BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
www.bea.aero
@BEA_Aero

INVESTIGATION REPORT

Accident to the PILATUS - PC6 - B2H4 registered F-GOCC

on 27 July 2018
at Bouloc (Tarn-et-Garonne)

Time	Around 10:15[1]
Operator	École de parachutisme de Midi-Pyrénées (Midi-Pyrénées Parachuting School)
Type of flight	Parachute drop
Persons on board	Pilot-in-command and ten parachutists
Consequences and damage	One parachutist fatally injured; left wing shroud and flap damaged

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in May 2020. As accurate as the translation may be, the original text in French is the work of reference.

[1] Unless otherwise stated, all times given in this report are in local time.

In-flight collision between a parachutist (wingsuiter) and the drop aeroplane, during descent

1 - HISTORY OF THE FLIGHT

Note: the following information is based mainly on statements, the onboard GNSS receiver, the parachutist's VIGIL system and the camera of a second parachutist.

The pilot of the PC6 took off at 10:00 from runway 28 at Bouloc private aerodrome for his fourth flight of the day, with ten parachutists onboard. He planned to drop one parachutist at 1,500 m and then the nine others at 4,000 m. His drop path was aligned with a heading of 240° and passed overhead runway 28. The first seven parachutists left the aircraft at a rate of about one every six seconds, while the last two, who were wearing wingsuits[2], had to jump last.

[2] Suit that significantly increases lift and flight performance.

The pilot indicated that he reduced his speed to about 65 kt when the aircraft was 1.3 NM south-west of the aerodrome. The pilot observed the jump of the first wingsuiter (WS1), but indicated that he quickly lost visual contact. He added that this was not unusual. After the second wingsuiter (WS2) exited the aircraft, the pilot immediately began his descent at a speed of 100 kt. He thought that he was deviating from the supposed path of the wingsuiters by taking a left turn. He estimated his vertical descent speed at that time to be between 3,500 and 4,500 ft/min. A few seconds later, he felt a violent impact and realised that he may have hit one of the wingsuiters.

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

A collision had occurred between the first wingsuiter and the left wing of the aeroplane a few seconds after he had exited the aircraft. The wingsuiter was fatally injured upon impact; his reserve parachute deployed and slowed his rate of descent to the ground.

An examination of the aircraft confirmed that the wingsuiter had collided with the left wing shroud and wing of the aircraft. The left flap had been damaged. This damage did not affect the rest of the flight and the pilot was able to land.

The second wingsuiter was equipped with an HD camera mounted on his helmet. It was filming and following the first wingsuiter at the time of the collision. The data stored on it provided useful information for the safety investigation.

2 - ADDITIONAL INFORMATION

2.1 Pilot and parachutist information

The 59-year-old pilot held a commercial pilot licence for aeroplanes with a class instructor rating and a Pilatus PC6 SET rating.

He was employed as chief pilot at the Midi-Pyrénées parachuting school.

On the day of the accident, he had logged 13,366 flight hours, including 7,560 hours on the Pilatus PC6.

He held a Class 1 medical certification with VDL[3] and OML[4] limitations. The pilot was the sole pilot flying F-GOCC.

Wingsuiter drops are a minor activity at the school: about 200 jumps per year.

The 40-year-old parachutist (WS1) held a C parachutist licence issued in 2016 and a Level 1, 2, 3 Wingsuit WS licence[5]. He had started parachuting in 2013 and had logged 379 jumps, including 226 in a wingsuit.

2.2 Meteorological information

The meteorological conditions in the vicinity of the accident site were as follows:

- surface wind: 140° to 200°, 5 kt;
- wind at 4,000m: 230°, 15 kt;
- CAVOK;
- ground temperature 22 °C, dew point temperature 17 °C;
- temperature at 4,000 m -2 °C, dew point temperature -9°C;
- QNH 1,013.

[3] Obligation to wear suitable corrective lenses in flight to correct distance vision: implies carrying a spare set of spectacles (and having them immediately within reach).

[4] Imposes multi-crew work: indicates that the presence at the controls of a second qualified pilot is mandatory. Applies only to Class 1 privileges.

[5] Respectively beginner, experienced and expert wingsuit flying levels.

