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SAFETY INVESTIGATION REPORT

Accidents

1 - to the CIRRUS SR20 registered **D-EFCD**
2 - to the REIMS Aviation CESSNA FR172H registered **D-EFTP**
on 22 August 2021
at Vars

Time[1]	Accident 1 – at 13:38 Accident 2 – at 16:24
Operators	Accident 1 – Private Accident 2 – Private
Type of flights	Cross country
Persons on board	Accident 1 – Pilot and passenger Accident 2 – Pilot and two passengers
Consequences and damage	Accident 1 – Pilot and passenger seriously injured, aeroplane destroyed Accident 2 – Pilot and rear passenger seriously injured, front passenger 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.	

Collisions with terrain in a valley, in mountainous environment

1 HISTORY OF THE FLIGHTS

Note: the following information is principally based on statements, recordings from the mobile phone of the passenger on board the SR20 (D-EFCD) and data from the Skydemon application installed on the tablet of the front-seat passenger on board the FR172 (D-EFTP).

Both aeroplanes were part of a group of around 20 aircraft making a cross-country flight in the Alps to give a group of German pilots the opportunity of familiarizing themselves with flying in a mountainous environment.

The pilot of the Cirrus SR20, accompanied by one passenger, took off at 13:31 from Mont-Dauphin Saint-Crépin aerodrome (Hautes-Alpes) (see Figure 1, point ❶) bound for Barcelonnette aerodrome (Alpes-de-Haute-Provence). At 13:35, he was heading in climb at an altitude of approximately 4,880 ft (1,487 m) (point ❷) towards the valley leading to Col de Vars mountain pass located at an altitude of 6,918 ft (2,108 m). The height of the aeroplane at this point was around 195 ft[2]. At 13:35:21, he was flying at an altitude of 5,233 ft (1,595 m) and passed over the top of a very high voltage power line and close to one of the power line pylons situated at an

[1] Except where otherwise indicated, the times in this report are local.
[2] Under VFR, the minimum flight height is 500 ft (150 m) above the ground or water, and above obstacles situated in a 150 m radius around the aeroplane.

altitude of around 4,723 ft (1,440 m) before entering the valley. He then continued to climb, flying along the left side of the valley.

At 13:36:40 (point ❸), he flew close to the hamlet of Sainte-Catherine at a height of around 170 ft. At 13:38:10, the aeroplane climbed to an altitude of 6,600 ft (2,010 m) abeam the village of Vars, situated at 3.6 km from the pass. The height of the aeroplane at this point was around 430 ft. The pilot then turned roughly 90° to the right, facing the terrain (point ❹). He continued to climb in a straight south-westerly line, up to an altitude of 6,900 ft (2,105 m), while the height of the aeroplane quickly decreased. Several witnesses on the ground and in flight saw the aeroplane, on a straight path at low height, collide with the trees, facing the slope (point ❺).

