous symmetry (ball or string in middle of windshield).

3.5.2.2 Blind navigation training provided by other operators

Other operators give training in loss of visual references by day, to VFR pilots. They train their pilots to deal with such a danger in order to provide them with the tools to recover from flight without external references and thus avoid collision with the ground or loss of control of their aircraft.

For example, at one operator's, if the pilot loses his external visual references when flying at low altitude, he is advised to climb to a safety altitude that he has determined, and when in cruise flight to:

- hold the altitude;
- pre-select the appropriate power to obtain a safety speed;
- carry out a rate-of-one 180° turn;
- make small corrections.

This training helps VFR pilots become aware of the reality of the risk of inadvertently entering a cloud layer and the need to be trained to exit it.

Pilots are also taught to select the available radio navigation equipment as well as the frequencies of the control units in their sector of flight in order to navigate and request assistance from air traffic control services if necessary.

These operators stress that this training in no way allows the horizontal visibility minima defined in the rules of the air to be reduced, for starting or continuing a VFR flight by day or night. Complying with the safety distances from clouds and the ground is the best way of ensuring that ground visual references are not lost.

3.5.2.3 Consultation of inspector pilots in the French civil aviation safety directorate (DSAC)

Through interviews with pilots and operators, the BEA has identified a certain number of deviations when carrying out the blind navigation in the "emergency procedures" module.

The inspector pilots from the DSAC's Flight Crew Division (DSAC- PN) specifically pointed out that:

- although required by the regulations, examiners sometimes omitted to carry out the blind navigation exercises or carried them out quickly, due to lack of time (these exercises are generally planned for the end of the flight, or on the return flight to the departure base) or due to lack of suitable equipment (flight goggles hiding the horizon or flight hood);
- in some cases, the examiners mentioned that they preferred to give more time to carrying out a failure exercise rather than carrying out exercises in holding parameters in blind navigation (turn, descent, unusual attitude). They explain that this practice seemed to them to be more relevant in the context of VFR flight;
- most of the examiners did not place the pilots in an operational context, with the result that the blind navigation was carried out without any added educational value and that, for them, it was a question of "ticking the box". More specifically, the following shortcomings were observed:
    - they didn't propose a fictitious scenario for entering a layer so as to allow the pilot to propose his own strategy for exiting the layer or returning to a nearby airport,
    - they carried out the exercises using either the automatic systems on in manual mode whereas the two flying modes can co-exist,
    - they neglected the use of the radio navigation equipment installed in the aircraft.

To explain this rather poor method, an argument often heard was that a VFR pilot must comply with the regulations in force and should not find himself flying without visibility. However, regulatory criteria alone cannot guarantee the preservation of visual flight conditions in the event of inadvertent loss of visual references.

3.6 Regulatory framework governing the use of psychotropic substances

3.6.1 Summary of regulatory texts

Only the elements relevant to the investigation are included in this paragraph. A distinction has been made between the requirements applicable to the aero-medical examiner, the operator and the oversight authority.

Aero-medical examiner

Screening for illegal drugs in France had been carried out in medical examination centres since 1 July 1988 for civilian personnel[9]. It is possible that due to the extremely low rate of personnel testing positive for drug use, and the absence of instructions requiring screening on reading the Order of 27 January 2005 relating to the physical and mental fitness of civil aviation flight personnel, the decision was taken in 2006 to stop drug screening during initial and check-up examinations.

Subsequently, implementing regulation (EU) 2019/27 modified regulation (EU) No 1178/2011, known as AIRCREW to impose that "*Drugs and alcohol screening shall form part of the initial class 1 aero-medical examination*." (regulatory requirement MED.B.055(b)).

Moreover, AMC1 MED.B.055(d)(2) proposes that "*For renewal/revalidation, random psychoactive substance screening test may be performed [...] in accordance with the procedures developed by the competent authority.*" Under the terms of this decision, it was up to the authority to define the screening procedures to be applied by class 1 examiners during these examinations. France has not defined these screening procedures.

[9] Dépistage des drogues illicites au CPEMPN. OLIVIEZ JF *& al*. Revue de médecine aéronautique et spatiale, SOFRAMAS, Tome 51, 189/10, p 13-20

Operator

The European Commission's advice following the publication of the BEA's preliminary report into the accident to the A320 registered D-AIPX operated by Germanwings on 24 March 2015 recommended setting up drug screening measures. This advice prepared regulation (EU) 2018/1042.

