BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

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SAFETY INVESTIGATION REPORT

Accident to the SOCATA - TB21 registered N229GC on Wednesday 28 December 2022 at Barcelonnette - Saint-Pons aerodrome

Time	Around 11:00[1]
Operator	Private
Type of flight	Cross-country
Persons on board	Pilot and three passengers
Consequences and damage	One passenger fatally injured, pilot and two passengers severely injured, aeroplane 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.	

Non-stabilised approach, bounces, go-around, collision with vegetation, fire

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on statements, videos taken by the passengers and by a witness on the ground as well as radio communication recordings and radar data.

The pilot, accompanied by three passengers, carried out a cost-shared flight between Cannes - Mandelieu airport (Alpes-Maritimes) and Barcelonette - Saint-Pons aerodrome. Before the flight, the pilot contacted someone from the Barcelonnette flying club who informed him that the runway was cleared, but that there was snow on the parking areas.

At approximately 10:20, the pilot took off from Cannes. He arrived at Barcelonnette from the south flying over Col d'Allos mountain pass (see **Figure 1**). At 10:57, the aeroplane was nearly overhead the aerodrome, at an altitude of approximately 8,150 ft[2] QNH (point 1). The pilot distanced himself from the aerodrome, following the Ubaye valley eastwards, then he joined on long final for runway 27[3].

The aeroplane touched down approximately 220 m after the runway displaced threshold (point 5) and then bounced several times. The pilot rejected the landing about ten seconds after the first touchdown. During the go-around, the pilot lost control of the aeroplane, which crossed an area clear of obstacles at the end of runway 27 and ended up in a wood to the left of the runway centreline. The aeroplane caught fire and was destroyed. The front passenger was fatally injured. The pilot and the two passengers in the rear seat were severely injured.

[1] Except where otherwise indicated, the times in this report are in local time.
[2] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.
[3] Runway measuring 800 m x 30 m (see paragraph 2.2).

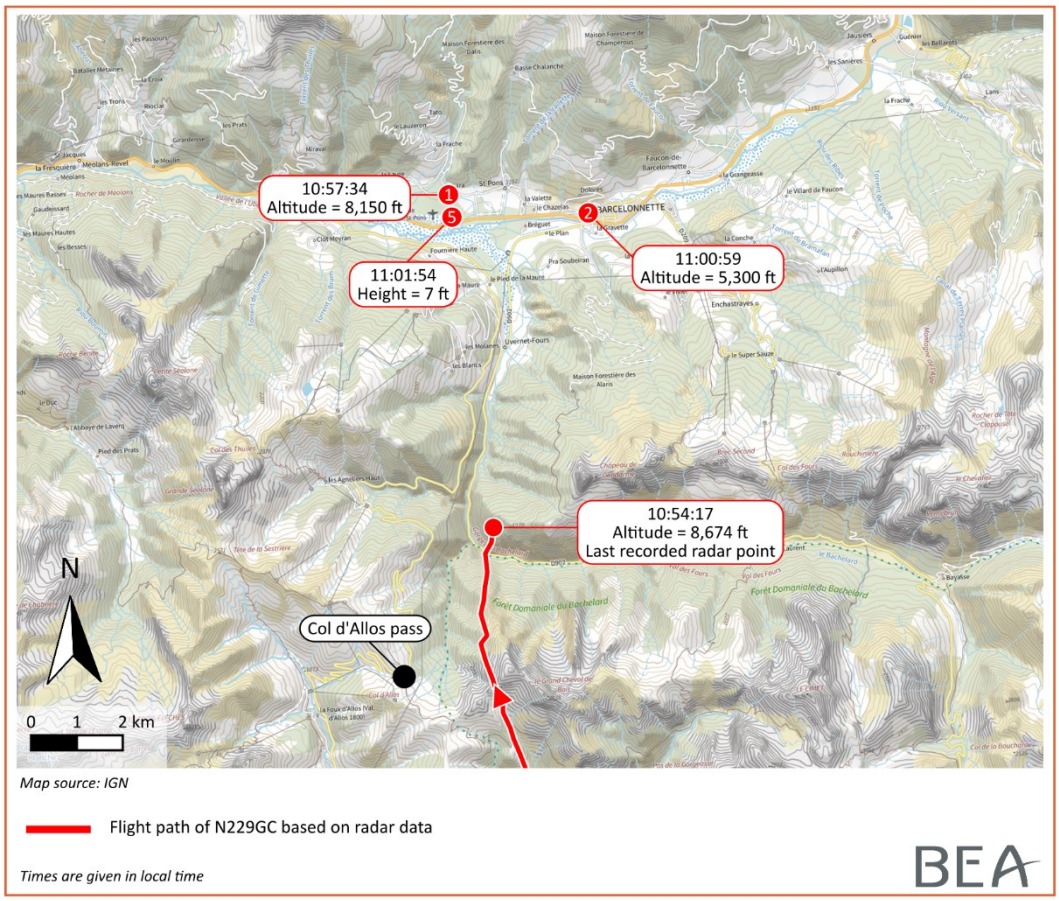

Figure 1: view of Col d'Allos mountain pass and the Ubaye valley (Source: BEA)