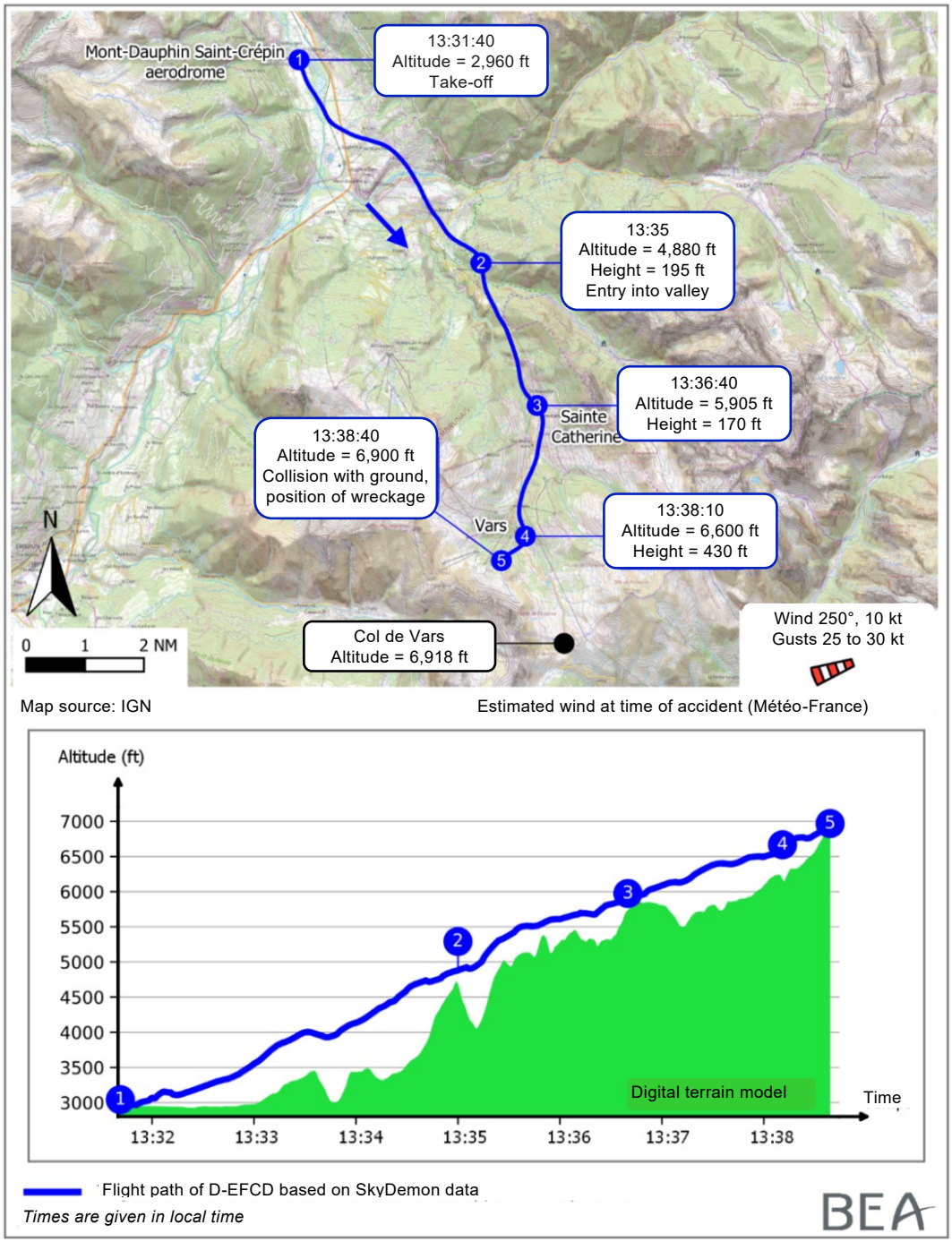

Figure 1: flight path of Cirrus SR20 registered D-EFCD

At 16:17, the pilot of the Cessna 172, accompanied by two passengers, then took off and headed in the same direction as the SR20 (see Figure 2, point ❶). At 16:21:15, at an altitude of around 4,730 ft (1,440 m), he flew in climb over the same very high voltage line situated on a ridge and entered the valley leading to the pass. At this point, the aircraft was at a height of around 275ft (point ❷). Around 30 s later, at 16:21:40 (point ❸), the aeroplane was at a height of approximately 80 ft. The pilot continued climbing, flying along the left side of the valley. A witness on the ground said he saw the aeroplane at a low height between the hamlets of Sainte-Marie and Sainte-Catherine, with a steep nose-up attitude and a fairly low speed. At 16:23:50, when the valley split into two after the hamlet of Sainte-Marie, the pilot turned 60° to the left instead of keeping to the right and continuing in the valley leading to Col de Vars mountain pass. The aircraft was at a height of around 180 ft (point ❹). The aeroplane's altitude continued to increase, reaching 6,270 ft (1,910 m) (point ❺) while its height quickly decreased. The pilot turned left towards the terrain. The aeroplane touched down in a grass field, facing the slope and performed a ground loop.

