Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

Air Transportation Safety Investigation Report A21O0006

LOSS OF CONTROL AND COLLISION WITH TERRAIN

Privately registered
Blackshape S.P.A. Prime BS100, C-GPOT
Ottawa/Carp Airport, Ontario
10 February 2021

History of the flight

On 10 February 2021 at approximately 1249,[1] a privately registered Blackshape S.P.A. Prime BS100 aircraft (registration C-GPOT, serial number BPU025) started conducting circuits on Runway 28 at Ottawa/Carp Airport (CYRP), Ontario, with only the pilot on board (Figure 1).

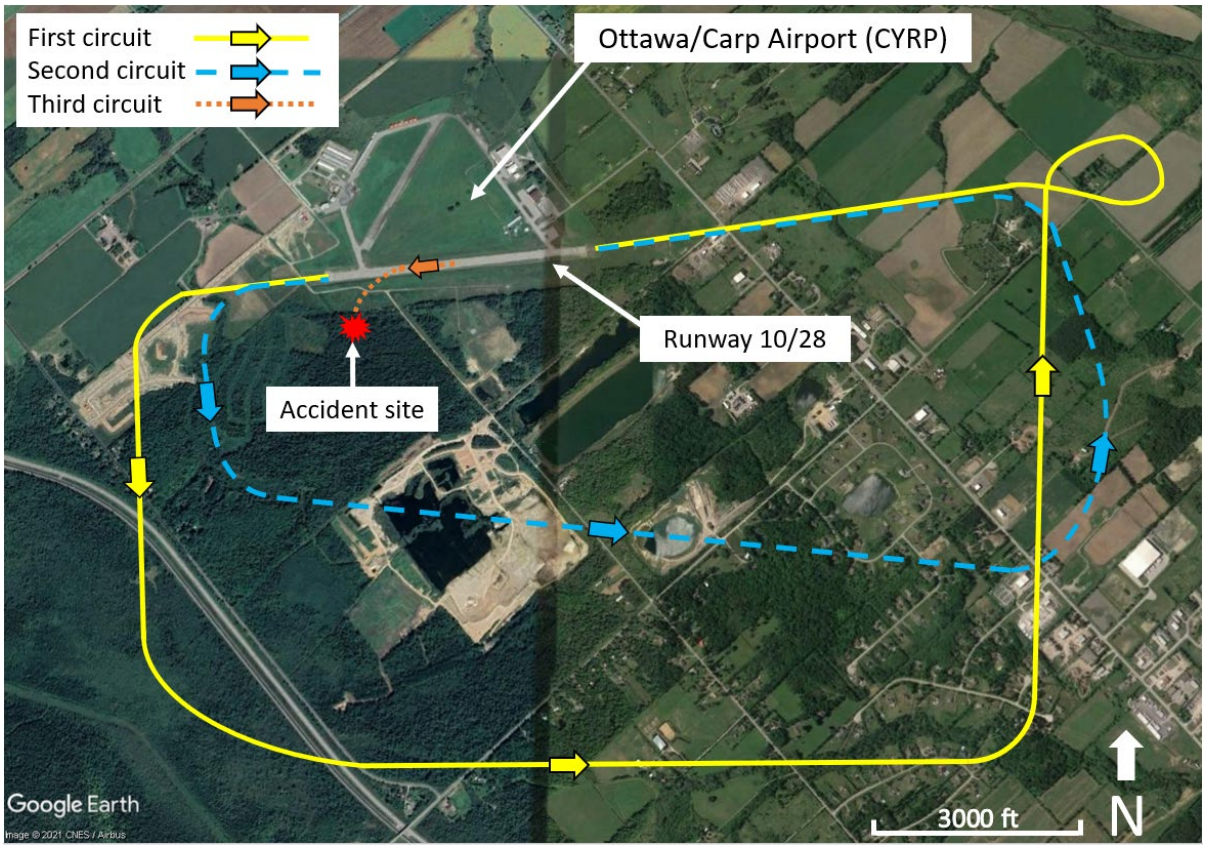
Figure 1. The occurrence aircraft (Source: N. Horn, with permission)

