Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Piper Twin Comanche PA 30 G-ATYR Report on the accident at Saulmore Bay, near North Connel aerodrome, Argyll on 17 October 1974

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No.	*Short title*	*Date of Publication*
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4/75	Boeing 707-436 G-APFH at Heraklion Airport, Crete June 1974	July 1975
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7/75	Iberia DC9 EC-BII Spantax Coronado EC-BJC in the Nantes area, France March 1973	June 1975
8/75	Cessna 150C G-ASHF at Swanage Bay, Dorset June 1973	August 1975
9/75	Piper PA25-235 G-ASVX and Phantom FGR2 XV493 at Fordham Fen, Norfolk August 1974	September 1975
10/75	Piper Twin Comanche PA30 G-ATYR at Saulmore Bay, near North Connel aerodrome, Argyll October 1974	November 1975
11/75	Vickers Vanguard 952 G-AXOP at Hochwald/Solothurn, Switzerland April 1973	September 1975
12/75	Douglas DC 7CE1-AWG at Luton Airport, Beds. March 1974	October 1975
13/75	Boeing 727 Series 46 G-BAEF at Luton Airport, Beds. June 1974	October 1975

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Department of Trade
Accidents Investigation Branch
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28 August 1975

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr G C Wilkinson, an Inspector of Accidents, on the circumstances of the accident to Piper Twin Comanche PA 30 G-ATYR which occurred at Saulmore Bay, near North Connel aerodrome, Argyll on 17 October 1974.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No 10/75
(EW/C502)

Aircraft:	Piper Twin Comanche PA 30 G-ATYR
Engines:	Two Lycoming I-O-320-B1A
Registered Owner and Operator:	D E C Stapleton
Pilot:	Killed
Passengers:	1 missing, believed killed
Place of Accident:	Saulmore Bay, near North Connel Aerodrome, Argyll. 56°26′45″N 05°24′25″W
Date and Time:	17 October 1974 at about 1640 hrs
	All times in this report are GMT

Summary

The aircraft took off normally from a runway which ended at the edge of a seawater loch.

Witnesses heard the engine noise stop abruptly while the aircraft was in a gentle right turn shortly after take-off. The turn tightened to a steep bank angle and the right wing struck the water some 600 metres beyond the upwind end of the runway.

The pilot's body was recovered from the wreckage which was located in about 50 feet of water but the passenger is missing.

It is concluded that the accident resulted from a simultaneous power loss from both engines. The reason for the power loss could not be established, but fuel starvation is suspected.

1. Investigation

1.1 History of the flight

G-ATYR was flown to North Connel aerodrome on the afternoon of 16 October 1974 from Glasgow by a private pilot, a businessman who was attending meetings locally and who had hired the aircraft from the owner. It had called at Glasgow in the course of a flight from Southend in order to be refuelled to the maximum capacity of 75 gallons, no fuel being available at Connel. The flight time from Glasgow to North Connel was about 45 minutes.

The following afternoon the pilot and a passenger were driven to the airfield and were seen to walk down a path leading towards the overnight parking area. No-one saw them enter the aircraft.

A short time later the engines were heard to start. An estimated 12 minutes later the aircraft took off using the shorter of two runways available which though sufficiently long was promulgated as out of use. In the position where it had been parked overnight, the aircraft was almost aligned with this runway which, like the main runway, effectively finished at the edge of the sea. (See Fig 1).

The take-off seemed normal to witnesses until the aircraft had reached a height of not more than 200 feet when it started a gentle right turn and the engine noise stopped abruptly.

Two distinct spluttering noises were heard from the engines in the next few seconds, during which time a steeply-banked turn to the right developed at a very low height. The right wing of the aircraft struck the water, causing it to cartwheel and disappear.

Local residents immediately alerted the police and boats made a search for survivors. None were found but a quantity of floating material including the aircraft's logbook was recovered. Divers from a nearby marine research laboratory found the wreckage lying in about 50 feet of water and marked it so that Royal Navy divers from HMS *Reclaim*, which was berthed in Oban, could examine the wreckage. They recovered the pilot's body but no trace was found of the passenger, who is presumed dead.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	1	1 (missing, presumed dead)	–
Non-fatal	–	–	–
None	–	–	

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

None.