This regulation modified the AIR OPS regulation with the implementation, by commercial air transport operators, of systematic screening tests for psychotropic substances on the various crew members.

Requirement CAT.GEN.MPA.170 regarding psychotropic substances particularly requires that,

> *"a) The operator shall take all reasonable measures to ensure that no person enters or is in an aircraft when under the influence of psychoactive substances to the extent that the safety of the aircraft or its occupants is likely to be endangered.*
> *b) The operator shall develop and implement a policy on the prevention and detection of misuse of psychoactive substances by flight and cabin crew members and by other safety-sensitive personnel under its direct control, in order to ensure that the safety of the aircraft or its occupants is not endangered.*
> *c) Without prejudice to the applicable national legislation on data protection concerning testing of individuals, the operator shall develop and implement an objective, transparent and non-discriminatory procedure for the prevention and detection of cases of misuse of psychoactive substances by its flight and cabin crew and other safety-sensitive personnel."*

The Acceptable Means of Compliance AMC1 and AMC2 regarding requirement CAT.GEN.MPA.170(b) particularly mention:

- setting up training and providing educational material on the misuse of psychoactive substances (AMC1);
- Setting up screening for psychoactive substances (AMC2) in the following cases:
  "(a) upon employment by the operator; and
  (b) with due cause in the following cases:
    (1) following a reasonable suspicion, and following an assessment by appropriately trained personnel; and
    (2) after a serious incident or accident [...]."

Furthermore, the Guidance Material GM2 for requirement CAT.GEN.MPA.170(b) indicates that, "*Nothing should prevent an operator from implementing a random testing programme in accordance with national requirements on testing of individuals, in order to mitigate the risk that misuse of psychoactive substances remains undetected and endangers the safety of the aircraft or its occupants."*

Monacair complied with the regulatory requirement CAT.GEN.MPA.170(b) at the time of the accident by providing annual training to prevent the misuse of psychotropic substances and by carrying out screening tests on recruitment or in the event of reasonable suspicion (see paragraph 3.6.4.2).

Oversight authority

The possibility of narcotic use by aircrew began to be taken into account in France in the 1980s, under the influence of military aviation medicine. An order issued in 1988 gave the examining doctor the possibility of carrying out biological tests for narcotics as part of the medical fitness examination. However, feedback from accidents[10] led the authorities to focus the measures on alcohol. Regulation (EEC) No 3922/91 confirmed this tendency by highlighting alcohol and drugs. The accident to D-AIPX provided the European safety authorities with the opportunity to introduce both an obligation to carry out biological tests for narcotics when pilots undergo the initial medical examinations and an obligation for operators to carry out this type of test upon employment.

The application of regulation (EU) 2018/1042 resulted in the French state entrusting the police and gendarmerie with the task of carrying out random (RAMP) checks based on the roadside checks model.

In Monaco, the provisions relating to testing for psychotropic substances were part of the general framework of Law No 1.430 of 13 July 2016 on various measures relating to the preservation of national security. This law is not specific to aviation.

In France, these random and unannounced drug-screening measures were entrusted to the police and gendarmerie via Order No 2022-830 of 1 June 2022 supplemented by Decree No 2022-978 of 2 July 2022 which amended the Code of Transport (article L-6225-1 et seq.).

Changes in regulations reflected the gradual inclusion of psychoactive products in aviation between the late 1980s and the 2020s, with a perceptible shift in semantics from "alcohol and medication" to "alcohol and psychoactive substances, including illicit narcotics".

3.6.2 Drugs

According to the French textual and lexical resources centre (CNRTL):

- a **psychotropic drug** is a substance or drug that acts on the psyche and behaviour;
- a **narcotic drug** is a toxic substance that acts on the nervous system, producing an analgesic, narcotic or euphoric effect, and whose repeated use leads to habituation and dependence;
- a **drug** is a narcotic or hallucinogenic substance (such as marijuana, mescaline, L.S.D., hashish, heroin, opium, cocaine) whose use can lead to intoxication, habituation and addiction.