[1] All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

The first 2 circuits were both normal. After the touch-and-go following the 2nd circuit, the aircraft climbed straight ahead likely to conduct a 3rd circuit. Before the aircraft reached the departure end of Runway 28, the pilot initiated a left turn. At the same time, the pilot made a radio call on the CYRP aerodrome traffic frequency, reporting an unspecified engine issue.

At approximately 1300, when the aircraft was approximately 787 feet (240 m) south of the runway and still in the left turn, a loss of control occurred and the aircraft entered a near-vertical descent, impacting the ground in a wooded area (Figure 2). The exact altitude at which the loss of control occurred could not be determined; however, based on primary radar data supplied by NAV CANADA, it was determined that the loss of control happened at an altitude below 550 feet above ground level (AGL).

Figure 2. Map showing the occurrence aircraft's circuits and the accident site (Source: Google Earth, with TSB annotations)



The pilot was fatally injured. The aircraft was destroyed by a post-impact fire, and no signal was received from the 406 MHz emergency locator transmitter.

Aerodrome information

CYRP is located approximately 15 nautical miles west of Ottawa/Macdonald-Cartier International Airport (CYOW) and has an elevation of 384 feet above sea level.

CYRP has 2 runways. Runway 10/28, on which the occurrence aircraft was conducting circuits, is an asphalt runway that is 3936 feet long and 98 feet wide. Runway 04/22 is a gravel runway that measures 2205 feet long by 65 feet wide, and is not maintained in the winter months.

Weather information

The weather was suitable for the flight under visual flight rules. The hourly aerodrome routine meteorological report issued at 1300 for CYOW, the closest airport to the accident site, reported the winds from 290° true at 10 knots, gusting to 17 knots. Visibility was 15 statute miles. There were few clouds at 6000 feet AGL, with a temperature of −8 °C and a dew point of −18 °C. The altimeter setting was 30.29 inches of mercury.

Pilot information

The occurrence pilot held the appropriate licence for the flight in accordance with existing regulations. He held a commercial pilot licence — aeroplane, a pilot licence — glider, and a pilot permit — gyroplane. His medical certificate was valid. He had accumulated approximately 766 total flying hours; approximately 70 of those hours were on the Blackshape S.P.A. Prime aircraft type.

Aircraft information

The occurrence aircraft was a 2-seat tandem, low-wing aircraft made mostly from carbon fibre. It was equipped with a Rotax 912 ULS3 engine, a retractable landing gear, a bubble canopy and an optional ballistic parachute.

The occurrence aircraft was manufactured and received its flight test certificate in Italy in 2015, and was imported to Canada in 2019. It was 1 of 3 Blackshape S.P.A. Prime aircraft registered in Canada. The aircraft had accumulated approximately 65 hours of total air time before the occurrence and had been owned by the occurrence pilot since August 2019. A review of the aircraft technical records indicated that the last annual inspection was conducted in January 2021.

The maximum certified take-off weight for the aircraft was 620 kg, and at the time of the occurrence, its weight was estimated to be approximately 538 kg. An estimated weight and balance calculation was completed and it was determined that the aircraft was being operated within the weight and balance limitations at the time of the occurrence.

The aircraft was registered with Transport Canada and had been issued a Special Certificate of Airworthiness (C of A) – Limited. The Limited classification means that the aircraft model must meet specific eligibility criteria outlined in the *Canadian Aviation Regulations* (CARs) Standard 507, or those in an exemption to that standard.[2] Except where specifically stated in the operating limitations, aircraft issued any Special C of A, including one with a Limited classification, are subject to the same operational and maintenance regulations as aircraft with a normal C of A issued pursuant to section 507.02 of the CARs.[3]

Ballistic parachute

The aircraft was equipped with a Magnum 601 ballistic rescue parachute system made by Junkers. The system is designed to be used in the event of an in-flight emergency and can be activated by the pilot from inside the cockpit.