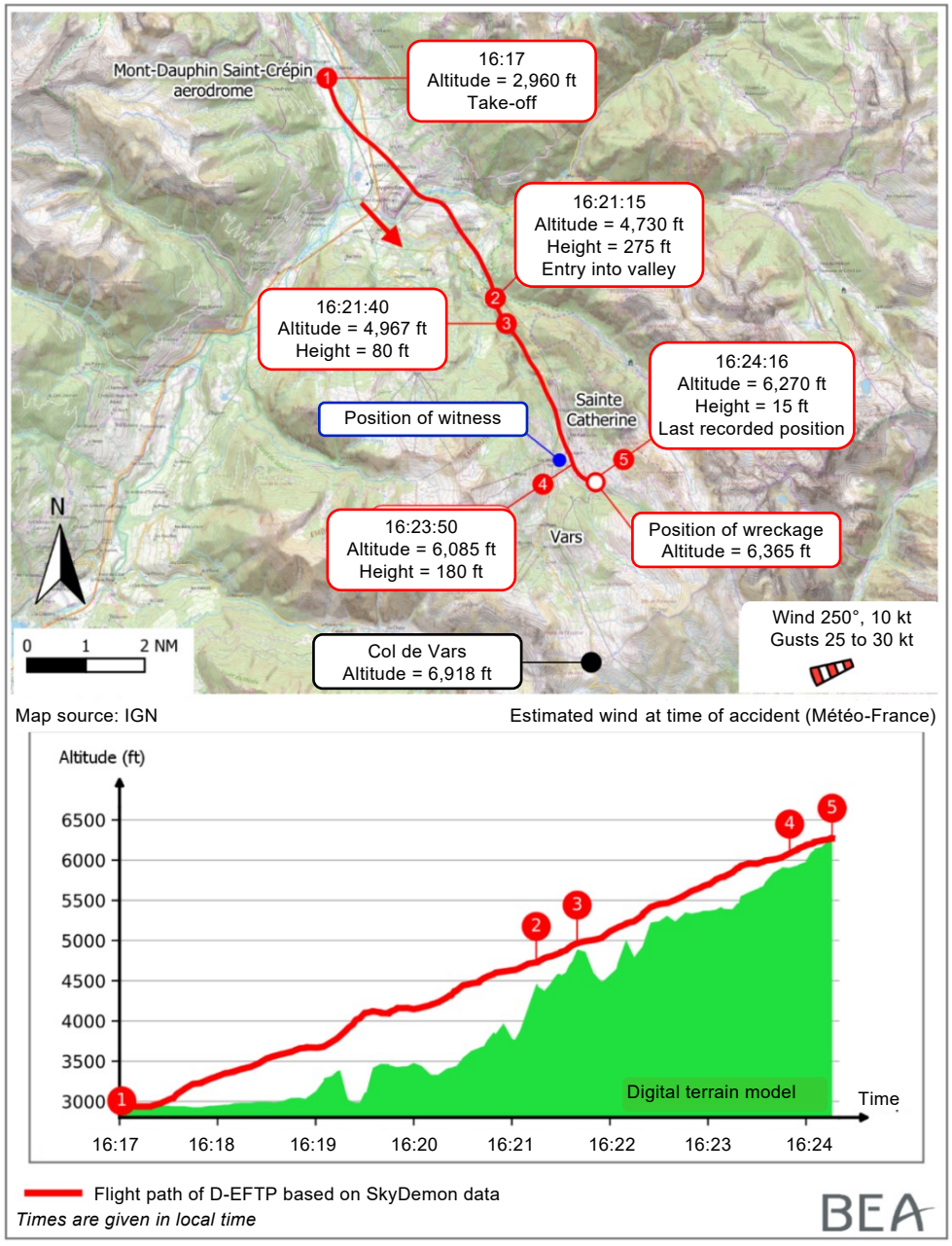

Figure 2: flight path of Cessna 172 registered D-EFTP

2 ADDITIONAL INFORMATION

2.1 Site and wreckage of two aircraft

2.1.1 Site and wreckage of SR20

The wreckage was found at an altitude of 6,905 ft (2,105 m), in a forest located on the right-hand side of the valley rising towards Col de Vars mountain pass, at approximately three kilometres from the pass (see Figure 3). The aeroplane had struck three trees, with its wings horizontal, before colliding with the ground and turning over. The examination of the wreckage indicated that the flaps were retracted at the time of the accident. The engine was producing power at the time of the impact and no anomaly was observed during the examination.

Figure 3: drone aerial view of the site and the wreckage of D-EFCD (source: BEA)

2.1.2 Site and wreckage of Cessna 172

The wreckage was located at an altitude of 6,365 ft (1,940 m), in a field clear of obstacles, with an average slope of 21%. The field, 5.6 km north of the Cols de Vars mountain pass, was in another valley that did not lead to the pass. Marks in the grass over a distance of around 10 m showed that the aeroplane had collided with the ground facing the slope, wings level and with a slight nose-down attitude. The left main landing gear was torn off, then the left wing touched the ground. The aeroplane next spun 180° and came to a stop with the nose facing down the slope (see Figure 4), which caused major damage to the front section of the aeroplane, and the collapse of the right main landing gear and nose gear. The flaps were retracted at the time of the accident. The engine was producing power at the time of the impact and no anomaly was observed during the examination of the wreckage.

Figure 4: position of wreckage of D-EFTP (source: BEA)

2.2 Meteorological information

The VAC chart for Mont-Dauphin Saint-Crépin aerodrome mentioned the possibility of a strong breeze and turbulence in the summer. The temperature recorded by the aerodrome's weather station was 28°C (i.e. International Standard Atmosphere (ISA) +19°C) at the time that both aeroplanes took off.