2.3 Recordings

2.3.1 Path of Pilatus PC6

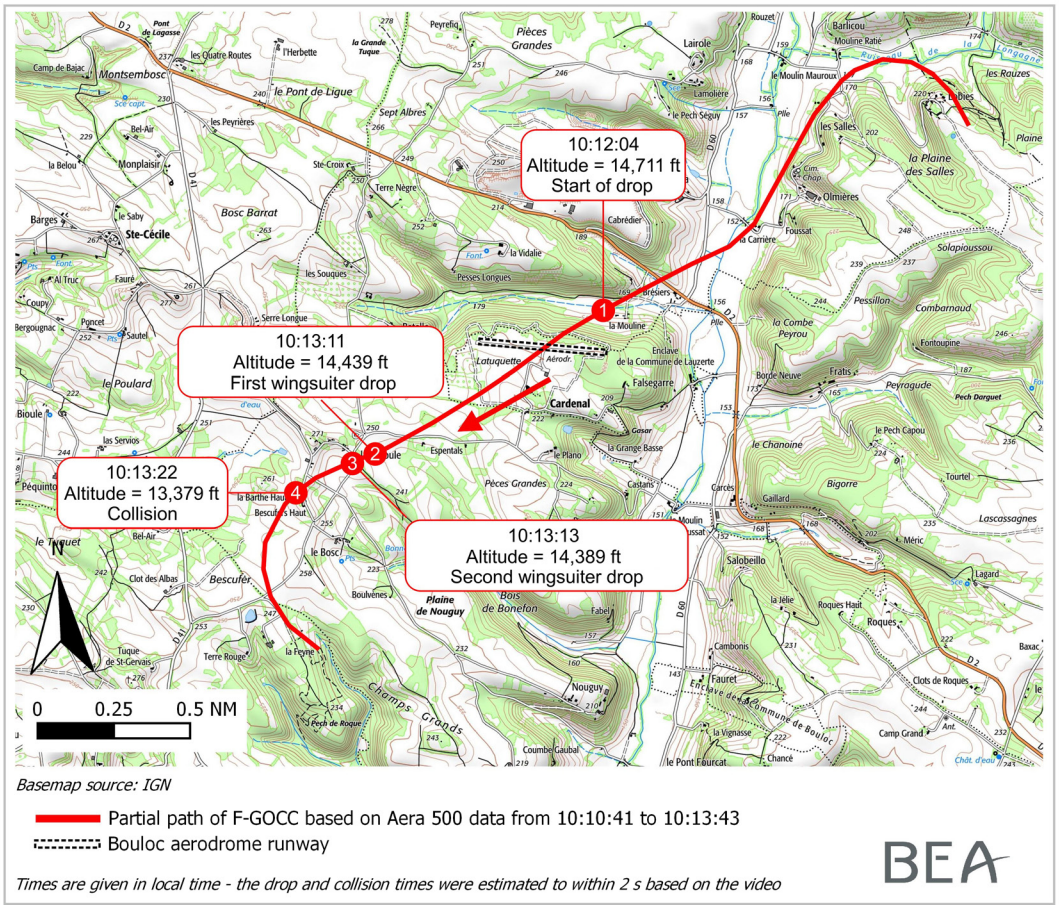

Figure 1: path

An analysis of the data on the GNSS receiver and WS2's camera confirmed that eleven seconds elapsed between WS1 exiting the aircraft and the collision. WS1 was dropped at about 14,400 ft and the collision occurred at about 13,400 ft. The gradient of the Pilatus's path increased significantly after dropping WS2 (two seconds after WS1). The path of the Pilatus was a straight-line descent between the last drop point and the collision with the wingsuiter. Its attitude was estimated to be about 50° for the first few seconds of the descent[(6)] and its average vertical speed was in excess of 5,800 ft/min between ❷and❹and 6,700 ft/min between ❸and❹. The pilot initiated a left turn after the collision, while still descending.

[(6)] Video recording.

2.4 Information on wingsuiting

2.4.1 Briefing

The second wingsuiter indicated that a «field» briefing had been conducted by the deputy technical director with the parachutists in the morning to give information about the specificities of the area, in particular the alternative landing areas if the aerodrome could not be reached, the special precautions in respect of the presence of power lines and the specificities of the landing. The wingsuit manoeuvre zones were not discussed, nor was the aircraft descent zone. The skydiving areas were not mentioned: however, those under canopy, in the event of a path that did not allow them to reach the aerodrome, were discussed.

