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Swiss Transportation Safety Investigation Board STSB

Aviation Division

Final Report no. 2210 by the Swiss Transportation Safety Investigation Board STSB

concerning the accident involving the Cessna 172 aircraft, registration HB-CPL

on 26 April 2013

1.2 km north-west of Bex aerodrome (LSGB) / VD

Aéropôle 1, 1530 Payerne
Tel. +41 58 466 33 00, Fax +41 58 466 33 01
info@sust.admin.ch
www.stsb.admin.ch

Cause

L’accident est dû à une collision avec une ligne à haute tension suite à une tentative de remise des gaz consécutive à un atterrissage manqué.

General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Article 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident/incident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the French language.

All information contained in this report, unless otherwise stated, refer to the moment of the accident.

All times in this report, unless otherwise indicated, follow the coordinated universal time (UTC) format. At the time of the accident, Central European Summer Time (CEST) applied as local time (LT) in Switzerland. The relation between LT, CEST and UTC is:
LT = CET = UTC + 2 hours.

Final Report

Aircraft type	Cessna 172	Registration HB-CPL	
Operator	Private		
Owner	Private		

Pilot	Swiss citizen, born 1950			
Licence	Private pilot licence aeroplane - PPL (A) according to the European Aviation Safety Agency (EASA), first issued by the Federal Office of Civil Aviation (FOCA) on 12 July 2012			
Rating class	Single-engine piston – SEP (land) valid till 31 July 2014			
Medical certificate	Class 2 with VML restriction (shall wear multifocal lenses), issued on 13 November 2012, valid till 13 November 2013			
Flying hours	**total**	139:48 hours	**in the last 90 days**	6:49 hours
	on the type involved	35:51 hours	**in the last 90 days**	6:49 hours

Location	1.2 km north-west of Bex aerodrome (LSGB), municipality of Bex / VD		
Coordinates	564 644 / 123 689 (Swiss Grid 1903) N 46° 15' 49.3" / E 006° 58' 48.2" (WGS 84)	**Elevation**	429 m AMSL 1407 ft AMSL
Date and time	26 April 2013, 17:31		

Type of flight	Daytime VFR, private
Flight phase	Go-around
Type of accident	Collision with a high-voltage power line

Injuries to persons	None
Damage to aircraft	Destroyed
Other damage	Two conductors of a high-voltage power line severed, several trees damaged

1 General information

1.1 History of the flight

1.1.1 General

The information contained in this report is based on the statements of the pilot and eye-witness.

1.1.2 The accident flight

On 26 April 2013, in the late afternoon, the pilot made his way to Bex aerodrome (LSGB) to fly a circuit pattern on board his Cessna 172 aircraft, registration HB-CPL. His objective was to develop his control of the airspeed on final approach.

He carried out the external checks, without refuelling the aircraft. Start-up, taxiing and pre-flight checks were carried out normally.

At approximately 17:25, the pilot, who was flying solo, took off from runway 33. He performed the manipulations required after take-off and when heading towards the town of Aigle began the climb to an altitude of 2800 ft. Then he turned left in order to join the downwind leg of the aerodrome's runway 33 circuit and descended to the prescribed altitude of 2200 ft. On his final approach, the pilot fully extended the flaps and set the propeller control to a low pitch. He noted that his approach speed was too high but decided to continue the landing manoeuvre.

The aircraft first made contact with the grass runway with its nose wheel. It rebounded and contacted the ground a second time in the bowl-shaped part of runway 33. The pilot then decided to go around and increased power. According to his statement the engine was: '*a bit slow to pick up*'. Two-thirds of the way along the runway the aircraft lifted off and the pilot did not retract the flaps. He flew over the last third of the runway at a height of approximately thirty metres, at low speed, gaining only very little altitude.