In its advice No 114 of 2011, the French advisory ethics committee for life sciences and health (CCNE) reported that man has always drawn from his environment natural products which we now know interfere with his neurological functions, modifying his emotions, perceptions, vision of the world and his place among his fellow human beings. However, it warns that our society must guard against being excessively demanding of its members and must have expectations corresponding to their real possibilities and vulnerability. In its advice, the CCNE pointed out that drug use is generally aimed at seeking pleasure and avoiding pain. It is a matter of individual freedom.

This point of view is in line with the addictology approach, which assumes that the subject feels the sometimes irrepressible need (craving) to take a drug despite knowing the negative consequences, in particular social, legal or health consequences. They are referred to as "users" in the rest of this report. The paradox of the users' situation is that by using this freedom to consume drugs, many of them become addicted and thus lose the freedom to abstain (Pierre Fouquet). In other words, once they become dependent, users lose control over their consumption, which no longer simply depends on a matter of willpower.

[10] In particular, the BEA investigation into the accident to the Dornier DO 228 registered F-OHAB on 18/04/91.

3.6.2.1 Properties of the drugs[11]

Cocaine

Cocaine is an alkaloid extracted from the leaves of a tropical plant that has stimulating effects. Its derivatives are used medicinally for their analgesic and anti-arrhythmic properties.
Its illicit forms are generally consumed for their effects of:

- euphoria;
- an impression of power;
- the attenuation of the perception of fatigue, and the absence of appetite and pain.

Cocaine use is highly addictive, with the following physical and psychological consequences:

- after the euphoria, a period of anxiety accompanied by a feeling of unease;
- bizarre or violent behaviour, irritability;
- panic, anxiety;
- impaired judgement.

Regular users do not well tolerate cocaine deprivation which can lead to fatigue, irritability, depression and even violent behaviour.

Alcohol

"Alcohol" refers to a preparation containing a chemical compound called ethanol, the production and marketing of which are subject to tax restrictions, and the consumption of which is limited, particularly among machine operators or in the workplace.

The impact of alcohol consumption on health and activities is characterised by a relatively linear relationship between the dose absorbed, blood alcohol levels, effects and risk: after consumption, a blood alcohol level of zero means that the ethanol has been eliminated from the body and no longer produces any effects.

Depending on the quantity and strength of the alcohol consumed and the person's resistance to alcohol which varies from one person to another, the period that follows ("hangover") may be marked by fatigue, a feeling of weakness, thirst, headaches, muscle pain, nausea, stomach ache, dizziness, sensitivity to light and noise, anxiety, irritability, sweating and increased blood pressure.

Cocaethylene

Consuming cocaine with alcohol leads to the production of cocaethylene in the liver. This powerful compound increases the risk of sudden death in addition to the risk associated with using cocaine[12]. Its effects are comparable to those of cocaine and it is a marker of recent alcohol consumption because it remains in the blood longer than ethanol.

Cannabis

"Cannabis" refers to a family of products generally classified as hallucinogenic (or disruptive), extracted from the "Indian" hemp plant. Two of these compounds are discussed here:

[11] In the scope of the accident to 3A-MVT, the safety investigation exclusively considered the properties of cannabis and cocaine, whether these drugs were associated with alcohol or not.
[12] https://www.camh.ca/fr/info-sante/index-sur-la-sante-mentale-et-la-dependance/la-cocaine

- **Tetrahydrocannabinol (THC)**, an illicit drug[13], can produce a state of euphoria or appeasement. It reduces immediate memory and concentration capacities, can affect motivation and can lead to psychological disorders, with in extreme cases, anxiety attacks and paranoia.

  Describing the taking of cannabis from time to time as "recreational" can give the user the impression that it is harmless, in contrast to the performance required for high-risk activities. According to the study, *"Cannabis and its Effects on Pilot Performance and Flight Safety: A Review"* carried out by the Australian safety investigation authority (ATSB), *"The psychomotor and performance-reducing effects of cannabis are dose-dependent and appear to be related to task difficulty. The more difficult the task required of the pilot, the more likely that carry-over effects of cannabis will result in impaired performance of the flying task. Thus, a pilot may cope well with a routine flight in the 24 hours after a cannabis dose, provided nothing goes wrong. However, in-flight problems such as engine failure or deteriorating weather conditions may overload the cognitive capacity of the pilot to a detrimental extent. Thus, the combination of recent cannabis use and other performance-reducing factors such as increased task difficulty can lead to serious impairment of pilot performance and a significant reduction in flight safety."*

