Aviation Safety Investigation Report 199600827

Cessna Aircraft Company Super Skymaster

13 March 1996

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Occurrence Number:	199600827	**Occurrence Type:**	Accident
Location:	45km E Albany		
State:	WA	**Inv Category:**	3
Date:	Wednesday 13 March 1996		
Time:	0920 hours	**Time Zone**	WST
Highest Injury Level:	Fatal		

Injuries:

	Fatal	Serious	Minor	None	Total
Crew	1	0	0	0	1
Ground	0	0	0	0	0
Passenger	3	0	0	0	3
Total	**4**	**0**	**0**	**0**	**4**

Aircraft Manufacturer:	Cessna Aircraft Company		
Aircraft Model:	337C		
Aircraft Registration:	VH-FAM	**Serial Number:**	3370797
Type of Operation:	Charter Passenger		
Damage to Aircraft:	Destroyed		
Departure Point:	Albany WA		
Departure Time:	0901 WST		
Destination:	Albany WA		

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Commercial	1122.0	11216

Approved for Release: Tuesday, January 14, 1997

Synopsis

This report outlines the circumstances surrounding a fatal accident involving a Cessna 337 aircraft near Albany, in Western Australia on 13 March 1996. The aircraft crashed during a low-level inspection of a bay on the coastline to the east of Albany.

The accident occurred after the pilot lost control of the aircraft at low level. Loss of control was precipitated by a loss of power on both engines whilst the aircraft was being flown in a maximum-performance turn.

Loss of power on the rear engine was the result of fuel starvation, probably caused by un-porting of the fuel supply line during prolonged unbalanced flight. The reason for loss of power on the front engine could not be determined although it is possible that the pilot inadvertently selected the front engine to off whilst attempting to change the fuel selection on the rear engine from the main to the auxiliary fuel tank.

History of the flight

Witness evidence indicates the aircraft and pilot were hired so the passengers, Federal and State officers, could complete an aerial inspection of some unidentified drums located in a small bay 45 km east of Albany. An attempt to reach the drums on foot had failed because of dense undergrowth.

The pilot's post-flight report form shows the flight departed Albany Airport at 0901. Passengers' watches indicate the accident occurred between 0920 and 0925. There were no witnesses to the route flown or the accident.

The aircraft was reported missing at 1500 and the wreckage was located at 1615, on the edge of the bay containing the drums.

Pilot information

The pilot held a current commercial pilot licence with a Cessna 337 type rating. He was approved to conduct low-level operations. He was experienced in low-level operations, having worked as an agricultural and whale-spotting pilot for many years. He should also have been familiar with the coastline in the area of the crash, having operated in the area as a whale spotter.

The pilot held a Class 1 medical certificate. Post-mortem examination did not disclose any medical condition that may have been a factor in the accident.

Aircraft information

Cessna 337C VH-FAM was manufactured in the USA in 1968 and placed on the Australian register on 16 October 1968. The aircraft had completed 5,390 hours time in service. The rear engine, Serial Number IO-360-C-10344, had completed 393 hours of its 1,500-hour service life. The front engine, Serial Number IO-360-C-10014, had completed 1,726 hours of its 1,800-hour service life. The additional 300 hours available on the front engine were the result of earlier maintenance which extended the service life of that engine. An inspection of the aircraft's logbooks revealed that it had been maintained in accordance with the manufacturer's and regulatory requirements. A valid maintenance release was in force and no unserviceable items were recorded prior to the final flight.

The Cessna 337 is a twin-engine aircraft with the engines located fore and aft on the main fuselage. The rear engine is reported by the manufacturer to be the critical engine. Single-engine performance is less with only the front engine operating rather than the rear. In addition, the front engine is positioned below the total thrust line and the rear engine above it. Any loss of power in the rear engine will result in a nose-up pitching moment.

The estimated weight of the aircraft at the time of the accident was 1,927 kg. Maximum allowable weight was 1,996 kg. The pilot and one passenger were seated in the front row. The other two passengers were seated in each of the other two rows. The centre of gravity was within the defined envelope.