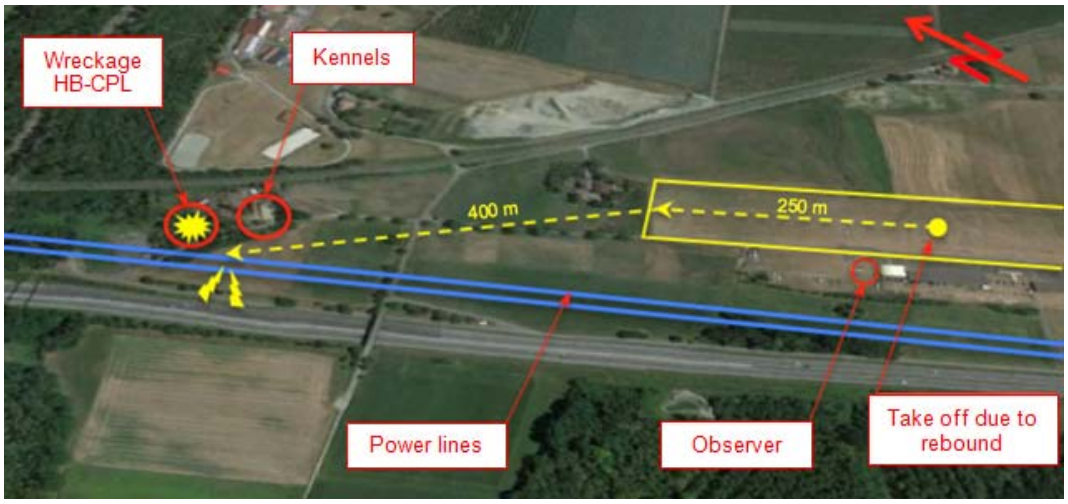

Fig. 1: Overall view

The pilot turned slightly to the left in order to clear the lowest wooded area at the end of the runway (Fig. 3). A few seconds later, he heard the stall warning, pushed on the stick and saw before him a high-voltage power line running parallel to the runway. The aircraft travelled approximately 650 m from the point where the go-around was initiated and was positioned close to the kennels situated in the small forest located along the extension of the runway.

The underside of the left wing made contact with the upper cable of the high-voltage power line. This earth conductor cable is equipped with orange marker spheres. The aircraft banked to the right and the propeller touched the no. 1 phase conductor. The latter is on the north-east side of the line, 3.7 m below the earth conductor (Fig. 7). Electrical arcing ensued, damaging the no. 1 phase conductor, the propeller and the underside of the left wing. A few fractions of a second later the circuit breakers cut the current. The no. 1 phase conductor, which was damaged, severed and in a whiplash effect wound itself around the right leg of the landing gear. This decelerated the aircraft, which rotated in a clockwise direction around the yaw axis. The conductor severed again and the aircraft fell into the trees below, severing the no. 2 phase conductor in passing, located 4 m below the no. 1 conductor. Large branches were broken, cushioning the fall of the aircraft, which impacted the ground with a negative attitude. The nose gear leg broke and folded under the fuselage (Fig. 4).

The pilot, who was uninjured, set the main electrical switch and the magneto switch to off. He released his lap belt and removed his radio headset. Since the left door of the cockpit was jammed, he vacated the wreckage by the right-hand door. He then made his way to the main building of the kennels where he met a person who greeted him a few minutes before the arrival of the emergency services.

An eye-witness positioned at the edge of the runway immediately raised the alarm by telephone. The aircraft was destroyed, though fire did not break out.

1.1.3 Eye-witness

The flight instructor at the edge of the runway (Fig. 1) observed the go-around and made the following statements:

- a striking lack of power, engine speed estimated at 1800 rpm
- the flaps remained in the landing configuration
- the aircraft was flying very slowly and hardly climbing at all

1.2 Meteorological information

1.2.1 General situation

Switzerland was at the forefront of a low pressure corridor extending from Scandinavia to the Bay of Biscay.

1.2.2 Weather at the time of the accident

A cloudy zone approximately 400 km wide extended from northern Spain to the North Sea. Foehn winds from the south were blowing within the Alpine arc, partially dissipating the cloud cover in the lower Valais and over Lake Geneva. Along the Pennine Alps, there was a local low-pressure area due to the Foehn wind. This caused a wind from the north-west close to the ground in the Chablais, whereas the wind was blowing from the southern sector on the surrounding peaks. In the Bex region, the wind at high altitude was heterogeneous, with shear.