  Absorbed THC circulates in the blood and binds to fatty tissue (including the brain), where it remains until eliminated. THC produces effects long after it has disappeared from the blood and saliva. The effects last for several hours after the drug was taken, and its elimination through urine can take several days. There is therefore no relationship between the level in the blood/saliva and the effect. The same ATSB study also concluded that, *"The exact duration of the cannabis carry-over effect and its interaction with other physiological stressors (altitude, fatigue etc) are largely unknown. While carry-over effects have been observed at 24 hours, the adoption of a 24 hour time limit between cannabis use and flying may well be insufficient. Some pilots may exhibit carry-over effects of cannabis more than 24 hours after a dose, depending on the circumstances and the level of task difficulty. An appropriate "cannabis- to-throttle" time remains to be determined, either scientifically or administratively (leaving aside the wider social and regulatory question of whether such a rule is acceptable or not)."*

  The THC-COOH found in the blood of the pilot of the accident, during toxicological tests, is the elimination form of THC. The work by Huestis shows that THC fixed in the body could be psychoactive when only THC-COOH was still detectable in the blood. It is therefore possible that the pilot was under the influence of THC at the time of the accident. This finding could be in favour of "recent" cannabis use, i.e. within the previous fortnight, given the absence of THC and its metabolites in the hair analysed.

- Cannabidiol (CBD) is the exception here as it is not classified as a narcotic. Consumption has been unrestricted in France since December 2022. It has relaxing properties, improves the quality of sleep, stimulates good humour, creativity and motivation. It relieves pain and eases tension. However, it is important to distinguish the molecule known as CBD from commercial CBD preparations, which are mixtures of CBD with other psychoactive compounds, including THC. This situation makes it legal to sell small quantities of THC, the

[13] The legality of these two products, THC and CBD, varies from state to state. At the time of publication, only CBD-based products with a THC content of 0.3% or less were authorised in France. The French Inter-ministerial Mission for the fight against drugs and addictive behaviour (MILDECA) provides information on the positive law applicable to CBD.

marketing of which was previously prohibited. The immediate consequence is that biological tests will no longer be able to identify the consumption of an illicit product solely on the basis of the presence of THC and its derivatives. In this context, it is possible that the THC-COOH found in the blood of the pilot of the accident during toxicology tests could result from the consumption of a form of CBD associated with the presence of THC in excess of the legal limit (0.3% in France).

3.6.2.2 Cocaine and surreptitious user

The representations generally associated with drugs are based on the model of alcohol or opiates, i.e. products with negative effects, which visibly cause dysfunctions in users that can then be identified by the social, health and/or legal structures or by the user's entourage, or even by the user himself. On the other hand, stimulants such as cocaine can have effects that are considered positive by users in terms of performance, whereas these products cause dysfunctions that have only recently been recognised, particularly by health, social and law enforcement institutions[14]. The term "surreptitious users" is used to describe those who are under the radar. A large number of them consume without their colleagues, friends or even close family knowing.

The pilot's next-of-kin told the BEA that they had not identified this regular consumption of cocaine.

These surreptitious users are generally socially integrated and control the frequency of their consumption to the point of being able to go through more or less long periods of abstinence. As a result, they are able to evade the checks that are currently carried out (saliva or blood tests, or even urine tests), either easily in the case of scheduled checks (examinations for medical fitness or job interviews) or by chance in the case of unannounced checks when they are scheduled to fly. Their addiction then expresses itself in the inevitable resumption of consumption. Blinding self-confidence prevents them from realising that their abilities, which they continue to believe as excellent, are inexorably deteriorating. They manage to maintain a balance between the desired effects and the undesirable ones by using multiple drugs, combining cocaine with alcohol, which reinforces the effects of cocaine, or cannabis, which moderates the sense of exaltation, or both.

Once established in the transgression, the user who flies an aircraft in spite of the regulatory prohibition knows no limits. He will find himself in a situation where he will be transporting relatives and third parties, in particular the passengers of any aircraft he pilots, having lost all critical thinking as well as the ability to cope on his own; at this stage, "outside" help is essential.