Meteorological information

The surface wind at 0900 at Albany was recorded as coming from 080 degrees at 16-18 kts. Meteorological advice indicates that the terrain around the crash site is conducive to the formation of small-scale eddies or rotors which cause turbulence. The pilot of the search helicopter reported that, 7 hours after the crash, conditions in the bay at low level were very turbulent. Wind conditions appeared to be significantly affected by the surrounding terrain. It was reported that the average wind conditions tended to push any aircraft operating in the bay towards the hills around the bay.

Communications

A review of the air traffic service recording tapes indicates that no radio transmissions from the pilot were recorded before or during the flight. There was no requirement for the pilot to contact an air traffic service agency.

Wreckage and impact information

On-site inspection

It was apparent from aircraft and foliage damage that the aircraft impacted at a nose-down angle of approximately 60 degrees with the wings level. The left wingtip contacted the ground first, because of the slope of the terrain, followed by the lower, forward fuselage. Damage to the cockpit/cabin area was extensive. The fuselage section, aft of the wings, exhibited only moderate damage. The wreckage remained upright and mostly intact after the impact. There was no wreckage trail.

The direction of the impact indicated that the aircraft was flying towards the north, following the coastline in the bay, when it crashed.

The front engine was torn from the fuselage and suffered considerable impact damage to the crankcase, cylinders and accessories. Engine oil was found on the ground under the engine. The rear engine suffered minor damage only, although the engine mounts fractured on impact.

The front propeller drive shaft fractured during the crash. Whilst both blades on the front propeller and one blade on the rear propeller were bent, neither propeller exhibited damage consistent with being under power at impact.

The landing gear was retracted.

The position of the flap motor worm drive indicated the flaps were extended to half travel.

All control surfaces were present and all systems appeared to be working correctly prior to the accident. All damage was consistent with being caused by the impact.

Both wings were destroyed. The main fuel tanks, two in each wing, were split at the seams and exhibited severe distortion caused by the movement of fuel. The auxiliary fuel tanks, one in each wing, were intact although each had been breached. They also exhibited severe distortion caused by the movement of fuel. The distortion made it possible to determine that the main tanks were almost full and the auxiliary tanks half full, at impact. The right auxiliary was the only wing tank still containing fuel (3 L) at the time of the inspection. All other wing fuel had drained from the damaged areas. Both fuel sumps, one in each tail boom, were intact and undamaged. Only the left sump contained fuel.

The fuel lines running from the main and auxiliary tanks to their respective engine fuel filters were intact (right tanks to the rear engine and left tanks to the front engine). The fuel supply line from the filter to the rear engine was intact. The line on the front engine had been severed although fuel in the line was trapped by crimping adjacent to the fracture and the angle at which the wreckage was lying. No pre-existing blockages were found in the fuel system.

Approximately 50 mL of fuel was removed from the fuel supply line, filter and engine-driven fuel pump for the rear engine. This amount is representative of residual unuseable fuel. The right fuel sump was empty although beach-marks indicated that it contained approximately 1.25 L of fuel at impact. Approximately 250 mL of fuel was recovered from the lines and filter for the front engine, the amount expected from a fully charged system. The left fuel sump contained 1.3 L of fuel and beach-marks indicated that it had been full at the time of impact. No water was evident in any of the fuel recovered. The fuel colour and smell indicated it was 100/130 avgas. The difference in the amount of observed fuel and fuel at the time of the crash was probably the result of evaporation. The on-site wreckage inspection took place 5 weeks after the crash (due to the unavailability of a suitable winching helicopter). Both fuel sumps were open to the atmosphere as a result of main tank damage and were lying at an angle which placed open lines above the fuel. The amount of evaporation was about the same for each sump.

Despite the damage to the main fuel tanks, the wreckage situation was such that it was possible for fuel to pool in the leading edge of the inboard left main tank following the accident. This fuel could have recharged the left fuel supply lines after the crash, leading to the fuel found during the post-crash investigation. A similar situation did not exist on the right side of the wreckage.