At the time of the accident to the SR20, the meteorological conditions estimated by the French met office, Météo-France, in the Vars valley were as follows: mean wind of 250°, 10 kt, gusts between 25 kt and 30 kt, moderate to strong turbulence on the slopes, mountain passes and in the valley, visibility greater than 10 km, scattered clouds (cirrus and altocumulus from 3,000 m), temperature +16°C at an altitude of 6,900 ft (i.e. ISA +15). Two other pilots from the same group of aeroplanes had flown over the area at the approximate time of the accident and had observed strong turbulence, downdrafts and a tailwind of 30 kt in the valley leading to Col de Vars mountain pass.

At the time of the accident to the Cessna 172, the meteorological conditions estimated by Météo-France were similar (with the exception of the temperature that was +13°C at an altitude of 6,300 ft, i.e. ISA +12). One of the other pilots of the group who was flying overhead the valley at the time of the accident, at an altitude of between 7,000 and 8,000 ft reported having encountered intermittent downdrafts and strong turbulence requiring him to apply full throttle, and having had

difficulties in gaining altitude. He added that there was a valley wind of around 30 kt which got stronger near the accident site.

According to the passengers of the Cessna 172, after taking off with a strong headwind, the air was fairly calm in the valley and they did not observe any strong turbulence.

2.3 Aeroplane information

2.3.1 SR20 information

At the time of the accident, the estimated total weight of the aeroplane was around 1,300 kg. The Maximum Take-Off Weight (MTOW) is 1,361 kg (3,000 lb). The centre of gravity was within the envelope defined by the manufacturer. According to the flight manual, at the MTOW, the normal climb speed in a clean configuration and full throttle, varies from 105 kt (at sea level) to 95 kt (at 10,000 ft). At an altitude of around 6,000 ft and in a clean configuration, the indicated best rate-of-climb speed (Vy) is 93 kt. The best angle-of-climb speed (Vx) varies between 81 kt (at sea level) and 85 kt (at 10,000 ft). The indicated stall speed is 65 kt.

According to the manufacturer's flight manual, in the temperature conditions of the day with a pressure altitude of 7,000 ft and in a clean configuration, the aircraft's theoretical climb gradient at the MTOW was between 4 and 4.5% and the maximum rate of climb was between 450 and 520 ft/min.

According to the same manual, the aircraft's ceiling is 17,500 ft.

The aeroplane was equipped with an airframe parachute which was not activated.

2.3.2 FR172 information

At the time of the accident, the estimated total weight of the aeroplane was around 1,137 kg for a MTOW of 1,157 kg, and the centre of gravity was within the limits defined by the manufacturer.

According to the manufacturer's flight manual, in cruise at 5,000 ft, the engine rating with 75% power is 2,560 rpm. Normal climb is performed with full throttle at between 80 and 90 mph with flaps retracted. The Vy varies between 77 mph (at sea level) and 80 mph (at 10,000 ft). If an obstacle requires a greater angle of climb, the pilot should use the Vx which varies between 66 mph (at sea level) and 71 mph (at 10,000 ft). The stall speed of the aeroplane in this configuration is 57 mph in straight flight.

According to the same manual, in the temperature conditions of the day with a pressure altitude of 6,300 ft , the maximum rate-of-climb speed is around 500 ft/min, in a clean configuration with a MTOW and full throttle.

The aircraft's flight manual indicates that the engine's maximum rating is 2,800 rpm and the aircraft's ceiling is 15,000 ft.

2.4 Readout of data from on-board devices

2.4.1 Mobile phone of the passenger on board the Cirrus SR20

The analysis of the path that was read out from the SkyDemon application installed on the mobile phone showed that between entering the valley and the accident site, the aeroplane's average rate of climb was around 550 ft/min. The aeroplane climbed on a gradient of between 5 and 6% whilst the

mean gradient of the terrain was around 8%. The average ground speed was calculated as being around 95 kt, decreasing to 80 kt 15 s prior to impact, then to 60 kt immediately before the impact.

The theoretical turning radius of the aeroplane with a speed of 95 kt and a bank angle of 30° was calculated as being around 425 m at sea level. At an altitude of 6,000 ft, this value must be increased by 20%, i.e. a radius of around 500 m.

The analysis of the geographical environment showed that the theoretical turning radius corresponding to the ground speed of the aeroplane was compatible with a U-turn before entering the valley and then at several places in the valley.

2.4.2 Tablet of front-seat passenger on board Cessna 172

The analysis of the path that was read out from the SkyDemon application installed on the tablet showed that between entering the valley and the accident site, the aeroplane's average rate of climb was around 500 ft/min, and the average ground speed was around 83 kt (72 mph). The aeroplane climbed on a mean gradient of around 7% whilst the mean gradient of the terrain was around 8%.

The turning radius of the aeroplane with a speed of 83 mph and a bank angle of 30° was calculated as being around 240 m. At an altitude of 6,000 ft, this value must be increased by 20%, i.e. a radius of around 300 m.