The on-board video enabled the BEA to identify and reconstruct the flight path and the successive piloted attitudes of the helicopter between entering the cloud layer and colliding with the terrain. When the helicopter entered the clouds, no deliberate change to the heading or descent slope was observed. Although it is not possible to demonstrate this, the continuation of the flight in conditions that exceeded the pilot's operational and physiological capabilities can be placed in the context of the effect of narcotics, and of cocaine in particular.

3.6.3 Screening means/Test type/Limits: duration and detection threshold

There are two main ways of detecting drugs in the body: use or influence, and screening or diagnosis. No method is perfect enough to give a result that is always positive when the product being tested for is present, or always negative when it is absent.

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[14] Reynaud-Maurupt, C., Maitena, M. & Cadet-Taïrou, A. (2011). Les carrières de consommation d'usagers de cocaïne inconnus des institutions socio-sanitaires et répressives une recherche qualitative conduite en France en 2007-2009. *Déviance et Société, 2011/4 (Vol.35), 503-529.*

3.6.3.1 Use/influence

When talking about the use of a product, this generally refers to its consumption. It is in opposition to abstinence, which refers to the total absence of consumption. Different levels of use are defined in addictology. It is more a marker than a habit that interferes with the sphere considered to be private.

Influence refers to a stage of use where the substance produces effects on the body. In particular, this is the period during which the substance is deemed to be "active". The influence of a substance concerns a limited period during which it produces its effects; this is why it is closely associated with activities, particularly social and professional activities.

The notion of use/influence is associated with that of matrix. In toxicology, a matrix refers to the biological material submitted for analysis, such as saliva, blood, urine or hair. For a given substance, each matrix covers a period during which the substance is present: a few minutes to a few days for blood and saliva (indicating recent use and influence), a few hours to a few days for urine (indicating semi-recent use), and a few weeks to months for hair depending on its length (indicating use in the past).

3.6.3.2 Screening/diagnosis

A diagnosis involves a set of methods for identifying and measuring substances present in the body. It requires analyses that are usually carried out in the laboratory, and are precise and subject to rigorous quality control. To obtain reliable results requires an investment in terms of time and cost.

Screening involves a set of methods to detect the suspicion of a substance in the body. It is characterised by ease of use, rapid results and moderate costs. However, the results may be more approximate than a diagnosis (detection of a family and not a specific substance or of a limited number of substances). The results are semi-quantitative, expressing a presence or absence relative to a given threshold.

The level of performance of a screening test is estimated by the number and/or proportion of errors. This is why they must be confirmed by a diagnosis method. False positives characterise a positive result when the substance is absent. Screening tests producing a large number of false positives are associated with high verification costs. False negatives indicate a negative result when the substance is present, in this case for a drug that the test subject has taken. This situation, which is not systematically verified, constitutes a proven danger for the activity in question. The number of false negatives associated with a screening test is a major safety issue and must be known for any means used in the context of prevention.

3.6.4 Procedures at Monacair

3.6.4.1 Management of psychological risks

Monacair had introduced a psychological assessment of all flight crew members prior to commencing line flights, in order to:

- determine the psychological characteristics and suitability of the flight crew member with respect to the working environment; and
- reduce the likelihood of a reduction in flight safety that could be linked to psychological weaknesses.

This assessment was introduced by Monacair in February 2021 for all newly recruited pilots. The assessment criteria included:

- personality traits;
- operational and professional skills.

To carry out this assessment, Monacair called on the services of a psychologist.

3.6.4.2 Policy for the prevention and detection of the abusive use of psychotropic substances

At Monacair, the policy for the prevention and detection of illegal narcotics concerned flight crew members (including those of subcontractors), personnel in charge of airworthiness management carrying out tasks directly related to safety, ramp mechanics, ground staff directly employed by the operator and having a direct role in flight safety, and any person in the company directly or indirectly related to flight safety.

Prevention policy

Annual training was provided by the Safety Manager. It covered:

- the effects of psychotropic substances and alcohol on individuals and on flight safety;
- the procedures established within the organisation to prevent the misuse of psychotropic substances and alcohol;
- individual responsibilities with regard to applicable legislation and policies on psychotropic substances and alcohol;
- the assistance provided by the support programme.