Although the cockpit/cabin area was destroyed, the engine control panel was recovered intact. The throttles, propellers and mixture levers were found set at a cruise power setting. There was evidence they had been locked in their pre-crash position by the impact. The ignition and battery switches were on and the auxiliary fuel pump switches were off. The flap selector was set to just below the first detent. This corresponded with the position of the flap motor drive shaft.

The fuel selector panel indicated that the front engine was selected to the left main tank and the rear engine to the right auxiliary tank. The left fuel selector valve was also set to the left main tank: the cable was intact and exhibited little damage. The fact that the selected position corresponded with the valve position and that cable stretch was minimal indicates that the control position was probably the selected position. The right selector valve was set between the main tank and off positions. The cable was severely stretched and kinked. The centre wire had been pulled from a clamp on the actuating arm at the fuel selector panel. Stretching of the right fuel selector cable could move the selector valve from the auxiliary position, through the main tank and towards the off position. There was some restriction to movement of the right selector valve.

Propeller examination

The fractured drive shaft from the front propeller was examined in detail. No evidence was found in either the mode of failure (bending) or in the nitride coating on the shaft, to indicate the propeller was under any power at impact.

The rear propeller was still attached to the engine. There was no evidence of any rotational damage on the blades. There was some evidence that the rear of the spinner had rubbed against the engine cowl during the crash. The rub marks were minor, indicating that, whilst the propeller was rotating, it was not under power. The rear propeller was lying across one tail boom following the crash. There were no strike marks on the boom.

Engine examination

The engines were examined at an engine overhaul facility. The inspection indicated that both engines should have been capable of normal operation prior to the crash. No faults were found with the engine's electrical and fuel systems.

Aircraft fuel system

Fuel contents

The aircraft was refuelled to full main tanks 1 month prior to the final flight. At that time the auxiliary tanks were estimated to be half full. The aircraft was kept locked in a hangar when not in use. The distortion of the fuel tanks during the crash confirmed that there was sufficient fuel on board at the time. There were no witnesses to the pilot's pre-flight inspection; therefore, it could not be confirmed that he had completed a fuel check, including a check for water. Fuel recovered at the crash site did not contain any water and there was no other evidence that fuel contamination was a factor.

Fuel caps

All fuel caps were fitted with vents and the vents were clear.

Fuel selector panel

The Cessna 337C fuel selector panel is mounted in the cockpit/cabin roof. There are separate selector knobs for the front and rear engines. The knobs are the same shape and size and are mounted longitudinally, with the knob for the rear engine at the rear.

To move the rear engine fuel selector from the main to the auxiliary tank position, the knob is turned one notch to the right. Moving the front engine fuel selector one notch to the right from the left main tank position, turns the fuel off. There is no bar to prevent accidental selection to the off position on either selector, as the knob must be moved through off to select crossfeed.

Selection of auxiliary on either selector depresses a button which changes the fuel gauge indication from main to auxiliary tank. The button is depressed as the lever moves and does not need to be depressed to move the lever. The normal method of fuel selection in the Cessna 337 is to operate the front engine from the left fuel system and the rear engine from the right fuel system.

The selector panel was dismantled and inspected. As was noted above, the operating cable for the rear engine/right fuel selector had been pulled from a clamp at the selector end of the cable. There were marks on the selector actuator arm which indicated that it had been pulled hard against the pinion gear shaft before the cable was pulled from the clamp. It was apparent that separation occurred during the crash process. Although the rear selector knob was set to the auxiliary tank position, it was free to move as a result of the separated cable. This, coupled with the witness marks on the selector actuator arm, indicates that the final knob position was not the selected position.

Fuel selector valves

The fuel selector valves were examined. Both valves appeared capable of normal operation. The restriction to movement reported in the right valve was determined to be excessive friction caused by a build-up of corrosion. It could not be determined if the corrosion was present prior to the crash.