Cloud	1/8 stratocumulus, base at 4700 ft/AAL 5/8 altocumulus, base at 9000 ft/AAL
Visibility	25 km
Wind	330° / 6 kt, gusting to 12 kt
Temperature / dew point	18 / 12°C
Atmospheric pressure	QNH 1010 hPa

1.2.3 Astronomical information

Position of the sun	Azimuth: 258°	Elevation: 30°
Lighting conditions	Daylight	

1.2.4 Eye-witness information

A flight instructor, who was at the side of the runway and who had flown just before the accident, estimated the wind on the ground at 330° / 5-8 kt, with no particular phenomena.

The pilot also stated: “the environment was calm”.

1.3 Aircraft information

Registration	HB-CPL
Aircraft type	Cessna 172
Characteristics	Single engine four-seater, high-wing, metal construction with fixed tricycle undercarriage.
Manufacturer	Cessna Aircraft Co., Wichita, USA
Year of construction	1956
Area of use	VFR day and night
Emergency beacon	ELT 406 AF-COMPACT Kannad. It was activated on impact.
Engine	Manufacturer: Franklin Engine Company Inc., Syracuse, USA Characteristics: six-cylinder piston engine, boxer type, air cooled, with a maximum power of 180 HP (134 kW)
Propeller	Manufacturer: Mc Cauley Propeller Inc, USA. Characteristics: two-blade, metal, variable pitch
Fuel	The fuel used was AVGAS 100LL. 60 l were recovered from the wreck.
Mass and centre of gravity	Basic empty mass: 1598 lb Maximum take-off mass: 2200 lb Estimated mass at the time of the accident: 1900 lb At the time of the accident, the mass and centre of gravity were within the prescribed limits.
Equipment	Standard VFR Wing tips of type Madras Air Service 'Super tips', improving performance at low speed, STC[1] SA2075WE.
Maintenance	Last 100-hour check carried out on 12 March 2013 at 3587:12 hours TSN[2].

[1] STC - Supplement type certificate

[2] TSN – Time since new

1.4 Features of the throttle control and engine response

The throttle could be operated in two ways. One was to slowly vary the power by screwing or unscrewing the control. The other required pressing the central button and keeping it pressed down (Fig. 2). This disabled the screw mechanism, allowing faster conventional linear adjustment. The travel of the central button was 8 mm. A relaxation of 3 to 4 mm from the "down" position re-activated the screw system and caused the linear movement to stop.

