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REPORT
ACCIDENT

Fuel starvation while managing a landing gear extension failure, forced landing in a field

Aircraft	Twin-engine Piper PA30 «Twin Comanche» aeroplane registered G-SURG with Lycoming IO-320 160 HP engines
Date and time	19 May 2015 at 17 h 45[1]
Operator	Private
Place	Bergerac (France)
Type of flight	General aviation
Persons on board	Pilot and four passengers
Consequences and damage	One passenger slightly injured, aeroplane severely damaged

[1]Except where otherwise stated, times in this report are local French time (UTC + 2h).

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.

1 - HISTORY OF FLIGHT

The pilot, owner of the aeroplane, was making a flight from Turweston (United Kingdom), where the aeroplane was based, to Bergerac. The passenger in the right front seat was the future owner of the aeroplane, accompanied by his family, seated at the rear. The pilot and the passengers communicated with each other in English.

The pilot explained that he took off at 12 h 00 UTC with the two main tanks full of fuel and the two auxiliary tanks each containing about 20 litres. The planned length of the flight was 3 h 10 min. Cruise level was FL105.

On arrival at Bergerac, runway 28 was active. When the pilot selected landing gear extension, this had no effect. The passenger then took over communications with the controller, in French. He informed him of the problem and asked to overfly the runway. The controller cleared him to do this and tried to check the position of the landing gear. After the flyover, at 17 h 10, he stated that the landing gear was retracted.

For about 35 minutes, the occupants tried to extend the landing gear, first using the standard procedure, then with the emergency procedure described in the flight manual. During this time, the pilot focused his attention on the flight path and the speed[2] while the front seat passenger tried to extend the landing gear and took care of communications with the controller. They were flying near the aerodrome and made some flyovers during which the controller, an aerodrome mechanic and some firemen tried to help determine the position of the landing gear. At 17 h 30, the various observations indicated that the nose wheel did not seem to be correctly locked down. The passenger said that they had a lot of fuel and that they hoped to be able to solve the problem. The controller told them that they had « *as much time as necessary* » and that they were alone in the CTR. At 17 h 42, the passenger indicated their intention to land on the grass runway to limit the damage.

[2]The flight manual states that the emergency extension of the landing gear must be performed at an indicated airspeed below 100 mph.

At 17 h 45, the aeroplane overflew the aerodrome towards the west. The observers confirmed that the nose landing gear leg was not correctly locked down, the latter moving slightly when the passenger moved the emergency gear extension lever.

The pilot stated that during this overflight, the left engine lost power. The height and the speed were low. The passenger called out that he was taking over control. In the emergency the pilot accepted, presuming that the passenger was more experienced.

The passenger stated that the aeroplane yawed to the left, which he countered by pushing the right rudder pedal. He did not feather the propeller, afraid that he would make a mistake with the engine. He selected the auxiliary fuel tank to fuel the left engine. The fuel pumps on both engines were operating from the start of the approach. At that moment the aeroplane was flying towards the south at a height of about 800 ft. The passenger had to keep the aeroplane in descent to maintain speed. He chose to make a turn 270° to the right, in order to reach the final for unpaved runway 10. During the turn, the aeroplane continued its descent. The passenger noticed a relatively open area in front of him and preferred to try to make a forced landing rather than risk losing control following the turn. He flared above a cultivated field and positioned the two fuel flow levers on idle-cut-off. The aeroplane touched the ground, slid for a few dozen metres, striking some trees in an orchard in which it came to rest.

The pilot stated that he placed the two fuel selectors on CLOSED, placed the two magneto selectors, as well as all the electrical switches, on OFF. The occupants evacuated the aircraft.

2 - ADDITIONAL INFORMATION

2.1 Personnel information

The pilot, aged 68, had held a valid private pilot's licence (PPL) since 1985, along with an MEP rating and a restricted instrument flight rating (IRR). He had held a commercial pilot's licence (CPL) from 2001 to 2014 and an instrument type rating without limitations. On the day of the accident, he had a total of about 860 flying hours, of which 670 as captain. His experience on light twin-engine aircraft (almost all on PA30) was 660 flying hours, of which 570 as captain. The majority of these flights were performed in the daytime in VFR. The pilot stated that he wanted to get a professional licence and an instrument flight rating in order to acquire greater skills than those that he needed for his usual flights, for safety reasons.

The pilot stated that he had undertaken a flight with his instructor a few days before the accident that included engine failure exercises. Previously, he had flown with the passenger in the context of the sale of the aeroplane.