No briefing between the pilot of the aircraft and the parachutists was conducted.

2.4.2 Path of the wingsuiters

- **Sortie d'avion**
  - Face moteur façon école ou façon saut de dérive : position « petit » face au vent (aile non déployée).
  - Dégagement latéral important de la porte car le risque de heurter le montant est réel (projection en wing suit moins importante qu'en lisse).
  - Déploiement progressif de l'aile : attention aux risques de collision avec le plan fixe (notamment sur certains avions, ex : Beech et Caravan) ou accrochage de l'aile sur le marche-pied.
  - Prise des grips ou non selon les souhaits : insister sur la non obligation d'avoir les grips en main dès la sortie.
  - Ordre : généralement Wingsuit en dernier, les moins expérimentés en wingsuit partent en 1er .
  - Définition des axes de vol. 2 groupes = un qui part d'un côté, l'autre à l'opposé.
  - Espacement : minimum 10 secondes entre chaque personne. Consigne : REGARDER où on se trouve, cela vous permettra de vous orienter et de définir votre axe de travail.

- **Déroulement du saut**

Axes de vol

  - Sortie face moteur et maintien de l'axe de largage pendant 20 secondes.
  - 90° pour se mettre perpendiculaire à l'axe de largage et s'en écarter suffisamment : voler pendant environ 20 secondes.
  - 90° pour revenir en direction de la zone de poser.
  - Vigilance permanente sur la position des autres parachutistes (tandem, élèves,...).

Figure 2: excerpt from the wingsuit induction document

The wingsuit induction document drawn up by the French Parachuting Federation (FFP) specifies that the path upon exiting the aircraft must be parallel to that of the aircraft for 20 s. WS1 complied with this instruction up until the collision.

As soon as they exit the aircraft, wingsuiters convert part of their vertical speed into horizontal speed. This phase lasts about fifteen seconds, during which the wingsuiter's lift-to-drag ratio increases from about 0.5 to 2.5. The lift-to-drag ratio then stabilizes between 2 and 2.5[7].

[7] For a category-3 suit, comparable to the one used by WS1, GNSS data, source: paralog https://www.paralog.net/ppc/

2.4.3 Compatibility of the Pilatus PC6 path and the wingsuiter path

The parachute drop is often made with the aircraft on a slight descent and with a negative attitude in order to increase the distance between the horizontal stabiliser and the parachutists. A Pilatus PC6's descent until the approach to the aerodrome is then usually performed at a high vertical speed (Vz) of between 3,500 and 5,500 ft/min. The Vz is the result of the parameter that determines the descent, namely the indicated airspeed. This equates to a slope in respect of the ground of approximately 20 to 30°.

By way of comparison, the slope of a wingsuiter in respect of the ground ranges from approximately 10° when he exits the aircraft, 35° after 15 seconds of descent and 20° in stabilized flight.

When the wingsuiter was in his acceleration phase, he had no possibility of detecting and, therefore, avoiding the Pilatus, which was arriving from behind and above him.

It was difficult, though not physically impossible, for the pilot to detect the wingsuiter.

The safety impact assessment conducted in 2016 by the FFP addresses only the risk of a collision between a parachutist under canopy and the drop plane or a skydiving parachutist and another aircraft. Given the developments to the equipment and performance of wingsuits, this assessment could well require updating to take account of the risk of a collision between a wingsuiter and the drop aircraft.

The FFP documentation does not include any recommended (lateral and vertical) path for the pilot of the aircraft to take account of parachuting disciplines[8]. The pilot usually adjusts his path to take account of environmental, ATC, meteorological and traffic constraints. The start of the post-drop descent is not subject to a specific procedure either.

[8] Parachute drop - Pilot adaptation course - edition 1 - August 2016.