---

[2] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, Standard 507: Flight Authority and Certificate of Noise Compliance, subsection 507.03(5).

[3] Transport Canada, Advisory Circular (AC) 507-001: Special Certificate of Airworthiness – Limited (Issue 02: 30 June 2020), at https://tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-507-001 (last accessed on 25 August 2021).

When the pilot activates the system, it triggers a ballistic charge that launches the parachute, which is harnessed to 3 anchor points attached to the aircraft's structure. The system is designed to slow the aircraft's descent to the ground in an upright controlled manner.

The parachute and associated ballistic charge are mounted in a compartment forward of the cockpit canopy. The Blackshape S.P.A. Prime *Pilot's Operating Handbook and Airplane Flight Manual* explains the sequence for operating the system in the event of an airborne emergency.[4] The minimum altitude required to deploy the ballistic parachute is 80 metres or 262 feet AGL.[5]

The examination of the wreckage from this occurrence suggests that the emergency rescue system was not activated by the pilot.

Flight display and angle-of-attack indicator

The occurrence aircraft was equipped with a Dynon Skyview Classic electronic flight instrument system display, which provides the display of primary flight instruments with an angle of attack (AOA) indicator displayed on the same screen.

The AOA indicator provides a visual indication of the AOA and improves pilot awareness of the situation when the aircraft is approaching a critical AOA. Such systems provide continuous visual information on the stall margin, regardless of attitude, airspeed, or power, and can help pilots avoid an aerodynamic stall.

The AOA audio alarm can be configured either as a steady tone that sounds very near the critical AOA or, in the case of the occurrence aircraft, as a system-generated beeping tone that increases in frequency as the AOA becomes higher until, very close to the critical AOA, it turns into a solid tone.[6] Beyond this point, the aircraft will enter an aerodynamic stall if corrective action is not taken.

Stall speed

The Blackshape S.P.A. Prime *Pilot's Operating Handbook and Airplane Flight Manual* contains a performance section that includes a table (Table 1) indicating the calculated stall speed for the aircraft at 2 different weights: 500 kg and 620 kg. The table references 3 different flap configurations: level flight, a 30° bank angle, and a 60° bank angle.[7]

---

[4] Blackshape S.P.A. Prime, 1st Issue BPUFM620SL, *Pilot's Operating Handbook and Airplane Flight Manual* (31 August 2015), section 3.14: Opening the Emergency Parachute (if Installed), p. 3-27.

[5] Deutscher Ultraleichtflugverband e.V. [German Ultralight Flight Association registered association], Beauftragter des Bundesministeriums für Verkehr [Representative of the Federal Ministry of Transport], Data sheet no. R10/18-1, Magnum 601, Gerätekennblatt für Rettungsgeräte für Luftsportgeräte [Device data sheet for rescue equipment for air sports equipment], revised 17 September 2019, at https://www.junkers-profly.de/Junkers-Magnum-601-Softpack-UL-Rettungssystem-bis-760-Kg::195.html#horizontalTab3 (last accessed 25 August 2021).

[6] Dynon Avionics, at https://dynonavionics.com/aoa-pitot-probes.php (last accessed 25 August 2021).

[7] Blackshape S.P.A. Prime, 1st Issue BPUFM620SL, *Pilot's Operating Handbook and Airplane Flight Manual* (31 August 2015), section 5.5: Stall Speed, p. 5-4.