The analysis of the geographical environment showed that the theoretical turning radius corresponding to the ground speed of the aeroplane was compatible with a U-turn before passing over the power line at the entrance to the valley , and then at several places in the valley.

2.5 Context of the cross-country flight and flight preparation

The occupants of the two aeroplanes were part of a group flying on board 19 aeroplanes which had left Bremgarten in Germany the day before, bound for Gap-Tallard (Hautes-Alpes). This cross-country flight in the Alps had been organised twice a year since 2002 and then once a year since 2012 by a German aeronautical association[3].

The pilots of the SR20 (see paragraph 2.6.1) took off from Münster-Osnabrück airport (Germany) and joined the group at Bremgarten. On the way to Gap-Tallard, the group also stopped at Bourg-en-Bresse aerodrome (Ain). They arrived at Gap-Tallard aerodrome situated at an altitude of 605 m in the afternoon of the day before the accident flight.

The pilots of the Cessna 172 (see paragraph 2.6.2) took off from Fribourg (Germany) and refuelled at Sion airport (Switzerland). They flew over the Alps and Mont-Blanc, stopping off at Annemasse airport (Haute-Savoie) before joining the other aeroplanes at Gap-Tallard aerodrome.

In the morning of the day of the accidents, the aeroplanes were divided into several groups and landed at Mont-Dauphin Saint-Crépin aerodrome situated at an altitude of 1,620 ft (903 m). They took off again bound for Barcelonnette-Saint-Pons aerodrome situated at an altitude of 3,714 ft (1,132 m), flying over Col de Vars mountain pass.

The organiser stated that the pilots of the SR20 attended the general briefing given by video conference from Germany, as well as the briefing of that morning. A safety file providing general

[3] Rhénanie-Palatinat aerial sports association (Luftfarhtverband Rheinland Pfalz).

information and detailing the intended route from Germany to Gap aerodrome had been sent to all the participants. It did not contain any additional instructions or recommendations for the subsequent flights to what was indicated on the VAC charts for Cannes, Alpe-d'Huez, Barcelonnette, Mont-Dauphin Saint-Crépin, Courchevel, Gap-Tallard, Bourg-en-Bresse and Carcassonne aerodromes. The day before, after they had arrived at Gap, the pilots of the SR20 received a tailored briefing. In the morning of the day of the accidents, all the pilots of the group attended the general briefing for that day's flight. The weather conditions, the specificities of Col de Vars mountain pass, as well as the risks associated with the loss of the natural horizon in the mountains were covered. The organiser explained that four or five pilots had never taken part in this cross-country flight, including those of the SR20. He stated that he had asked the two occupants of the SR20 not to fly alone in this mountainous sector.

2.6 Information about the occupants of the two aeroplanes

2.6.1 Occupants of SR20

The pilot and the passenger co-owned the aeroplane with two other pilots. This was the first time they took part in this cross-country flight. According to the passenger, this was the tenth flight that they had made together. In 2020, they had taken part in an alpine flight training course together in Austria on a DR400 and on a C172. They had swapped roles at each of the legs. The pilot-in-command had flown the leg between Bourg-en-Bresse and Gap and the passenger had flown the leg to Mont-Dauphin Saint-Crépin. They explained that during the general briefing, they had been told not to climb when they were in the terrain, but rather, to gain altitude beforehand and to always keep the option of a U-turn. The pilots had also been warned about the wind and turbulence in the valleys, in particular in the vicinity of Mont-Dauphin.

The 66-year-old pilot held a Private Pilot Licence - Aeroplanes (PPL(A)) obtained in March 2018. He had logged 237 flight hours, 7 hours of which had been in the Alps in July 2020 in a Cessna 172. He did not hold a mountain rating[4]. He had flown for the first time on D-EFCD on 19 May 2021 and had logged 15 hours in the aeroplane. He had no glider experience and had never carried out slope soaring flights in a mountainous region.

The 66-year-old passenger held a PPL(A) obtained in August 2018. He stated that he did not hold the mountain rating and that this was the first time he had flown in the region. He had logged around 215 flight hours, 30 hours of which on D-EFCD, including around 15 hours in the previous three months.

2.6.2 Occupants of the Cessna 172

The 81-year-old pilot held an aeroplane private pilot licence obtained in 1969 according to a handwritten indication in his logbook. He also held an instructor rating FI(A) and since 2008, a "wheel" mountain rating. According to his logbook, he had totalled around 4,510 flight hours as pilot-in-command, and 8 hours in the previous three months including 6 hours on type. He declared that he had flown more than 1,000 hours on the Cessna 172 and around 60 hours in a mountainous region. He indicated that he had flown on a glider. He knew the area as this was the fourth time he

[4] This rating is only mandatory to obtain the authorisation to use mountain airstrips and mountain airfields. It is not required to fly in a mountainous environment. This rating was not therefore required for the flight between Gap, Mont-Dauphin and Barcelonnette.

had taken part in this cross-country flight. The previous year he had already flown over Col de Vars mountain pass following the same route, on a KATANA DA20-C1.