The pilot had renewed his MEP rating in September 2014 on G-SURG. He didn't fly until 22 April 2015, on which date he made a flight with the passenger for the sale of the aeroplane. He stated that he then made a flight with his instructor, a few days before the accident, which included some engine failure exercises.

The passenger, aged 47, is a commercial pilot for an American airline. He said that he had a total of about 13,500 flying hours, of which more than 2,500 hours on piston or turbine twin-engines. Before the flight accident, he had flown for two hours on PA30 including one on G-SURG with the pilot, and one on another PA30 in the course of which the owner of the aeroplane had to make an emergency extension of the landing gear after an unsuccessful attempt to extend it normally. He had not made any recent flights with an instructor on a light twin-engine.

2.2 Aircraft information

G-SURG is equipped with four fuel tanks located in the wings:

- two main tanks with a capacity of 30 USG (113 litres) with a usable quantity of 27 USG (102 litres);
- two auxiliary tanks with a capacity of 15 USG (56 litres).

In a normal situation, the right main tank supplies the right engine and the left main tank the left. Each engine can also be supplied by the auxiliary fuel tank located on its side. The flight manual states that this possibility is limited to level flight only. For each engine, a selector makes it possible to select the tank that supplies it. Each selector includes four positions: OFF, AUX, MAIN or CROSSFEED (supply from opposing tanks, in case of flight with only one engine).

Two fuel quantity indicators, located at the right-hand end of the instrument panel indicate the quantity remaining in the two selected tanks. The aeroplane is not equipped with a warning light to indicate low fuel level.

The aeroplane is equipped with a double fuel flow indicator that shows the adjustment references for cruise of between 6.2 and 10 USG / h (23 l/h and 37 l/h) per engine according to the power percentage required.

The mechanism to extend and retract the landing gear is activated by an electric motor, commanded by a switch. Correct extension in the extended landing gear position is shown by a single green warning light located close to the switch. The system is protected electrically by two circuit breakers (GEAR SOL and GEAR MOTOR).

An emergency extension procedure, described in the flight manual, makes it possible to counter any electrical malfunction. It includes four steps:

- reduce the speed to below 100 mph;
- place the electrical landing gear extension switch in the extended position (GEAR DOWN LOCKED);
- disconnect the electric motor using the red control located between the two pilot seats;
- place the emergency lever in the appropriate place and activate it until the green light appears.

These instructions are repeated in a simplified manner in the condensed documentation used by the pilot.

The flight manual adds that reducing power and shaking the lever helps with manual extension of the landing gear.

The flight manual contains a procedure named *«feathering procedure»*. The first actions include increasing power on the engine that is running, then, for the failed engine, reducing the power and placing the feathering switch on *«feather»*.

2.3 Wreckage information

Observations showed that:

- ❒ neither engine was providing power on impact;
- ❒ the two main tanks were empty. The auxiliary tanks still contained fuel, 30 to 35 litres, split equally between the two tanks;
- ❒ in the cabin, the left fuel selector was in an intermediate position between the AUX position and the CLOSED position. The right selector was in the CLOSED position;
- ❒ the flaps were extended. Their setting was not measured precisely;
- ❒ the main landing gear was broken off towards the aft, showing that it was extended on impact;
- ❒ the nose landing gear was broken at the shock absorber, indicating that was at least partially extended. The nose landing gear mechanism and its surrounding area were damaged on impact;
- ❒ in the cabin, the landing gear control switch was on DOWN. The emergency landing gear extension lever was engaged and the electrical system cutoff was in the cutoff position.

The investigation did not try to determine the reasons for the landing gear not locking down.

2.4 Testimony

The pilot explained that he usually estimated typical consumption of 6.5 gal GB / h (that's to say 29.5 l/h) per engine, which translates as main tank endurance of a little under 4 hours[3]. For long flights, he generally used the auxiliary tanks during cruise, and the fuel quantity indicators to evaluate the remaining fuel.

[3] The calculation leads to 3 h 30 endurance for the quantity said to be *«usable»* and 3 h 50 for the total quantity.

He added that on the day of the accident, the passenger had said that he would prefer to stay on the main tanks, which the pilot had accepted, their endurance being greater than the planned flight time. As the total quantity of fuel on board was much higher than the quantity required, precise fuel management was not a priority for this flight.

The pilot stated that the use of the French language between the passenger and the controller meant that he did not understand the messages exchanged.

The passenger explained that while dealing with the failure, he checked the circuit breakers. None of them had tripped. He explained that they tried to use the mirror located on the inside of the left engine fairing to determine the position of the landing gear, without success. The flat rather than rounded shape of the mirror may have limited the observable field. He added that his attention was also drawn to the flight path to help the pilot, in addition to communications with the controller and his attempts with the landing gear extension lever. The workload was high. The female passenger seated at the rear helped by consulting the flight manual. When the left engine lost power, he proposed to take over the controls, thinking that the pilot was in difficulty.