This training was based on teaching materials produced by the Safety Manager through her own research. It aimed to ensure compliance with the regulatory requirement CAT.GEN.MPA.170 of the AIR OPS (see paragraph 3.6.1). The messages transmitted corresponded to the recommendations made in the various documents relating to the prevention and use of narcotics.

The pilot of 3A-MVT had followed the initial prevention training on 10 June 2021 during the operator conversion course (see paragraph 3.3.2) and again on 3 October 2022.

Detection policy

Monacair's policy was based on the AIR OPS regulations and was backed by a procedure that aimed to be objective, transparent and non-discriminatory for the prevention and detection of cases of psychotropic substance/alcohol abuse by the staff concerned.

The company's policy and procedure provided for psychotropic substance and alcohol screening for certain staff, including pilots:

- on recruitment;
- following a reasonable suspicion confirmed by an assessment carried out by a duly trained staff member;
- after a serious incident or accident.

In the event of physiological or material signs being detected and reported by a company employee, the safety and conformity department was responsible for ensuring the veracity of the statements in order to determine whether or not the screening test was necessary.

3.6.4.3 Screening process for psychotropic substances

Monacair's initial and confirmation screening tests were saliva tests (for narcotics) and the measurement of the blood alcohol level using a breathalyser.

The psychotropic substances tested for were:

- THC (cannabis, marijuana, hashish);
- alcohol;
- cocaine and crack;
- heroin and opiates;
- amphetamines;
- methamphetamine and ecstasy.

Two samples were taken for the saliva test. They were then sealed with the name and signature of the person tested.

The tests were carried out discreetly and out of sight, by the Safety and Conformity Manager (SCM). The SCM's responsibilities included:

- preparing the tests;
- carrying out the tests in a confidential manner;
- recording the tests;
- deciding whether to withdraw the person from his/her position in the event of a positive test.

Monacair used a NarcoCheck screening test made by Kappa City[15]. These tests were marketed in two forms, differing only in the packaging:

- a medical device with the EC logo that can be used by health professionals;
- a test without the EC logo that can be used as a non-medical prevention tool by private individuals and non-medical personnel. The latter could be trained to use the test with the same degree of reliability as health personnel.

Monacair had not followed the Kappa City training but complied with the instructions and had not encountered any difficulties.

Monacair's OM stated that the test results were processed by the safety and conformity department, which was deemed to be impartial, and guaranteed compliance with the procedure, determined true positives and avoided false positives. Safety and conformity department staff with access to the results of these tests were made aware of the need to respect confidentiality.

In the event of a positive breathalyser and/or saliva test result, two blood samples were to be taken within 30 min in a public or private medical biology laboratory with the standard NF EN ISO 15189 accreditation. The samples had to be sealed and bear the name of the person being tested and their signature. Refusal to undergo a test carried out in accordance with the rules in force was considered to be a "positive confirmation”.

As safety was to take precedence over any doubt, the staff tested were removed from their duties as soon as the screening result came back positive and until this result had been invalidated by a laboratory diagnostic test.

However, this doubt was not to be detrimental to them. Thus, the reasons for deprogramming were to remain confidential and the laboratory diagnostic test was normally carried out as quickly as possible.

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[15] Kappa City Biotech SAS is specialized in the manufacturing of In Vitro Diagnostic (IVD) medical devices, and more particularly of lateral flow immunoassays, or in other words, rapid tests based on the principle of an antibody/antigen reaction.

If the result of the test was given directly to the person tested by the laboratory, and this person did not inform the relevant department of the company of the result, the test was then considered a positive confirmation.

Once the result had been given by the laboratory or the person concerned, if it was positive, the SCM was to inform the accountable manager in order to temporarily stop the person's activities while the case was being processed.

3.6.4.4 Health precautions to be taken by crew

Monacair specified that the areas covered were not exhaustive and were to be supplemented by the crews themselves.
In its OM, Monacair required its pilots to comply with the following rules:

- the blood alcohol level had to be 0 g/l before the flight and its preparation, and the consumption of alcohol was forbidden in the 12 hours preceding the flight and during the flight. These measures were more restrictive than those specified in AMC1 CAT.GEN.MPA.100(c)(1), which stipulates 0.2 g/l and 8 hours;
- the use of products likely to induce narcosis was strictly prohibited;
- any means of correcting visual acuity, if necessary, was to be used in flight. In addition, as indicated on the licence, a spare set of spectacles was to be within the pilot's immediate reach;
- as rest is a determining factor in human performance, pilots were strongly advised not to devote their rest time to activities that could disrupt their sleep cycle.