The 64-year-old front-seat passenger held a PPL(A) obtained in 1992. He had logged 684 flight hours, and approximately 27 hours in the previous three months. He did not hold a mountain rating but flew regularly in mountainous regions in Switzerland. He indicated that he flew the aeroplane to Mont-Dauphin from the left seat, guided by the instructor. He explained that the indications given by the instructor had troubled him as he advised him to fly close to the terrain to benefit from updrafts and on the right side of the valley which was in the shade whereas it had been stated in the briefing to use the slopes in the sun. The instructor had taken the controls and flown very close to the terrain to find updrafts but without success. After landing at Mont-Dauphin, he did not wish to continue piloting and left the controls to the instructor. This handover had not been planned when they took off from Gap-Tallard. He indicated that they encountered some strong turbulence at around 13:30 between Gap and Saint-Crépin but not during the flight towards the Col de Vars mountain pass.

The rear-seat passenger had logged two flight hours and had started her Light Aircraft Pilot Licence (LAPL) training in July 2021.

2.7 Statements

2.7.1 Occupants of SR20

The pilot indicated that the goal of the flight was to fly over the Col de Vars mountain pass and then Barcelonnette aerodrome before returning to land at Gap-Tallard aerodrome. He indicated that he took off after the other two aeroplanes in his group and lost sight of them after the take-off. Shortly before entering the valley, his attention was drawn to the presence of one of the two aeroplanes from his group on his right side. This aeroplane, lower than him, was climbing, and crossing his flight path heading towards the west slopes of the valley probably to benefit from the thermal lifts. To reduce the risk of collision, the pilot of the SR20 offset his flight path a little more to the centre of the valley so that the other pilot would have more of a possibility of seeing him. At this moment, the aeroplane encountered difficulties in gaining altitude. The pilot believed that carrying out a right-hand U-turn was too risky as this would bring him close to the east slopes situated on the other side of the valley and he was worried that there would be downdrafts due to the westerly wind. He explained that there was not enough height to use the airframe parachute. In the last moments of the flight, he looked for an option to carry out an emergency landing and saw a wooded area on his right. He thought that an attempted landing on tree tops was the only option left in view of the environment. The pilot added that he had carried out all of the flight with the flaps extended to the first detent position and had not changed their position during the flight.

The passenger stated that during the general briefing prior to take-off from Gap, they had been warned about the strong wind and turbulence in the valleys in the vicinity of Mont-Dauphin. He indicated that they had initially planned to return to Gap. However, once at Mont-Dauphin, the pilot changed his mind and decided to follow the other two aeroplanes in their group (an instructor being on board one of them) to Barcelonnette aerodrome. The passenger explained that before taking off, he had suggested circling after take-off to gain enough altitude, or to follow the least penalizing route in the valley. Around two minutes after the take-off, he advised the pilot to fly closer to the terrain and leave the centre of the valley to find updrafts. One minute later, just before entering the valley, he asked the pilot to perform a U-turn due to the terrain ahead of them. As the pilot did not react, the passenger envisaged taking the controls but did not do so. Very soon after

this, they encountered difficulties gaining altitude because of, according to him, the decreased performance of the aeroplane due to the air density, the altitude and the aerological conditions. He indicated that the pilot flew in the valley with the flaps extended to the first detent position, close to the stall speed. When they realised that they would not be able to cross the mountain pass, and at a height of 300 ft, he suggested to the pilot that he stay tight to the terrain on their left and prepare a right-hand turn in the middle of the valley. The passenger indicated that the pilot's only reaction was to say that he should not have flown in these conditions. The aeroplane flew over houses at a low height whilst the pilot tried to continue to climb. The pilot then turned to the right towards the terrain which appeared to have the shallowest slope. The pilot seemed very stressed and hesitated for several seconds before turning 90° to the right, then to the left. The passenger explained that there was not enough height to use the airframe parachute. He explained that the pilot then attempted to land in the trees. He remembered that the wind had been strong, especially after take-off. Lastly, he added that they had considered taking less fuel on board but that the gain in terms of rate of climb had not seemed to outweigh the gain in flying range.