He explained that he didn't dare feather the propeller, fearing that he might make a mistake on the choice of engine, while the low height and speed would not allow any possible error to be recovered. He referred to a recent public transport accident where the crew made a similar error[4].

[4] Flight TransAsia 235, 4 February 2015, Taipei (Taiwan), ATR72 registered B-22816.

3 - LESSONS LEARNED AND CONCLUSION

3.1 Managing an anomaly

The testimony and the radio exchanges indicate that the occupants were not sufficiently aware of the exact quantities of fuel that they had to manage the failure while the flight time was reaching the endurance limit for the main tanks (the aeroplane had been flying for about 3 h 45 at the time of the loss of power).

This accident illustrates the importance of evaluating the conditions for dealing with a non-urgent anomaly, before starting to deal with the anomaly itself. This evaluation can extend, for example, to the meteorological conditions, identification of the holding area, the fuel or the assistance of other actors.

Awareness of the quantity of fuel remaining depends on regular updating by the pilot, using the flight time and fuel quantity indicators noted in the flight log, for example. When this updating mechanism is made impractical by sloppy practices, or by the management of other priorities, a «low fuel level» warning light can stimulate awareness. In the context of the accident, this barrier was not available.

3.2 Loss of power

The left engine lost power due to fuel starvation. The low height meant that there was likely insufficient time for the fuel circuit to be re-primed after selection of the auxiliary fuel tank, which contained some fuel. Feathering of the left engine was not carried out. The windmilling propeller then generated drag that added to that from the flaps and the landing gear. In this configuration, the majority of light twin-engine aeroplanes cannot be kept in level flight. Feathering would have made it possible to reduce the rate of descent.

This part of the event illustrates the importance of the technique to identify the engine with no power based on maintaining flight symmetry (dead foot, engine dead during request for power) and the need to apply the actions proposed in a quasi-reflex manner. Added to fatigue and stress that the end of this flight caused and to the risk of mis-identifying the engine, the absence of recent training for the situation on this type of aeroplane for the passenger did not favour carrying out this action.

However, it is not possible to state that feathering would have avoided the accident. In fact, the absence of fuel in the right tank indicates that the right engine was on the point of losing power as well. It cannot be ruled out that it lost power while the aeroplane was descending.

3.3 Teamwork

Task-sharing between the two pilots is formalised for most public transport aircraft. The passenger, a commercial pilot, was familiar with that kind of teamwork. It was apparently natural for him to intervene in the management of anomalies, especially as this aeroplane was going to belong to him. On the other hand, this situation was likely new for the pilot. The passenger's status as a commercial pilot and his overall experience may have led the pilot to suppose that the passenger was more likely to be able to manage the situation and to let him progressively take over all the tasks.

The need to organise the task-sharing, in an improvised way, probably consumed resources. This task-sharing seems to have been initially effective since it enabled them to manage the immediate workload (piloting, communications, and emergency gear extension). It did not however enable them to detect the fresh priority that came with the fall in the quantity of fuel.

3.4 Causes

The accident resulted from a combination of the following factors:

- a probable technical anomaly in the normal and emergency devices for extending the landing gear, not determined by the investigation;
- improvised task-sharing that made it possible to absorb the immediate workload but did not include appropriate fuel management;
- the absence of a *«low fuel level»* warning system.

The accident also brought to light inadequate application of emergency actions planned in case of an engine failure, without however being able to state that they would have avoided it.

The decision to abandon trying to reach the aerodrome and to make a forced landing likely reduced the seriousness of the consequences of the accident.

This accident can be put into perspective by the accident that occurred on 28 December 1978 to the DC8 registered N8082U in Portland (Oregon, USA)[5]: confronted with an anomaly during landing gear extension, the three crew members put the aeroplane into hold south of the aerodrome to deal with the failure and allow the cabin crew to prepare the cabin for an unusual landing. After one hour, the aeroplane crashed, short of fuel. The NTSB report mentions contributing factors linked to teamwork and to attention being focused on the anomaly and preparation of the landing. With other accidents that happened around the same time, this led to the setting up of Crew Resource Management methods.

[5] Details are available on the FAA's *«Lessons Learned»* website: http://lessonslearned.faa.gov/ll_main.cfm?TabID=1&LLID=42. The complete NTSB report is accessible at: http://www.ntsb.gov/investigations/AccidentReports/Reports/AAR7907.pdf