The selector operation had been checked during the periodic servicing which took place 41 flying hours prior to the crash. Evidence was also available that the fuel selector controls and valves had operated correctly two flights prior to the final one. The selector had not been moved on the penultimate flight.

Fuel tanks

In the Cessna 337C the auxiliary fuel tanks, mounted inboard of the tail booms, feed directly to the engines via their respective selector valves.

The main fuel tanks, mounted outboard of the tail booms, feed the engines via a fuel sump located in each tail boom. Each sump has a capacity of 2.7 L and is gravity-fed from the main tanks. Fuel is drawn through an outlet, located in the top of the sump, by the engine-driven fuel pump. The outlet is displaced to the inboard side of the sump centreline. As a result the unuseable fuel, in a 45-degree banked turn, varies from 1 L to 1.25 L, depending on the direction of the turn. The unuseable fuel in the right sump in a right turn is 1.25 L. The unuseable sump fuel, in level flight, was measured at 500 mL. An auxiliary fuel pump is provided in the event of engine-driven pump failure.

Under normal conditions (balanced flight), unuseable fuel is not a consideration as the fuel system is designed to keep the sumps full. In some circumstances (unbalanced flight), it is possible that gravity feed to the sump may cease. For example, in an unbalanced turn to the right, if the pilot introduces left rudder to help keep the nose up as bank angle is increased, gravity feed from the main fuel tanks to the right fuel sump will stop. The sump is above the main tanks and gravity and centrifugal force will tend to move the fuel downwards and away from the main tank outlet. Fuel will continue to feed to the left sump as the situation is reversed. Selection of the right auxiliary tank will overcome this problem as it bypasses the sump and the outlet is on the lower part of the tank in a right turn.

At cruise fuel consumption rates (37.5 L/hour/engine), it will take just over 2 minutes for the rear engine to use the 1.45 L of useable fuel available in the right sump in an unbalanced turn. If the fuel selector is selected off or moved to a position were fuel supply is interrupted, tests indicate power loss will occur after approximately 9 seconds, as fuel supply is stopped downstream from the sump.

In the Cessna 337D and later models the auxiliary fuel tank is interconnected with the main tank and also feeds the sumps. This arrangement overcomes any possible fuel feed problems that might occur during an unbalanced turn.

Survival aspects

The crash was not considered survivable. Crashworthiness information indicates that aircraft occupants are unlikely to survive an impact at 60 degrees to the horizontal if the airspeed is more than 55 kts. As the stalling speed was probably in excess of 80 kts, impact speed would have exceeded 55 kts.

Although no evidence was found that the pilot had left a formal flight note with a responsible person, an associate of one of the passengers raised the alarm when the aircraft had not returned. Initial concerns were expressed to the manager of Albany Airport at 1330. A formal search was started by the Melbourne Search and Rescue Centre at 1500, once local attempts to establish the whereabouts of the aircraft had failed. The wreckage was located at 1615 by aircraft from the Western Australian Police Air Wing. The search aircraft initially flew over the wreckage without sighting it. The crew were directed back to the site by the signal from the emergency locator transmitter.

The aircraft was fitted with a fixed installation emergency locator transmitter that complied with TSO C91a. The transmitter was activated by the crash. However, its signal was not received by the search-and-rescue satellite until the day after the accident and therefore did not provide an early indication that a crash had occurred. The coaxial cable from the transmitter to the fixed aerial had been severed at the aerial. Movement of the coaxial cable during recovery of the bodies probably led to the signal being received by the satellite.

Organisational and management information

The operator held an appropriate air operators certificate. No organisational or management issues were identified as contributing directly to the accident. The drums were later found underneath bush on the edge of the bay. They were not visible from the air. A State Police helicopter was operating in the area of the crash site at the time but was not used in the search for the drums.