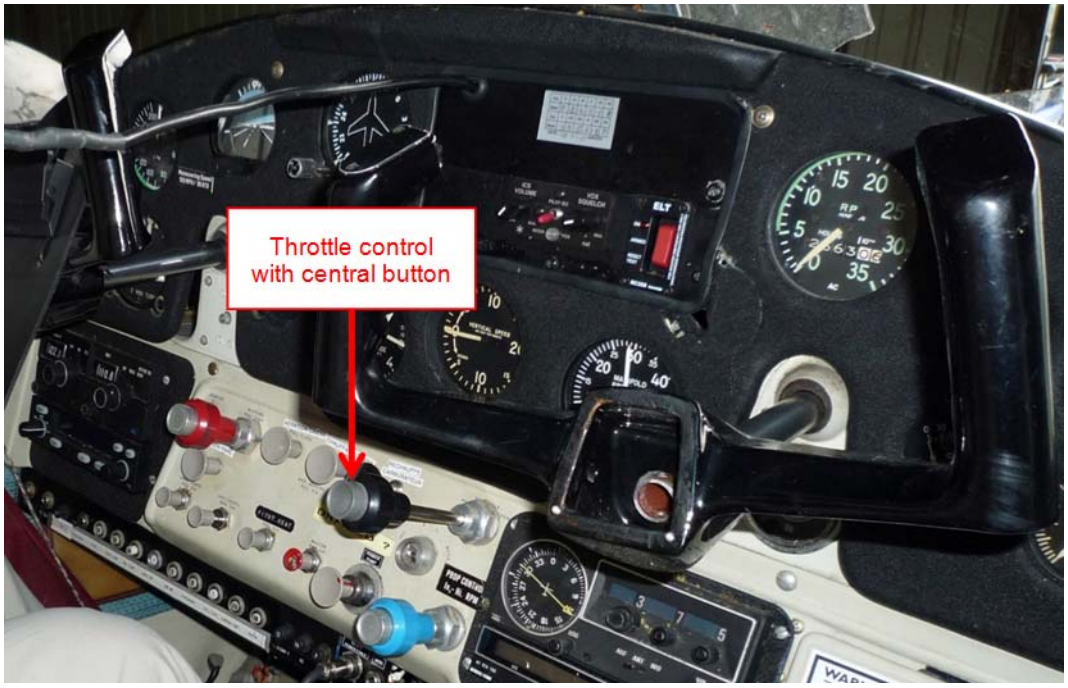

Fig. 2: Instrument panel of HB-CPL

The pilot, his instructor and a former user of HB-CPL all confirmed a peculiarity of the "Franklin" engine fitted to this aircraft:

During a rapid increase in power from idle, the engine tended not to increase speed or to operate irregularly. This phenomenon required stopping the linear movement, or even reducing power, before advancing the control again, more slowly, until the engine reached approximately 1400 rpm; above which the throttle response was not subject to any delay.

1.5 Information on the site of the accident

The accident occurred in a small forest, close to the motorway and situated on the runway 33 extended centreline. It housed kennels consisting of several buildings and was crossed by two high-voltage power lines. These power lines ran parallel to the runway centreline and were located approximately 150 m to the side of it. The terrain between the runway and the forest was flat and partially wooded. The first trees and the house located after the end of the runway constituted obstacles during take-off. To the left of the runway centreline was an area where the tops of the trees were lower.

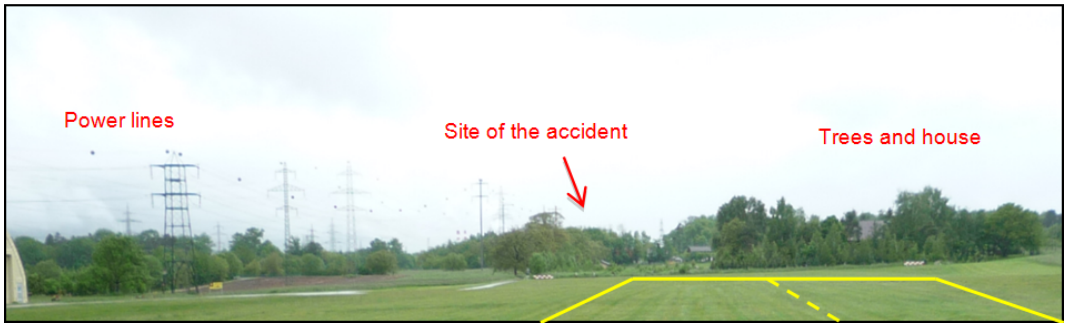

Fig. 3: View from two thirds along runway 33

1.6 Wreckage and impact information

The fuselage, which suffered little damage, was pointing east. The nose gear was broken and folded under the fuselage. The wings were badly damaged by large branches.

Fig. 4: Position of the wreckage

The underside of the left wing had several puncture holes due to electrical arcing. They were located approximately 1 m away from the left fuel tank. A segment of the no. 1 phase conductor of the power line was wrapped around the right leg of the landing gear.

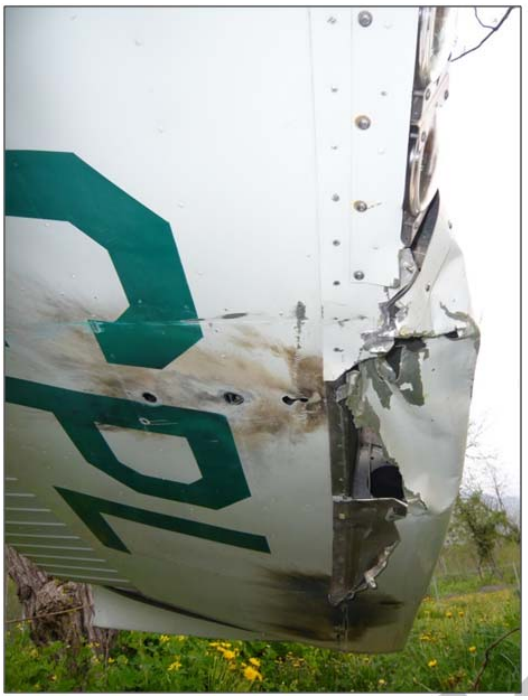

Fig. 5: Puncture holes in the underside of the left wing

Fig. 6: Right landing gear with segment of electrical conductor

A visual examination of the flight controls was carried out. Despite extensive damage, no pre-existing fault was found.