Table 1. Stall speeds at different weights and flap configurations for the Blackshape S.P.A. Prime BS100 (Source: TSB table based on Blackshape S.P.A., Pilot's Operating Handbook and Airplane Flight Manual, Table 5-1: Stall Speeds)

Aircraft weight	Flap configurations	0° bank angle (level flight)		30° bank angle		60° bank angle	
		KCAS*	km/h	KCAS	km/h	KCAS	km/h
620 kg	Flaps up	50	93	54	100	71	131
	Flaps takeoff (10°)	48	89	52	96	68	126
	Flaps down (30°)	45	83	48	90	64	118
500 kg	Flaps up	46	85	49	91	65	120
	Flaps takeoff (10°)	44	81	47	87	62	115
	Flaps down (30°)	41	76	44	82	58	108

* KCAS: knots calibrated airspeed

Wreckage information and flight profile

The occurrence happened after the 2nd touch-and-go, during the departure for the 3rd circuit while the pilot was making a left turn. The aircraft entered a near-vertical descent and collided with the ground at the base of a stand of large trees.

The maximum angle of bank during the left turn could not be determined; however, the approximate airspeed at the time of the loss of control was calculated to be 45 knots indicated airspeed (±5 knots) based on analysis of a video recording from a nearby security camera. The calculated descent rate was between approximately 4000 and 6000 fpm at the time at which the aircraft struck the ground. The wreckage was examined to the extent possible, given that the aircraft had been almost entirely consumed by fire.

Due to the level of damage to the occurrence aircraft, the investigation was unable to determine the flap position at the time of the occurrence. As well, a flight control continuity check could not be performed due to the level of damage. However, no problem had been reported with the flight control system. The landing gear was in the down position at the time of the occurrence.

The Emergency Procedures section of the *Pilot's Operating Handbook and Airplane Flight Manual* lists 65 knots calibrated airspeed as the speed to be kept during an emergency procedure for an engine failure after takeoff with the flaps in the take-off position.[8]

Engine and propeller examination

The Rotax 912 ULS3 engine sustained significant damage from both the collision with terrain and the post-impact fire. It was disassembled and examined to the extent possible at the TSB Engineering Laboratory in Ottawa, Ontario.

The engine examination did not find any mechanical failures of the crankshaft, pistons, valves, gearbox, or any other major engine components. There were no signs of catastrophic engine failure.

[8] Ibid., section 3.3: Speed to be Kept During an Emergency Procedure, p. 3-3.

Damage to the propeller indicated the propeller was rotating at impact; however, it could not be determined how much engine power was being produced.

The investigation was unable to assess the integrity of the associated engine components such as the fuel and ignition systems due to the extent of heat damage. The reason for pilot's reported engine issue could not be determined.

Aerodynamic stall during a turn

An aerodynamic stall occurs when the wing's AOA exceeds the critical angle at which the airflow begins to separate from the wing. When a wing stalls, the airflow breaks away from the upper surface, and the amount of lift generated is reduced to below that needed to support the aircraft.

The speed at which a stall occurs is related to the load factor of the manoeuvre being performed. The load factor is defined as the ratio of the aerodynamic load acting on the wings to its gross weight, and represents a measure of the stress (or load) on the structure of the aircraft. By convention, the load factor is expressed in *g*.[9]

In straight and level flight, lift is equal to weight, and the load factor is 1*g*. In a banked level turn, however, greater lift is required. It can be achieved, in part, by increasing the AOA (by pulling back on the stick/elevator control), which increases the load factor. As the load factor increases with bank angle, there is a corresponding increase in the speed at which the stall occurs. As a result, steep turns are often accomplished with the addition of engine power to maintain or increase airspeed. A stall that occurs at a higher speed as a result of a high load factor, such as bank angle increased beyond 30°, is called an accelerated stall.

Accelerated stalls are usually more severe than unaccelerated stalls and are often unexpected. As an example, a stall from a steep bank angle (greater than 30°) can result in one wing stalling before the other, leading to a spin and the aircraft rapidly losing altitude.