Terrain

The bay in which the accident occurred is open to the south-east and surrounded by hills up to 1,843 ft high. The average ground slope, which starts at the waterline, is 33 degrees. The bay is rectangular in shape and 300 m wide and 400 m deep. Calculation based on the manufacturer-supplied performance figures indicates a Cessna 337 can not out-climb the terrain from inside the bay with only one engine operating.

Stalling speeds

The Cessna 337 owners manual details the expected stalling speeds for various configurations. At 1,905 kg the stalling speeds are:

- At 0 degrees of bank: 65 kts with flap up, 60 kts with flap at one-third and 55 kts with full flap.
- At 30 degrees of bank: 69 kts with flap up, 64 kts with flap one-third and 59 kts with full flap.
- At 60 degrees of bank: 91 kts with flap up, 85 kts with flap one-third and 78 kts with full flap.

Thus stalling speed reduces with the application of flap but increases significantly with increasing bank angles. The estimated stalling speed for the aircraft configuration was between 80 kts and 85 kts.

Post-accident inspection flights and other operational information

During the investigation, flights were conducted in a twin- and a single-engine aircraft over the bay area. The pilot of the twin-engine aircraft reported he could not remain inside the bay in a right turn with less than 60 degrees of bank selected. He was operating at a higher speed (120 kts) than the Cessna 337's assumed operating speed. The investigator in charge inspected the bay in a Cessna 182. His pilot flew a pattern which he thought was the best way to view the bay: this consisted of commencing an orbit over the bay at 900 ft (clear of the terrain and turbulence). When the drums were not sighted, he descended in a continuous 30-45 degree banked turn, at 75 kts with flap set, to 500 ft (the limit because of turbulence and safety).

Discussion with experienced pilots indicates that during low-level inspections it is not unusual for a pilot to introduce top rudder in a turn to allow bank angle to be increased, and thereby improve the view below the aircraft without losing altitude in the process.

Flight tests and calculations indicate that to operate a maximum-weight Cessna 337 with half flap set, with both engines operating at cruise power, in nil-wind conditions and at low level in the bay area, requires a steep turn of more than 51 degrees of bank and an airspeed of no more than 90 kts. Once committed to the turn inside the bay, a pilot would have no option but to continue the turn to exit. Any adverse wind conditions would cause an increase in the bank angle required.

Experience indicates that operations at low level in confined situations place pilots in a high workload environment where they need to concentrate their attention outside the cockpit. In previous investigations it has been determined that this type of operation often leads to poor airspeed control. It can also lead to the unsighted operation of ancillary controls such as fuel selectors, particularly if the pilot is experienced on the aircraft type and does not need to look at the control to confirm where it is or how it operates.

Information from fuel starvation occurrences indicates that an engine will usually start surging rather than just stop when the fuel quantity available is low, particularly when operating in turbulent conditions. Usually, the first action by the pilot in the event of a sudden and unexpected power loss in cruise flight is to move the fuel selector to another tank that has fuel in it. If there is no response, this action is usually followed by selection of the auxiliary fuel pump. Fuel pump selection varies, depending on aircraft type.

Tests and research

BASI Report 87-116 (Australian Aviation Occurrences Involving Fuel Starvation & Exhaustion 1969-1986) concludes that pilot factors were involved in 89% of fuel exhaustion occurrences and in 45% of the fuel starvation occurrences reviewed. It goes on to report that 71% of the factors involved mismanagement of the fuel system. The report looked at all types of general aviation aircraft, both single and multi-engine.

To further refine the information obtained from Report 87-116, the air safety occurrence databases of the Bureau and the US National Transportation Safety Board were reviewed to determine the types of events that led to loss of power to both engines in twin-engine aircraft in general and to loss of power in one or both engines in the Cessna 337.

The following are explanations of some of the terms used.

Fuel exhaustion occurs when all the useable fuel in the aircraft has been consumed. Pilot miscalculation is often the main factor, although there are some occasions where problems with the fuel system may give the pilot false information or fuel is lost overboard.