2 ADDITIONAL INFORMATION

2.1 Meteorological information

The METAR report at 11:00 for Cannes - Mandelieu airport, located 53 NM away, indicated a variable wind of a speed of 2 kt, a CAVOK situation with a temperature of 13°C.

The meteorological conditions estimated by Météo-France at Barcelonnette at the time of the accident were as follows: visibility greater than 10 km, temperature 0°C, no low clouds, clear sky and easterly to south-easterly light wind of less than 5 kt. There was no turbulence or noticeable gust.

2.2 Aerodrome information

The Barcelonnette - Saint-Pons aerodrome is located in the Ubaye valley at an altitude of 3,700 ft. The highest terrain in the aerodrome's area culminates at an altitude of 5,300 ft. The only runway 09/27 is 800 m long and 30 m wide. The VAC chart indicates that its profile is "curved longitudinally". As a result, the altitude of the middle of the runway is 16 ft higher than that of threshold 27 and 26 ft higher than that of threshold 09. Since the threshold of runway 27 is displaced, the landing distance available is 720 m on runway 27.

The arrival procedure in clear weather described on the VAC chart consists in flying overhead the aerodrome at an altitude of at least 5,000 ft and then joining the downwind leg of the runway circuit at an altitude of 4,500 ft. The approach slope is a standard slope of 5%[4].