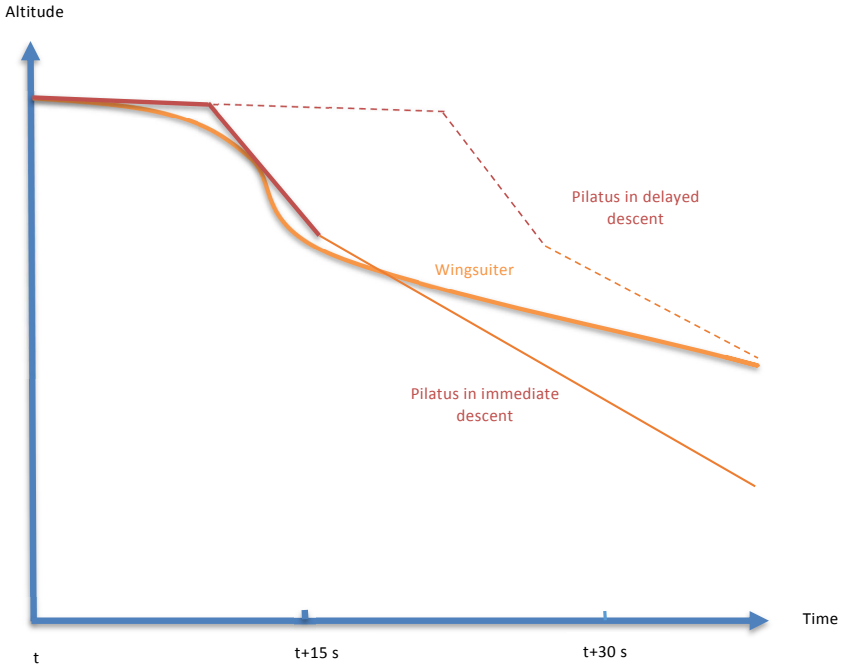

Figure 3: usual theoretical vertical descent profile for a Pilatus and a wingsuiter

The BEA was informed by some club officials that a descent delayed by a few seconds after dropping the wingsuiter allows for vertical paths to be separated if no lateral separation from the parachutists is specified.

3- CONCLUSIONS

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

Scenario

The pilot of the Pilatus PC6 was on his fourth flight of the day. He had ten parachutists onboard, including two wingsuiters, who left the plane last, at an altitude of about 4,400 m. During the descent, on a steep slope and in a straight line from the drop point, the plane passed a few metres in front of the second wingsuiter and hit the first wingsuiter. His reserve parachute instantly deployed upon impact. The parachutist, who was fatally injured, was found in a field near Bouloc aerodrome.

Contributing factors

The following factors may have contributed to the collision:

- lack of an onboard briefing between the parachutists, the wingsuiters and the pilot;
- the French Parachuting Federation (FFP) not identifying the risk presented by the coexistence of aircraft and wingsuiter paths immediately after exiting the aircraft;
- the immediate descent of the Pilatus, on a steep slope, commanded by the pilot even though he did not have visual contact with the wingsuiter(s).

Safety lessons

The accident investigation found that the collision between the wingsuiter and the Pilatus PC6 occurred on the first section of the path recommended in the FFP's wingsuit induction manual. Given the paths usually followed by Pilatus aircraft after the drop, which are determined by the activity (aircraft performance, descent time, runway circuit), it was established that the aircraft path and wingsuiter path were conflicting in the first few seconds after the drop.

Onboard briefings between the pilot and the wingsuiters should be systematic. They would serve to determine the intended actions of the different protagonists and would enable them to ensure vertical and lateral spacing, which would guarantee the segregation of their paths.

Measures taken by the FFP and the parachuting school

In July 2015, following a mid-air collision between tandem parachutists and the drop aircraft, the FFP issued an information bulletin to the technical directors of its affiliated structures ("*Flash info - sécurité aero*") notifying them of the risk presented by the coexistence of the paths of the aircraft and the parachutists and highlighting the importance of both parties communicating their intentions at a briefing.

In September 2018, the FFP published a new information bulletin addressed to technical directors and pilots of drop aircraft stating its intention to draft a technical directive with the aim of defining and separating the aircraft's descent space from the wingsuiter's manoeuvring space.

Pending finalisation of this document, this bulletin requests that the technical director and the pilot conduct a briefing with wingsuiters before any drop.

The Midi-Pyrénées parachuting school informed the BEA that it had amended its documentation and was applying these instructions and that it was asking its pilots to adjust their power to maintain level flight for 10 to 20 seconds after the wingsuiter drop to ensure sufficient longitudinal and vertical spacing.