2.7.2 Occupants of the Cessna 172

The pilot explained that he had planned to climb to 8,000 ft (2,440 m) to clear the mountain pass but that he observed after taking off, on heading towards the entrance to the valley, that the aeroplane would not climb - in his opinion - due to the wind. He explained that he entered the valley at low height and that the aeroplane was immediately subjected to downdrafts preventing it from gaining altitude. He thought he would be able to use the updrafts along the slope to gain altitude but observed that the aeroplane did not climb quickly enough. He had the impression that the aeroplane was descending. His concern was to keep the aeroplane flying and avoid being pushed to the ground. He added that it was then not possible to perform a U-turn and that he prepared to make an emergency landing. He fully reduced the speed to reduce the energy and consequences of the landing for the occupants. He remembered having landed at 50 mph with the flaps deliberately retracted as there was too much wind and he was worried about stalling.

The two passengers remembered having flown over an electrical power line pylon at a height of only a few dozen metres when they entered the valley.

The front-seat passenger stated that the pilot climbed in the valley at an indicated airspeed of around 80 mph (70 kt), which corresponds to the maximum rate-of-climb speed with the flaps retracted, and said that the tachometer showed 2,600 rpm. Observing that the aeroplane was not climbing quickly enough, he shared his concerns with the pilot, who told him not to worry and that they would climb. The front-seat passenger considered that the pilot, who was an instructor, knew what he was doing. He specified that during the briefing given in the morning before the flight, the organiser of the cross-country flight had recommended never entering a narrow valley at low height and to turn around before it was too late. He added that during the leg between Sion and Annemasse, when crossing the Alps, he was the pilot-in-command and he had managed to climb to an altitude of 13,800 ft.

The rear-seat passenger shared her serious concern with the other two occupants, given the proximity of the aeroplane to the terrain, and asked them to climb. She explained that the pilot did not warn the passengers of his intention of carrying out an emergency landing.

2.8 Navigating in a mountainous region[5]

2.8.1 Absence of natural horizon

The guide reminds pilots that the mountainous environment can make the management of flight paths difficult, particularly for pilots not used to this sort of environment. Indeed, a pilot's sensory perception is distorted due to the terrain and can result in unsuitable flying actions by an untrained pilot. As the horizon line is often not visible, this makes the notion of level flight difficult to perceive. When there is a mountain wall ahead, the pilot may unconsciously pull on the stick, often resulting in him following a path parallel to the ground, when flying over gently sloping terrain. With slopes generally being steeper than the aeroplane's rate of climb, the speed will gradually decrease without this being perceived straight away. Frequent checking of the vertical speed indicator and the airspeed indicator is therefore essential to detect changes to flight paths, in particular in the vertical profile.

2.8.2 Engine performance at altitude

According to the guide, air density[6] is the basic measurement to be used to assess the performance of an aeroplane at altitude. The guide specifies that a naturally-aspirated piston engine loses around 10% of its power per 3,000 ft of altitude gained. It recommends that pilots have in-depth knowledge of the performance of their aeroplane at the density altitudes at which they intend to fly, prior to entering the terrain.

2.8.3 Navigating in terrain

The guide states that in a light aeroplane, the power and the rate of climb are too low to rapidly fly over summits. The pilot must navigate by tracking geographical references, often near the terrain, in a sometimes hostile environment and with flight conditions that can change rapidly.

The guide specifies that the path must be continuously adapted so that a turn-around can be performed safely at any time. To ensure this, it is important to remember that the turn radius increases with altitude[7] (+20% at 6,000 ft and +40% at 11,000 ft). As a consequence, to benefit from all of the available space, it is important not to fly in the middle of the valley but to stay tight to the slope on the most favourable side depending on the aerological conditions on the day.

2.8.4 Flying over a mountain pass or a ridge

The guide also indicates that even if the pilot has not detected strong wind or severe turbulence during the flight, the mountain pass or ridge line must be cleared very carefully, always at an angle and with an altitude margin[8]. When the mountain pass is in sight, the en-route altitude is sufficient to clear it if the terrain in the background appears to rise behind the obstacle on approaching in level flight.

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[5] Excerpts from third edition of *Le vol en montagne expliqué au pilote*, published by Cépaduès.

[6] Ratio between the air density in the conditions considered and the density in standard conditions (1013 hPa and +15 °C).

[7] For the same indicated airspeed and bank.

[8] If the meteorological ceiling allows it, pilots are advised to allow an altitude margin of around 1,000 ft, or even more in strong wind conditions.

3 CONCLUSIONS

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

Scenario

During a cross-country flight in a mountainous region, the pilots followed a circular route out of Gap-Tallard, stopping at Mont-Dauphin Saint-Crépin aerodrome and then flying over Barcelonnette -Saint-Pons aerodrome via the Col de Vars mountain pass. The aeroplanes, in groups, were following each other on the route in the afternoon.