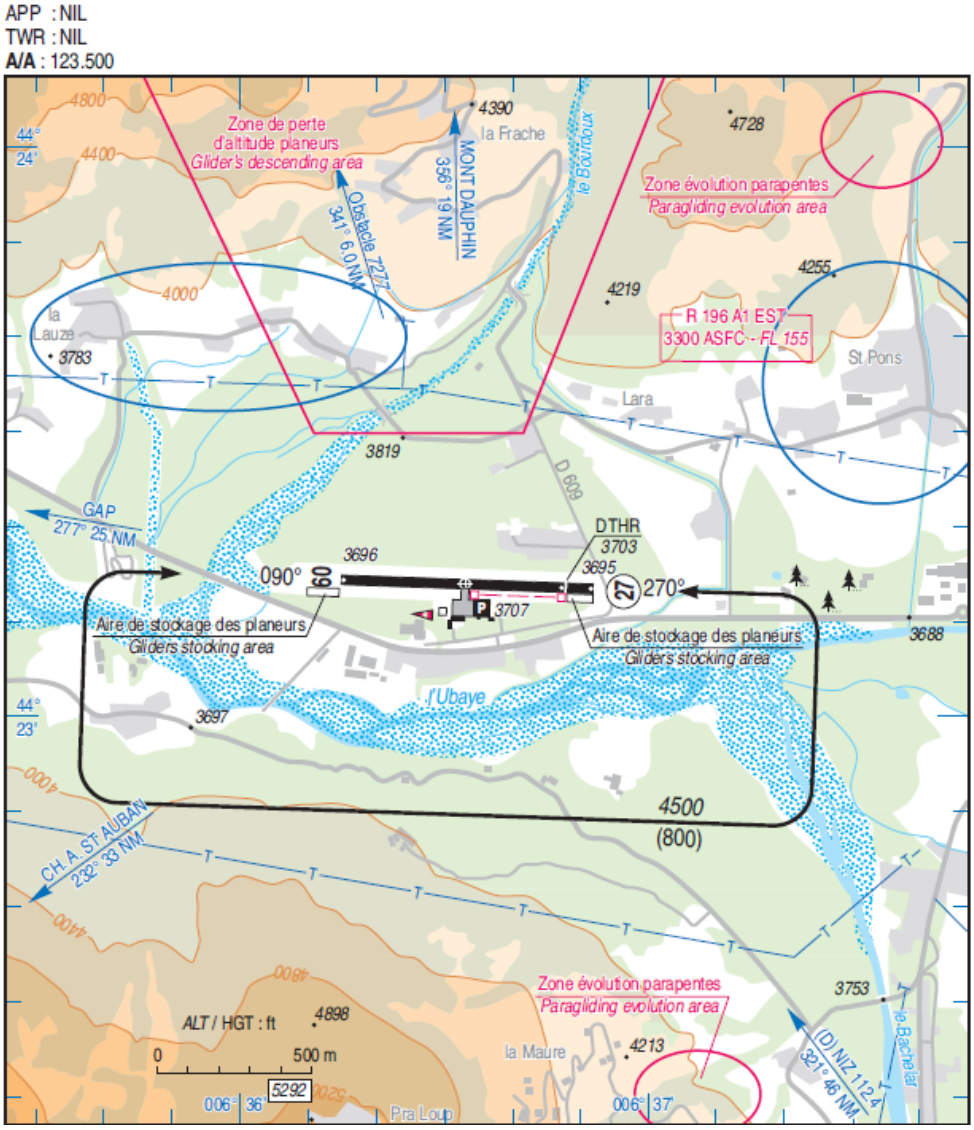

Figure 2: excerpt from the VAC chart in force on the day of the accident (Source: AIS)

2.3 Aircraft information

N229GC was a Socata TB21 TC Trinidad aeroplane equipped with a LYCOMING TIO-540-AB1AD engine delivering 250 hp at 2,575 rpm. Its serial number was 871 and its maximum landing weight was 1,335 kg. The aeroplane landed with an estimated weight of approximately 1,390 kg, based on the quantity of fuel at take-off that the pilot indicated and on the aeroplane's estimated fuel consumption given in the flight manual.

[4] According to the VAC chart published after the accident on 7 September 2023, the view of the slope in final is distorted due to the curve of the runway, with a vision of 7% that gives the impression of a strong slope.

According to this manual[5], taking into account the landing weight, the meteorological conditions on the day of the event, a flat runway and an approach made at the landing speed recommended in the flight manual (75 kt), the landing distance was approximately 585 m, and the landing run distance was approximately 275 m.

The velocity flaps extended (V_{FE}) was 129 kt IAS with the flaps in the take-off position and 103 kt IAS with the flaps in the landing position.

2.4 Examination of site and wreckage

The black marks observed on the runway and attributed to N229GC were consistent with those left by tyres rubbing on the ground with braked wheels. The first mark was observed approximately 320 m after the displaced threshold. Two marks, about 1 m apart and offset in relation to the runway centreline, were visible on the upper part of the 50 cm-high mound of hard snow located at the end of runway 27.

Figure 3: mound of snow at the end of runway 27 (Source: BEA)

The distance between these marks was consistent with the distance between the left or right main landing gear and the front landing gear. Moreover, their shape was similar to the marks that tyres can leave. A broken tree, as well as marks in the snow and debris, were observed in an area clear of obstacles between the end of runway 27 and the slope, where the wreckage was found.

The wreckage, which was not dispersed, was located in a wood, approximately 150 m to the left of the end of the runway. It was oriented on a 130° heading. Some trees were uprooted during the collision with the aeroplane. Apart from the rear section of the fuselage and the tail units, the wreckage was destroyed by the post-accident fire.

All of the damage observed on the fuselage, wing and tail units was the result of the aeroplane entering the vegetation or colliding with the ground and then catching fire. Due to the fact that parts were missing or destroyed by the fire, the continuity of the flight control linkages and the position of the flaps could not be confirmed. Likewise, the braking system could not be examined.

[5] Post-SN 879 flight manual, used to calculate landing performance with a weight of up to 1,400 kg. Changes made after SN 879 increased the maximum landing weight, but did not modify braking performance. The post-SN 879 flight manual chart therefore remained valid for SN 871.

Due to the fire-related damage to the engine, its examination was very limited. The observations made on the propeller and engine were therefore unable to determine the power delivered by the power unit at the time of the collision with the vegetation.

2.5 Radar data analysis information

The data from the Cannes radar was used to establish the path of the aeroplane between the moment it took off, at 9:20, and the moment when the signal was lost due to the terrain, at 9:54, i.e. eight minutes before landing.

This data indicated that the aeroplane crossed Col d'Allos mountain pass at 9:53 at an altitude of 9,000 ft, i.e. a height of approximately 900 ft. After he crossed the mountain pass, the pilot continued on his path and started to descend. The last radar blip showed that, at a distance of 3.7 NM from the aerodrome, the aeroplane was at an altitude of 8,700 ft, i.e. 4,200 ft above the runway circuit.