The traces of impacts and deformations on the blades of the propeller indicate that the engine was delivering power at the time of the collision with the power line.

The controls and important switches were found in the following positions:

- throttle control — approximately halfway
- propeller control — low pitch
- mixture control — rich
- carburettor heating control — cold
- fuel selector — open both
- rudder trim — neutral
- flaps lever — 3rd notch (30°)
- master switch — off
- magnetos switch — off

Note: the flap lever was located between the two front seats. The change of position involved pressing a button located at the end of it. The lever protruded between the two seats when the flaps were fully extended.

1.7 Information on the power line

1.7.1 Conductors and pylons

The line damaged in the accident was a 132 kV high-voltage line. It consisted of four phase conductors supported by insulators, an earth conductor fitted with orange marker spheres and an auxiliary coaxial cable. In the section of damaged line, the conductors were supported by two reinforced concrete pylons approximately 30 m high and 227 m apart. One of the pylons was positioned in the forest where the accident occurred (Fig. 7); the other was near the end of runway 33.

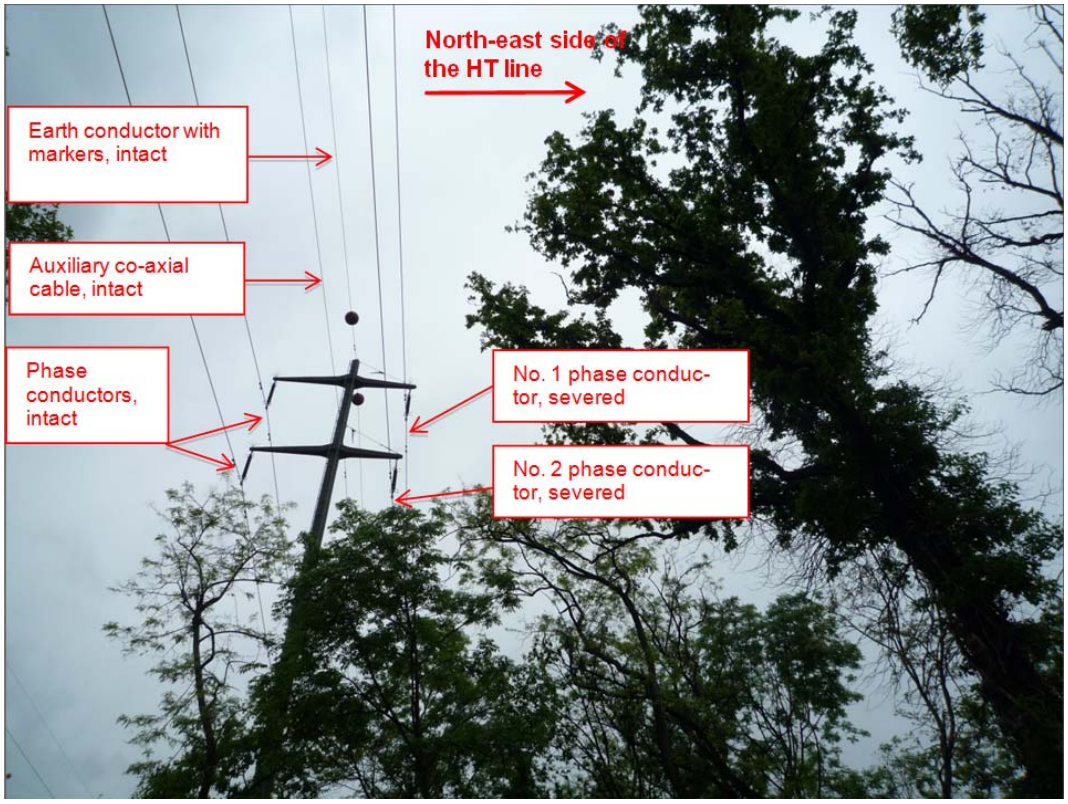

Fig. 7: Pylon and cables after repair. View from the position of the wreckage.