After the stop at Mont-Dauphin Saint-Crépin aerodrome, the pilots of the SR20 and the FR172 took off again at an interval of three hours and both entered the valley rising to the Col de Vars mountain pass at an insufficient height. The performance of both aeroplanes in view of their weight, the flight altitude and the weather conditions that day was not sufficient for clearing the pass given the height at which each of the two aeroplanes had entered the valley.

According to the pilot of the SR20, he moved towards the centre of the valley to put distance between him and another aeroplane which was lower than him. He then encountered difficulties in gaining altitude. The pilot realised at a late stage that he would not be able to clear the mountain pass. The passenger asked the pilot to carry out a right-hand U-turn several times; the latter did not react as he was concerned about getting close to the terrain and experiencing downdrafts near the east slope situated on the other side of the valley. When he realised that he would not be able to cross the Col de Vars pass, the pilot looked for a suitable site for an emergency landing. He identified a wooded area on his right which he believed to be his only option given the environment, and tried to land on the tree tops.

When the pilot of the Cessna 172 entered the valley, he thought that the aeroplane did not climb due to the downdraft effect. He then thought he would be able to use the updrafts along the slope to gain altitude but was surprised that the aeroplane did not climb quickly enough. When he realised that he had no other option for continuing the flight, he changed direction midway to the Col de Vars pass and then decided to abort the flight and land in a grass field that seemed suitable to him.

The investigation was not able to determine the reason why neither of the two pilots gained more altitude or performed a U-turn before entering the valley.

Factors contributing to the accident to the Cirrus SR20

The following factors may have contributed to the collision with vegetation during the emergency landing:

- insufficient flight preparation resulting in an underestimation of the decrease in the aeroplane's performance associated with the altitude, temperature and heavy weight;
- the small amount of mountain flying experience of the pilot and the passenger and their insufficient command of the specificities associated with this type of flight;
- a 'group effect' which may have influenced the decision of the pilot of the SR20 to follow the other aeroplanes, despite his small amount of experience in mountain flying.

Factors contributing to the accident to the Cessna FR172

The following factors may have contributed to the collision with the terrain during an emergency landing on the slope:

- insufficient flight preparation resulting in an underestimation of the decrease in the aeroplane's performance associated with the altitude, temperature and heavy weight;
- the pilot's overestimation of the effect of the updrafts in the valley to climb and clear the mountain pass;
- the small amount of recent mountain flying experience of the pilot.

Measures taken since accident

The organiser of the cross-country flight now proposes to participating pilots, a theoretical and practical training course of one week within its training organisation during which the specificities of mountain flight are addressed.

Safety lessons

Valley flying

Piloting aircraft in the mountains is complex, particularly because of the gradual disappearance of the natural horizon and the proximity of the terrain and natural obstacles. In these conditions, the decision to perform a U-turn may be made difficult for pilots not trained in mountain flight. In particular, if there is no or little recent experience, a pilot who does not regularly carry out this type of flight will lose his reflexes.

Although the regulations do not impose training for valley flying, pilots will nonetheless be exposed to a number of hazards if a mountain flight instructor has not made them aware of the specificities of flying in this environment.

In the mountains, aerological conditions are often wrongly seen as the main hazard, to the detriment of training. However, whilst aerological conditions can effectively be a contributing factor to an accident, they are often only a secondary factor. Awareness-raising flights performed with instructors who have the necessary skills for this type of flight would allow pilots to better understand the risks of flying in mountainous areas.

Two practical guides written for pilots, *Pilote de plaine et vol en montagne* and *Performances de montée & vol en montagne* were published in December 2021 and June 2022 by the French Aeronautical Federation (FFA). The purpose of these guides is to inform pilots of the main hazards of mountain flying.

In addition, the FFA also compiled a quiz entitled "PETITE VIRÉE EN MONTAGNE" that enables pilots to assess their knowledge and to exchange with their instructors before undertaking a mountain flight.

Organisation and management of cross-country flights by flying clubs

The organisers' precise prior assessment of the level of flying proficiency of every participant is essential as it enables any risks specific to the intended flights to be identified, in addition to any risks associated with a group excursion, in particular those linked to the 'group effect'. The taking into account of these risks might lead to the flight experience of the pilots being better taken into consideration, and to renouncement criteria being defined from the outset.

One of the topics identified in the reports published in 2021 pertaining to light aeroplane accidents and highlighted in the BEA review[9] was the 'group effect' during a club excursion. On 1 June 2021, the FFA published a guide (*Sorties club*) for flying club managers pertaining to safety within the context of group excursions, to help them to effectively manage this activity.

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

[9] Safety lessons – Light aeroplanes 2021.