2.6 Video examination information

Photogrammetric analysis of four recordings was used to obtain several positions and speeds of the aeroplane:

Three videos taken by the passengers of the aeroplane were analysed to obtain points ❶, ❷ and ❹. The rest of the points were obtained by analysing a video recorded by a witness on the edge of the runway.

All the altitude, height and speed values displayed hereafter were derived from these video analyses. Nevertheless, as parts of the videos that can be analysed only lasted a few seconds, the path followed by the aeroplane between these points could not be determined. The information obtained is summarised in Figure 4. The position numbers are in chronological order. The altitudes indicated at points ❶, ❷, ❸ and ❹ has a measuring uncertainty of ± 30 ft. The measuring uncertainty of the other points is negligible.

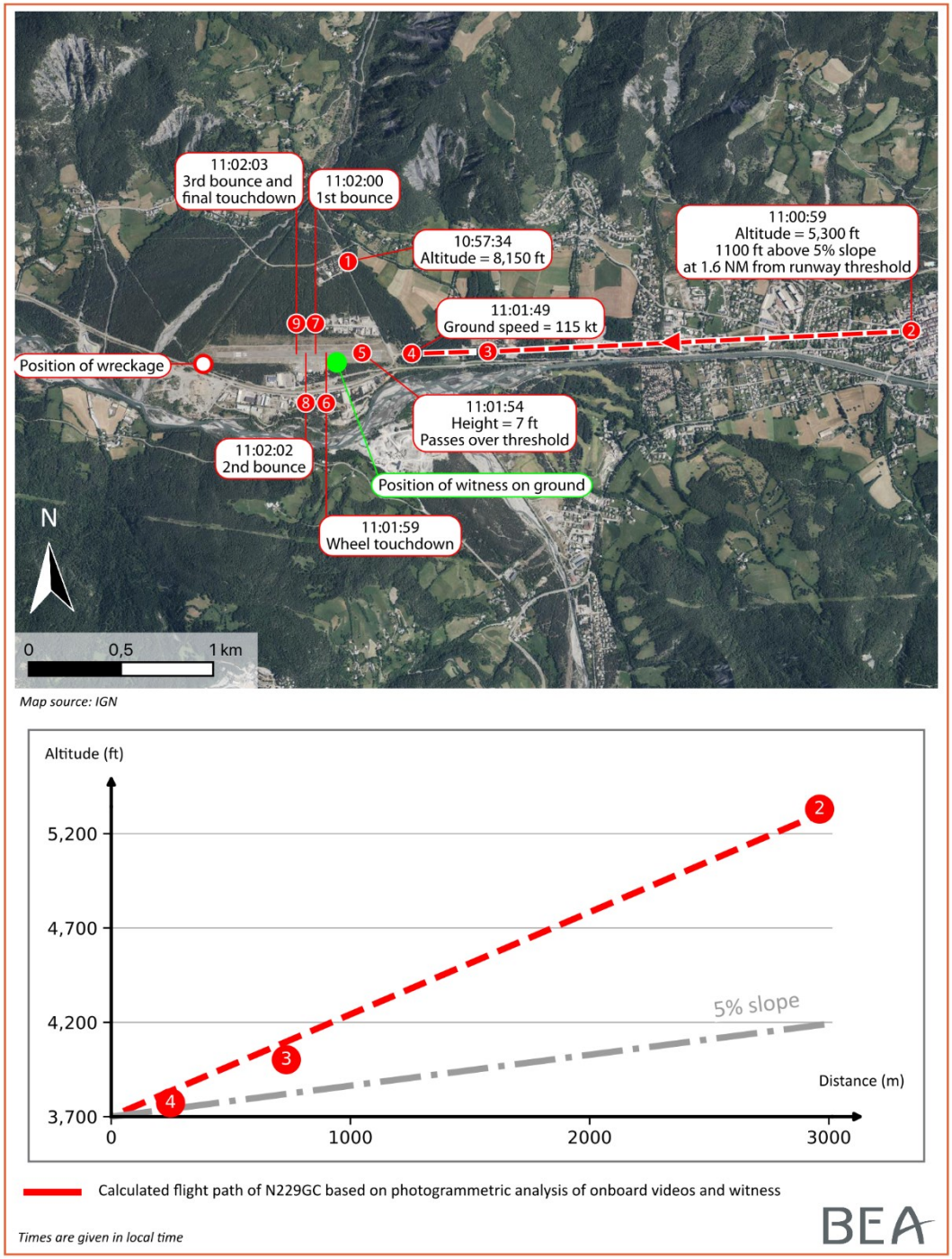

Figure 4: successive positions and final glidepath of N229GC based on video analysis (Source: BEA)

The aeroplane's estimated height at point 2, obtained from the video recorded by one of the passengers, was used to calculate an average aeroplane ground slope on final of approximately 16%, between point 2 and the displaced threshold. The aeroplane's estimated height at point 3, obtained from the video recorded by the witness on the ground, is consistent with this slope value. This slope is three times greater than the 5% recommended for an approach to Barcelonnette.