The data obtained from the repair company made it possible to establish that the phase no. 1 and no. 2 conductors were severed approximately 60 m before the pylon located in the forest and at height of 21 m and 17 m respectively. These Aldrey conductors[3] have a cross-sectional area of 550 mm^2 and a tensile strength of 162 kN. The reinforced concrete supports of the insulators were damaged.

1.7.2 Circuit breaker

A circuit breaker is a protective device for electrical lines. In the event of excessive current, it breaks the circuit and attempts to re-establish it approximately 300 ms later. If the excessive current persists, it is again broken.

The monitoring records indicate that, at the time of the accident, two circuit breakers operated 30 ms apart. The break in the current enabled the time of the accident to be established as 17:31.

[3] Aldrey is an alloy of aluminium (99%), magnesium (0.5%) and silicon (0.5%).

1.8 Training of the pilot

1.8.1 Basic training

The pilot began his practical training as a private pilot on 10 December 2010 and completed it on 12 July 2012. Apart from an evaluation flight, he carried out all of his basic training with the same instructor.

The training lasted 101 hours with 382 landings, including 14 hours and 31 solo landings. The practical training was interrupted for a few months for the benefit of theoretical instruction. The instructor felt that the main learning difficulty had been irregular progress with a partial loss of the knowledge acquired from one lesson to the next.

The two-seater training aircraft used was a Robin HR20. It was equipped with dual controls with control sticks and two throttles, one located on the left of the dashboard and the other in the middle. Maximum power was obtained by fully depressing one of the levers, and deceleration by pulling it fully out. The pilot usually held the control stick in his right hand and the throttle in his left.

1.8.2 Training on HB-CPL

During his basic training on the Robin HR20, the pilot became the owner of aircraft HB-CPL. Following his request to continue training in his own aircraft, the instructor judged it more appropriate to refuse this. In this respect, he stated: "...I didn't want to confuse things and have to begin again to learn the acquired knowledge." He also pointed out that integration of HB-CPL into the fleet of the Bex powered flying school was not desired. However, the pilot did fly on HB-CPL before completing his training on the Robin HR20. He was seated in the right front seat and accompanied by a pilot qualified on the aircraft. These flights enabled him to acquire a degree of familiarity with the various procedures and manipulations.

HB-CPL was equipped with a variable-pitch propeller. This involved a process of familiarisation with the Cessna 172 and training using the variable-pitch (VP) propeller variant. To achieve this the pilot turned to the instructor who had provided him with his basic training. This training on HB-CPL began on 20 July 2012. It was carried out over two days, including flights to several aerodromes. Several go-around exercises were performed, emphasizing the significant feature of the engine response when power was increased. The single throttle located in the centre of the dashboard required steering with the left hand and manipulating the throttle with the right hand. The particular feature of the throttle is explained in Section 1.4. The instructor noted that the pilot was already well acquainted with the manipulations of the aircraft before this training. The end of the Cessna 172 familiarisation and the training on the VP variant were attested on 26 July 2012 after 5:05 hours and 13 landings.

1.9 Tests and research

1.9.1 Propeller

The two blades were separated from the pitch regulation system with the ball bearings moving freely inside the hub.

Traces of melting due to a short-circuit were visible at the end of one of the blades.

1.9.2 Examination of the ignition system

The two magnetos were examined and tested on a test bench. The results are as follows:

- The left magneto was defective up to 400 rpm due to a malfunction of the ratchet system used for start-up. From 400 rpm up to 3500 rpm it functioned normally.
- The right magneto functioned normally from 0 to 3500 rpm.
- On both magnetos, the adjustment of the contact breakers was not optimal but was within the prescribed tolerances. The contact surfaces of the contact breakers were damaged due to a malfunction of the capacitors.

The defects observed affected the start-up of the engine but not its power.

All the spark plugs were tested. They functioned correctly. Their wear was 10 to 20% and their colour indicated a slightly rich mixture.

1.9.3 Carburettor

The carburettor was disassembled and examined. Special attention was paid to the recirculation pump arrangement allowing direct injection of fuel during rapid throttle movement. The carburettor was functioning correctly. Only a slightly rich adjustment of the carburation and a small calibration error in the high position of the float were found. However, this did not affect the power or engine response during a go-around.