The safety investigation did not include a study of the pilot’s fatigue. The amplitude of the flight hours and rest periods of the outward and return flights did not give rise to any particular remarks. It was not possible to trace the pilot's activity between the two flights.

4 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

The investigation was able to establish that the pilot had undertaken the flight while under the influence of cocaine and showed signs of recent consumption of CBD, THC and alcohol.

The pilot was on a VFR flight from Lausanne (Switzerland) to Monaco. Based on the flight file and the meteorological data available to the pilot, it was not possible to predict the appearance of mist and fog on arrival in the region around Nice and Monaco.

After descending towards Nice, as he approached the coast, the pilot was confronted with this local phenomenon of sea haze, centred on the Col d’Èze pass between Nice and Monaco. This meteorological phenomenon, although sudden, is known of by most people who, like him, live in the region.

The pilot, who was not qualified for instrument flight and had little training in blind navigation, reduced speed in the face of this meteorological hazard, continued on his heading, entered the clouds and lost all external visual references.

The topographical and meteorological analysis showed that it would have been possible to avoid the clouds around the accident site by easily circumventing them via Nice to the west of him or by turning east to stay north of the terrain in clouds. It is possible that the pilot's ability to reason was impaired by drug consumption.

The pilot then banked the helicopter to the left, reaching a roll of 50°. When he briefly regained sight of the ground, he made an impulsive input on the flight controls to cancel the left bank. He then banked the helicopter to the right before returning to a horizontal attitude. The helicopter then entered a nose-up attitude and gained height, before inverting, carrying out a 180° turn (half-turn) around its yaw axis and entering a 60° nose-down attitude. All these unusual attitudes were the result of the pilot's actions on the controls.

When the pilot briefly regained sight of the ground, he made a nose-up input on the cyclic pitch stick. The helicopter collided with the ground in a nose-up attitude, parallel to the slope of the mountain.

The pilot's profile was that of a surreptitious user in the habit of repeated transgressive use of cocaine in the months preceding the accident. The ability of these users to get around controls based on saliva screening tests, which at best detect drug consumption in the previous few days, explains why they remain unrecognised for so long. The inexorable deterioration in their abilities contrasts with their continuing high self-esteem, which prevents them from realising their true limitations.

The operator had implemented a screening policy, training and resources that complied with European regulations and were comparable to those recommended in France. In particular, the pilot had undergone tests on recruitment which had proved negative.

Although experienced in flight under day VFR, the pilot had not received sufficient training to fly without visual references and did not have clear instructions in the event of inadvertent entry into these conditions. His piloting was impaired by the sudden change in the brightness of his environment with the onset of sea haze, as well as by the adverse effects of drugs. In this context, once he had entered the cloud layer, with his judgement impaired by the drugs, it was difficult for him to maintain the flight parameters and to undertake, at low height and close to the terrain, any rectification manoeuvre such as climbing to a safe altitude.

Contributing factors

The following factors may have contributed to the loss of control in the absence of external visual references:

- a lack of training in the risk of inadvertent entry into a cloud layer and the associated exit procedure, as well as insufficient practical training in blind navigation. The investigation showed that the pilot had only been trained to maintain flight parameters (attitude, height, speed, turn) without being put into a blind navigation situation, which meant that he was not provided with any backup tools;

- the short time allocated to blind navigation practical training exercises and checking;
- impaired performance by the pilot under the influence of drugs;
- the wearing of sunglasses, which reduced the pilot's ability to read the instruments and interpret the indications in a low-contrast environment.

The following factors may have contributed to the flight being carried out under the influence of drugs:

- a perception of the harmlessness of certain drugs such as cocaine, which contrasts with the performance required for high-risk activities. The pilot, like most drug users, gave priority to his experience of drug use and his perception of the short-term positive effects of this type of drug, despite the fact that it is prohibited, and despite his knowledge of the associated risks and prevention messages;
- a screening system that is not very effective in detecting surreptitious users who manage their substance use and find that they can break the rules without a high risk of being tested positive.