In addition to the positions, the aeroplane's ground speed at point 4 was 115 kt ±5 kt. This corresponds to an indicated airspeed of approximately 110 kt, taking into account the no-wind condition and the effects of altitude and temperature.

An excerpt from a video showed that the engine speed on short final was 2,600 rpm. A frequency analysis of the associated audio recording also confirmed this result. Flights carried out by the BEA showed that it is unlikely that the propeller would have reached a speed of 2,600 rpm and that the aeroplane would have reached an indicated airspeed of approximately 110 kt on final, with the flaps and landing gear extended, without tractive power being provided by the power unit.

Analysis of the video taken by the witness on the ground made it possible to calculate an estimated average ground speed of 90 kt between points 5 and 6, i.e. an indicated speed of around 85 kt. The video recording also showed the windsock, confirming that there was no wind at ground level.

2.7 Survival aspects

The aeroplane ran off the runway before colliding with trees and then catching fire. The autopsy report showed that the passenger seated in the front right seat died when the aeroplane collided with the ground. The pilot and the two passengers in the rear seat managed to escape through the right side of the wreckage.

Less than ten minutes after the accident, the emergency services took care of the injured people. They all suffered severe burns.

2.8 Pilot's experience and statement

The 54-year-old pilot held a Private Pilot Licence (PPL) issued in 2012 and a Commercial Pilot Licence (CPL) issued in 2017, along with the single-engine (IR/SE) and multi-engine (IR/ME) instrument ratings, as well as the single-engine piston (SEP) and single-engine turbine (SET) ratings. The pilot had logged 637 flight hours, more than a hundred hours of which on TB21s. He had landed four times in Barcelonnette, never onboard a TB21. His last landing at Barcelonnette was in 2021.

The pilot reported that before the flight, he checked the weather conditions and called someone from Barcelonnette flying club to determine whether the runway was cleared of snow. He also reported that he checked that the take-off weight was not greater than the maximum take-off weight. The pilot reached Barcelonnette via Col d'Allos mountain pass, which he said he crossed at an altitude of approximately 8,500 ft. After crossing the mountain pass, the pilot started his descent and got overhead the aerodrome. He said that he then lowered the landing gear before carrying out a reconnaissance circuit along runway 27 towards the west, at an altitude of around 5,800 ft, according to him. During this reconnaissance, the pilot did not identify the mound of snow near the threshold of runway 09. Observing that there was no wind, the pilot decided to land on runway 27. His decision was motivated by the possibility of a rejected landing, which, according to him, is easier on runway 27 due to the absence of trees close to the path.

The pilot joined the start of the downwind leg while continuing his descent. He then extended the downwind leg to increase flight time and lose altitude. The pilot flew an extended base leg and then a long final to runway 27. He added that he carried out the approach by following a fairly steep slope, which he estimated to be around 7°[6], in order to have some margin against trees located before the threshold, according to him. He reported that the aeroplane was then lined up on final, with the landing gear extended, the flaps in the landing position and the engine at reduced speed.

[6] i.e. approximately 12%.

According to him, the pilot landed with an indicated airspeed of 78 kt. After touchdown, he had the impression that the aeroplane was not braking and did not feel it bounce. At the runway mid-point, noticing snowdrifts at threshold 09 and to avoid a runway overrun, the pilot decided to reject the landing. He reported that the aeroplane was then at a speed of 48 kt. After displaying maximum power, he made an input on the flap retraction control without having time to visually check the position of the flaps. The pilot indicated that he turned around just before the strips of the threshold of runway 09. Once airborne, it seemed to him that the rear left of the aeroplane hit something beyond the runway. The aeroplane yawed to the left and the attitude decreased. The aeroplane then slid across the ground and hit some bushes. The aeroplane finally collided with a tree.