Fuel starvation occurs when there is still adequate fuel on board the aircraft but it is not being supplied to the engine(s) for some reason. Mismanagement of the fuel system is often the main factor. However, there are occasions where such problems as fuel contamination or fuel blockage may be factors.

Un-porting occurs when the fuel tank outlet is uncovered and air enters the system. A low fuel state or unusual manoeuvres can lead to un-porting.

Mechanical failure/malfunction includes failure of an engine component or accessory, low oil pressure, low fuel pressure, fouled spark plugs and rough running.

"Undetermined" covers those factors which could not be or were not determined by the investigating authority.

The events listed as "other" include one-off occurrences such as icing conditions.

The review of the Bureau's database covered the years 1969-1996 and included power-loss occurrences (accidents and incidents) in all types of aircraft and the Cessna 337 in particular.

Fifty-nine occurrences involving loss of power in both engines in all types were identified. Of these, 31 were the result of fuel exhaustion, 20 of fuel starvation, six for other reasons and two were of undetermined origin. Sixty-five percent of the fuel starvation occurrences involved pilot factors.

There were 67 occurrences involving a loss of power on one engine in the Cessna 337. Of these, 52 were the result of mechanical failure/malfunction, 12 were due to fuel starvation and three were for undetermined reasons. There were seven occurrences where there was a loss of power on both engines in a Cessna 337. Four were the result of fuel exhaustion and three involved fuel starvation. Two of the three involved pilot factors. The factors in the third were undetermined.

The review of the National Transportation Safety Board's database covered the years 1985-1995 and Cessna 337 accidents involving a loss of power on one or both engines.

There were 12 accidents involving loss of power on one engine and 23 accidents involving loss of power on both engines. Four single-engine accidents resulted from mechanical failure/malfunction, four were for undetermined reasons, two were from fuel starvation and two occurred for other reasons. The records for the multiple-engine failure accidents indicate 11 resulted from fuel exhaustion, eight from fuel starvation, three were for undetermined reasons and one was the result of un-porting of the fuel supply lines. A breakdown of factors in the National Transportation Safety Board's recorded accidents could not be determined from the information available.

No occurrences were identified, in either database, where a loss of power in both engines resulted from mechanical failure/malfunction.

The one report of un-porting in a Cessna 337 involved a pilot entering a wings-level, steep descent whilst there was minimum fuel in the tanks. Both engines stopped during the descent as a result of un-porting of the fuel lines.

The manufacturer reported that a military version of the Cessna 337C was used extensively as a forward air control aircraft in Vietnam without any similar fuel feed problems being reported. Forward air control often results in extreme flight attitudes.

Anecdotal evidence indicates that the rear engine of early model Cessna 337s occasionally stopped without warning during varying phases of flight. Some of these stoppages led to accidents when the loss of power was not identified early enough by the pilot. A common reason for these stoppages was not formally identified.

Overview

It is evident from information provided on the purpose of the flight, the location of the crash, the impact direction and the damage, that the pilot was conducting a low-level inspection of the bay area in an attempt to find the drums. To complete this task he had to fly the aircraft in a steep, right turn at a slow speed. During the turn both engines lost power. The loss of power led to a loss of control and the pilot was unable to recover the situation prior to impact.

Engine power loss

The lack of rotational damage to either propeller indicates that both engines had lost power prior to impact.

The lack of fuel in the system supplying the rear engine suggests fuel starvation contributed to its loss of power. The fact that the sump was depleted indicates that the fuel supply to it was interrupted. As no blockages were found, the most probable reason is that a prolonged, unbalanced, right turn stopped fuel feed to the right fuel sump from the right main tank. In less than 3 minutes, all useable fuel in the sump had been consumed and the engine stopped.

One flight conducted during the investigation indicated that the accident aircraft probably commenced an orbit over the bay area at a higher altitude than that used for the final circuit. When unable to see the drums, the pilot probably descended until he entered the bay on the final orbit at low level. As a result the turning-time required to deplete the useable fuel in the sump could have been exceeded.