Turning back following engine failure

In this occurrence, an examination of the departure flight paths flown during the previous circuits and the last departure, combined with the fact that the landing gear had been left in the extended position, suggest that the pilot may have attempted to turn back to the runway after reporting an unspecified engine issue shortly after becoming airborne.

If a mechanical problem occurs during takeoff that necessitates an immediate landing, pilots are faced with either attempting to carry out a forced landing in an unsuitable location—risking damage to the aircraft and injury to themselves—or attempting a 180° turn back toward the departure point.

Transport Canada's *Flight Training Manual* states the following:

> Numerous fatal accidents have resulted from attempting to turn back and land on the runway or aerodrome following an engine failure after take-off. As altitude is at a premium, the tendency is to try to hold the nose of the aircraft up during the turn without consideration for airspeed and load

[9] *g* is a unit of measurement of the force resulting from vertical acceleration due to gravity. An acceleration of 1*g* is 9.8 m/s^2.

factor. These actions may induce an abrupt spin entry. Experience and careful consideration of the following factors are essential to making a safe decision to execute a return to the aerodrome:

1. Altitude.
2. The glide ratio of the aircraft.
3. The length of the runway.
4. Wind strength/ground speed.
5. Experience of the pilot.
6. Pilot currency on type.

Should you have only partial power, it may be possible to complete a circuit and execute an emergency landing.[10]

Safety message

In this occurrence, the pilot reported an unspecified engine issue shortly after becoming airborne and conducted a low-altitude left turn. Numerous fatal accidents have occurred involving pilots attempting to turn back to the runway or aerodrome following an engine failure after takeoff. Given the aircraft's low altitude and low airspeed during the initial climb, turn-back manoeuvres during this phase of flight involve a high level of risk and often lead to a loss of control and collision with terrain.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 25 August 2021. It was officially released on 09 September 2021.

[10] Transport Canada, TP1102E, *Aeroplane Flight Training Manual*, 4th Edition (revised August 2004), Exercise 22: Forced Landing, p. 128.

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 4 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

TERMS OF USE

Use in legal, disciplinary or other proceedings

The *Canadian Transportation Accident Investigation and Safety Board Act* states the following:

- 7(3) No finding of the Board shall be construed as assigning fault or determining civil or criminal liability.
- 7(4) The findings of the Board are not binding on the parties to any legal, disciplinary or other proceedings.

Therefore, the TSB's investigations and the resulting reports are not created for use in the context of legal, disciplinary or other proceedings.

Notify the TSB in writing if this report is being used or might be used in such proceedings.

Non-commercial reproduction

Unless otherwise specified, you may reproduce this investigation report in whole or in part for non-commercial purposes, and in any format, without charge or further permission, provided you do the following:

- Exercise due diligence in ensuring the accuracy of the materials reproduced.
- Indicate the complete title of the materials reproduced and name the Transportation Safety Board of Canada as the author.
- Indicate that the reproduction is a copy of the version available at [URL where original document is available].

Commercial reproduction

Unless otherwise specified, you may not reproduce this investigation report, in whole or in part, for the purposes of commercial redistribution without prior written permission from the TSB.

Materials under the copyright of another party

Some of the content in this investigation report (notably images on which a source other than the TSB is named) is subject to the copyright of another party and is protected under the *Copyright Act* and international agreements. For information concerning copyright ownership and restrictions, please contact the TSB.

Citation

Transportation Safety Board of Canada, *Air Transportation Safety Investigation Report* A21O0006 (released 09 September 2021).

Transportation Safety Board of Canada
200 Promenade du Portage, 4th floor
Gatineau QC K1A 1K8
819-994-3741; 1-800-387-3557
www.tsb.gc.ca
communications@tsb.gc.ca

Air transportation safety investigation report A21O0006

Cat. No. TU3-10/21-0006E-PDF
ISBN: 978-0-660-40177-5

This report is available on the website of the Transportation Safety Board of Canada at www.tsb.gc.ca

Le présent rapport est également disponible en français.