Safety lessons

Risk prevention strategy with respect to the consumption of psychoactive products by crews

Requirements applicable to the operator: to meet the AIR OPS regulatory requirement CAT.GEN.MPA.170(b), Monacair had introduced, prior to the accident, a policy designed to:

- prevent crew members from boarding an aircraft under the influence of alcohol and illegal psychotropic substances, by means of breathalysers and saliva screening kits (CAT.GEN.MPA.170(a));
- avert through in-house training provided by the Safety Manager (CAT.GEN.MPA.170(b));
- detect the misuse of psychotropic substances through targeted checks on recruitment with the possibility of additional checks at a later date (CAT.GEN.MPA.170(b));
- implement the objective, transparent and non-discriminatory procedure developed to prevent and detect the misuse of psychotropic substances (CAT.GEN.MPA.170(c)).

However, surreptitious cocaine users pose a permanent threat to flight safety and are difficult, if not impossible, to detect using current means. It was the investigation’s analysis of the pilots' hair that revealed this particular addictology, thus showing the shortcomings of the usual screening tests based on saliva or urine, which are often scheduled.

Aero-medical examinations: the regulations limited the screening to just the initial class 1 fitness examination. Insofar as it is periodic, scheduled and uncorrelated with any intention to fly, the initial or renewal medical fitness examination conducted under regulation (EU) No 1178/2011, known as AIRCREW, allows pilots to conceal the use of psychotropic drugs. However, precisely because it is periodic and recurrent, this unavoidable examination could be an opportunity to deal with a consumption problem likely to threaten safety. Here again, the means must be adapted to the prevention objective by working on misuse rather than influence.

Although published in 1995, ICAO Doc 9654, Manual on Prevention of Problematic Use of Substances in the Aviation Workplace contains current thinking on the awareness, treatment and rehabilitation of personnel whose use of substances poses a problem. It also deals with the consequences of use on employment.

Based on these elements, the BEA calls on:

- the authority to open a consultation on the detection of the abusive use or "use" of psychotropic drugs by pilots throughout their career;

- operators to take advantage of all the safety opportunities offered by the provisions associated with CAT.GEN.MPA.170(b) relating to the abusive use or "use" of psychotropic drugs by pilots;
- social partners and staff representatives to provide pilots with up-to-date addictology information;
- operators and pilots' representative bodies to encourage closer links between in-house peer support systems and addiction self-help organisations;
- the authorities, Aero-Medical Centres (AeMC) and Aero-Medical Examiners (AME) to adapt their strategy for detecting the abusive use or use of psychoactive products, so as not to limit themselves to unannounced checks by the police and gendarmerie, on the model of roadside checks.

These players could consider the following options, taking into account the technical limitations and social acceptability of the various measures:

- tests during renewal medical examinations;
- random tests by operators in the absence of any suspicion;
- unannounced tests during operations;
- social measures and support for pilots found to be positive, provided by both the authorities and operators;
- efforts to improve the effectiveness of prevention campaigns;
- selection of suitable biological matrices (particularly hair) to detect surreptitious users.

Blind navigation

The pilot of 3A-MVT had benefited from the regulatory exercises relating to blind navigation. These exercises, as they are generally carried out today, appear to be insufficient to prepare a pilot, whether professional or not, for the inadvertent loss of external visual references and the appropriate use of onboard instruments.

The blind navigation instruction module should be reinforced, as it is too often undervalued on the pretext that its content and the amount of time allocated do not guarantee, in the view of some examiners, flight safety for pilots who are only qualified for VFR and are required to maintain VMC flight conditions in all circumstances.

Compliance with regulatory criteria alone is not enough to prevent inadvertent loss of external visual references, and instruction in blind navigation should not be minimised on the pretext that pilots must comply with them.

Regular training based on realistic scenarios, as carried out by some operators, can provide backup tools: climb to a predefined safe altitude, maintain altitude, preconfigure power, perform a controlled U-turn and/or use radio navigation aids. This type of training does not prevent pilots from complying with VFR flight rules and VMC conditions, but does ensure that they are better prepared for situations where they inadvertently lose external visual references.

In addition, the new virtual reality flight simulators, which are transportable and therefore easy to make available to operators, could be an alternative to the cost per flight hour of most aircraft.

The BEA investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.