No direct evidence was available to establish why the front engine was not producing power. The investigation found that fuel was available and that all the engine systems were probably serviceable. The engine controls were all selected to the operating position at impact.

The research indicates there are no recorded occurrences where a loss of power to both engines resulted from mechanical failure/malfunction of the engines. The most common reasons for loss of power to both engines in a twin-engine aircraft (and in particular the Cessna 337) are either fuel exhaustion or fuel starvation. There was adequate fuel on board the aircraft; therefore, fuel exhaustion is not a consideration. As a result, fuel starvation is considered to be the most likely reason for the loss of power to the front engine. Pilot factors were identified in 45% of fuel starvation occurrences in all types of aircraft and in 65% of those involving twin-engine aircraft. In the absence of any evidence indicating a problem with the aircraft systems, pilot factors are considered the most probable contributors to loss of power to the front engine.

As it is common practice to select a different fuel tank following sudden power loss, it is possible that the pilot inadvertently selected the front engine off whilst he was attempting to restart the rear engine by changing the fuel tank selection. The design of the fuel selector switches and the pilot's concentration outside the cockpit may have contributed to his action. Fuel supply to the engine was probably re-established when the pilot realised his mistake and reversed the selection. Fuel then flowed backed into the lines but the engine had insufficient time to restart.

Loss of control

The pilot had extended the flaps to reduce the stalling speed and increase his safety margin. Evidence indicates the aircraft was probably flying at 85-90 kts. This speed gave the pilot a small margin above the stall and allowed the aircraft to remain inside the bay. Under the circumstances, any interruption to engine power would have resulted in a sudden reduction in flying speed. This may have been sufficient to cause the aircraft to stall. If the rear engine lost power first, the nose-up pitching moment would have exacerbated the situation. The tendency for the prevailing wind to push the aircraft towards the hills could have resulted in an unconscious action by the pilot to increase bank and tighten the turn, thereby further reducing the safety margin. Turbulence may also have been a factor.

Impact sequence

The steep nose-down attitude indicates the aircraft was probably in an aerodynamically stalled condition for some time prior to impact. Considering the pilot's experience, the stalled condition probably resulted from a loss of control at inspection height. In a more controlled situation the pilot would have attempted to manoeuvre the aircraft to a crash landing, and any last minute stall would have been less severe. The relatively intact nature of the wreckage and the lack of severe damage to the aft fuselage indicates the loss of control occurred at low altitude.

Summary

As the right sump fuel contents approached the unuseable level, it is likely the rear engine began to surge rather then just lose all power immediately. Re-establishment of fuel supply from the auxiliary tank would have corrected the situation and prevented complete power loss. The pilot probably attempted to change the tank selection. The lack of fuel in the rear fuel supply lines indicates that this did not occur. Although there is no substantive evidence to explain the loss of power to the front engine, it is possible the pilot inadvertently selected it off instead of selecting the rear engine to the auxiliary tank.

Failure of the rear engine alone may have been sufficient to cause the loss of control, particularly if the pilot was distracted from flying the aircraft by the engine/fuel situation. Failure of both engines at a critical point in a maximum-performance turn in a confined area will almost certainly lead to loss of control.

The low operating altitude probably prevented recovery from the loss of control situation before impact.

1. The task requirements and the terrain conditions meant the pilot had to fly the aircraft in a continuous maximum-performance right turn at low level. Whilst they approached the limits, these conditions were still within the aircraft's and the pilot's capabilities. As the aircraft was operating at or near the limits, there was little margin for error. The margin available was insufficient to prevent loss of control when the situation changed unexpectedly.

2. To improve visibility, the pilot probably introduced left rudder and increased the angle of bank, thereby creating an out-of-balance condition.

3. A prolonged, unbalanced turn probably led to fuel starvation and loss of power to one engine.

4. A sudden, unexpected loss of power during a maximum-performance turn resulted in loss of aircraft control.

5. The loss of power and control occurred at low altitude and there was insufficient height to effect recovery.