2.9 Framework of flight information

2.9.1 Cost-shared flights

Cost-shared flights consist in dividing the direct costs of a flight[7] between the various people on board. Initially, this practice was widely used by flying club members and their relatives. It increased with the advent of flight-sharing platforms online. By regulation, cost sharing is authorised by EASA for non-complex motor-powered aeroplanes[8], provided that the cost is shared between all occupants, including the pilot[9].

EASA also published a charter for flight-sharing platforms, laying down best practices for cost-shared flights. This charter includes:

- a code of conduct for passengers and pilots, summarising the rules that passengers and pilots must obey during the flight;
- guidance material and checklists on safety best practices, in relation to the conduct the flight and passenger management, in particular. In addition, the charter reminds platforms that passengers must be aware that the safety level for a cost-shared flight in light aviation is not the same as for a flight in commercial aviation, and that the associated risks are higher.

A number of flight-sharing platforms have signed up to it.

2.9.2 Event flight

The flight was initially organised for two passengers who did not know the pilot. One of them contacted the pilot via a flight-sharing platform[10] for a flight for two people. The passenger in question chose the pilot because he seemed to be the most experienced, according to him. The flight was then organised by email rather than via the platform, to avoid the costs associated with using the platform, as indicated by the passengers.

[7] The direct costs of a flight are those directly associated with the operation of the aircraft. They do not include aircraft maintenance, insurance or depreciation costs.

[8] Aeroplane with a maximum certificated take-off mass of less than 5.7 t, certificated for operation with one pilot-in-command only, with a capacity of less than 19 passenger seats, using one or more piston engines or a single turboprop engine.

[9] According to Article 6, paragraph 4a (a) of European Regulation No. 965/2012 (known as Air OPS).

[10] The flight-sharing platform had signed up to the EASA charter.

The passenger told the pilot that he wanted to go to Barcelonnette, which the pilot accepted. Afterwards, the pilot also invited one of his relatives to take part in the flight. This was the passenger seated in the front seat.

3 CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.

Scenario

The pilot chose to fly to Barcelonnette aerodrome via Col d'Allos mountain pass, which he crossed at an altitude of approximately 9,000 ft, i.e. a height of around 900 ft. The aeroplane arrived near the aerodrome at an altitude of 8150 ft, i.e. approximately 3,500 ft above the runway circuit. To increase his flight time and the loss of altitude, the pilot extended the downwind leg and flew an extended base leg and a long final.

The aeroplane lost around 3,000 ft between its position overhead the aerodrome and the start of the long final. At 1.6 NM from the runway threshold (55 s before landing), the aeroplane was about 1,100 ft above the standard approach slope of 5%. This represented a slope of more than 15% to reach the runway. In addition, the pilot probably maintained engine power during the final. In these conditions, the aeroplane arrived on short final with the gears extended, the flaps in the landing position and an indicated airspeed of around 110 kt, i.e. 35 kt above the speed recommended for landing in the conditions of the day.

The aeroplane touched down approximately 215 m after the displaced threshold, which left a runway distance of 510 m. Due to the excessive energy of the aeroplane, it then bounced three times. The position of the last touchdown was 330 m from the opposite threshold.

To avoid making a runway overrun and hitting a snowdrift some 50 cm high located at the end of the runway, the pilot decided to reject the landing. During the go-around, the landing gear hit the snowdrift, which probably destabilised the aeroplane. The pilot lost control of the aeroplane, which hit the vegetation to the left of the runway centreline before catching fire.

Contributing factors

The following factors may have contributed to the aeroplane's collision with the vegetation:

- the management of the descent and path in the aerodrome circuit, which led the pilot to follow a path with a steep slope on final;
- the continuation of the approach although it was not stabilised, with an approach slope and speed that were too high.

Safety lessons

As the BEA points out in its Safety lessons 2020 and 2022 for light aeroplanes, the majority of accidents that occurred during landing and resulted in severe injuries took place during a rejected landing.

More specifically: "*When confronted with an unexpected situation during the landing (long flare, bounce, lateral swerve), the pilot may have to make choices in a very dynamic situation: continue the landing with the risk of damaging the plane or take-off again. The study of previous events shows that the accidents with the most serious consequences during the take-off occur, above all, during go-arounds performed with insufficient control of the aircraft. On the other hand, the accidents which occurred when the landing was continued, while they often lead to material damage, rarely result, on a light aeroplane, in serious or fatal injuries. During training or recurrent training, it is important to mention the various mechanical phenomena of the flight occurring during a rejected landing. It is also essential to consider all the criteria to be taken into account in order to decide whether it is preferable to reject rather than continue the landing.*"

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