No defects were found on the link between the throttle and the carburettor.

1.10 Flight manual

Aircraft HB-CPL was manufactured and delivered in 1956. Sections I to III of the Cessna 172 flight manual (Owner's Manual) refer to a "Continental" brand engine, with different engine controls from those fitted to HB-CPL. Furthermore, it does not mention any specific procedure in the case of a go-around. The classic technique consists of gradually bringing the flaps back to the take-off position, 1st notch or retracted, while adjusting the trim and the climb speed. This method was used during the training on HB-CPL.

The "Franklin" engine, with different engine controls, was installed in 1967. In Section IV, Engine Instruments Markings, the flight manual refers to the "Franklin" engine manual, the Operating Engine Handbook. The latter includes a recommendation referring to applying changes to power in a gradual and measured manner.

2 Analysis

2.1 Technical aspects

The investigation did not reveal any factor which might have caused or contributed to the accident. The peculiarities of the throttle control and the response of the engine were known to the pilot.

2.2 Operational and human aspects

The excessively fast approach, the landing on the nose wheel followed by a rebound and the proximity to the end of the runway put the pilot in a high-stress situation. The go-around required the application of full power and a gradual retraction of the flaps. The instructor located at the side of the runway noticed a striking lack of power, without any particular engine noises, as well as the non-retraction of the flaps. He also observed that the aircraft was not climbing and was flying slowly at an estimated height of 30 m. This low height and the proximity of the trees at the end of runway took all the attention of the pilot, who turned left to avoid them.

The aircraft travelled approximately 400 m in level flight before contacting with the power line. This flight profile indicates that the engine was delivering some power, but it was insufficient to allow a stabilised climb. Considering the mass and temperature at the time of the accident, the aircraft should have gained altitude if full power had been selected, even with the flaps fully extended. This situation corresponds to a secondary flight phase with a power reserve that was not used.

The throttle was found to be set at approximately the half-way position. The manipulation of this control, which was central and equipped with a screw, represented a significant change from the Robin HR20 aircraft which had been used for the pilot's basic training.

During the go-around, it is likely that the pilot released the central button before reaching the full power position, causing premature locking of the control. The fact that the pilot did not realise this halfway position or discern the lack of power can also be explained by a state of intense stress.

The pilot and the eye-witness located at the side of the runway stated that the full flaps position (4th notch, 40°) was set during the go-around. The flap lever was found in the 3rd notch (30°). It protrudes between the two front seats and was probably knocked by the pilot when he vacated the wreckage.

2.3 Survival aspects

The pilot was restrained only by a lap belt. The high-voltage line, the risk of fire and the height of the fall represented factors which were likely to cause serious injury or death. Several large branches helped to cushion the fall and the impact with the ground, and this enabled the pilot to escape unscathed.

3 Conclusions

3.1 Findings

3.1.1 History of the flight

- The aircraft came onto its final approach at an excessive speed.
- The plane landed on the nose wheel, bounced and touched down again.
- The pilot initiated a go-around at the two-thirds point along runway 33 and did not retract the flaps.
- At low speed, with the flaps fully extended, the aircraft maintained a height of approximately 30 m over a distance of approximately 400 m.
- Approximately 650 m after the go-around was initiated the aircraft struck a 132 kV power line.
- The aircraft crashed into the forest situated along the runway 33 extended centreline.

3.1.2 Technical aspects

- The investigation did not reveal any defect which might have caused or contributed to the accident.

3.1.3 Operational and human aspects

- The pilot had completed his basic training on a Robin HR20.
- During his basic training on the Robin HR20, the pilot became the owner of aircraft HB-CPL.
- The flight controls and engine of HB-CPL were different from those of the Robin HR20.
- The throttle had a screw adjustment system unlocked by depressing the central button.
- The throttle was found set at approximately the half-way position.
- The mass and centre of gravity were within the prescribed limits.
- There are no indications of the pilot involved suffering any health problems during the flight involved in the accident.

3.1.4 General conditions

- The meteorological conditions did not influence the accident.

3.2 Cause

The accident is attributable to a collision with a high-voltage cable following an attempted go-around following a balked landing.

Payerne, 30 March 2015 Investigation Bureau STSB

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

Berne, 31 March 2015