1.5 Crew information

The pilot, aged 33, held a Private Pilot's Licence issued in 1965, endorsed for aircraft groups A and B. He took an IMC rating test in 1970 and passed a full instrument rating test in 1973. This was current, having been renewed in April 1974, at which time he was also tested on the PA30.

He had flown a total of 516 hours on 12 types of aeroplanes, three of them twin-engined, and he had flown into Connel aerodrome three times. During October 1974 he had flown G-ATYR exclusively and in 10 flights had flown 12 hours 5 minutes, of which 5 hours 20 minutes was at night. His total flying experience on PA 30 aircraft was 62 hours.

1.6 Aircraft information

G-ATYR was a Piper PA 30 Twin Comanche, powered by two 160 hp Lycoming I-0-320-BIA four-cylinder fuel-injected engines, driving two-bladed Hartzell HC-E2YL-2BS constant-speed feathering propellers.

The engines were supplied from four bladder-type fuel tanks installed in the forward sections of the wings. The inboard main tanks had a capacity of 25 Imperial gallons each, with 3 gallons unusable and the auxiliary tanks, fitted outboard of the engines, had a capacity of 12½ Imperial gallons each, all usable. Fuel selection was by means of two rotary selectors situated side-by-side on the floor between the two front seats; these controlled the fuel supply to the engine on the same side as the selector.

Each selector had four positions: OFF, AUXILIARY, MAIN and CROSSFEED. The selectors were located in these positions by means of a spring-loaded plunger locating in a detent. (See Fig 2).

The aircraft was built in USA in 1966 and registered in the UK in that year. It had a Certificate of Airworthiness (C of A) in the General Purpose category, which was renewed on 29 May 1974. A Check 1 was completed on 7 September 1974 after 477 flying hours. It had been inspected and maintained as required by the conditions of the C of A.

1.7 Meteorological information

The following aftercast was produced by the Meteorological Office for the North Connel area for 1600 hrs on 17 October 1974:

A ridge of high pressure was moving East across Scotland and the 1500 hrs observation from Oban was:

Surface wind	Northwesterly, less than 5 knots
Visibility	40 kilometres
Cloud	Two-eights Cumulus, base 3,500 feet
Temperature	11°C
Dewpoint	9°C

This was typical of the weather for all stations in the vicinity and the weather for North Connel was almost certain to have been similar one hour later. Up to 2,000 feet turbulence is unlikely to have been more than slight and no icing would have been experienced.

The regional QNH for Portree was:	1500-1600 hrs	1013 millibars
	1600-1700 hrs	1012 millibars

The weather is not considered to have been a factor in this accident.

1.8 Aids to navigation

Not applicable.

1.9 Communications

No radio communications facilities were available at Connel aerodrome.

1.10 Aerodrome and ground facilities

North Connel aerodrome is licensed by the CAA to Argyll County Council for day operations only and was inspected in August 1974. Situated 20 feet above mean sea level, it has two tarmac-surfaced runways, 02/20 1,128 metres long and 05/23 which is 850 metres long.

The UK Air Pilot gives details only for runway 02/20, while the UK and Ireland Air Touring Flight Guide, a publication frequently used by private pilots, declares '05/23 unserviceable'.

During the summer season there are scheduled flights by small local airlines and the prescribed firefighting and rescue facilities are provided for these flights. For private flights the airfield is used with prior permission only and no facilities are provided unless the flight happens to coincide with a commercial operation.

1.11 Flight recorder

Not fitted and not required.

1.12 Wreckage

1.12.1 *Initial examination*

The aircraft came to rest in about 50 feet of seawater some 630 metres beyond the end of the runway used for take-off and about 145 metres to the right of the extended centreline. When the AIB team arrived the main structure of the aircraft had been dragged into shallow water and the two engines recovered to shore.

It was established that both engine nacelles had failed in an upward and rearward direction, the starboard one becoming detached complete with the wing leading edge D-box containing the associated fuel cells. Fuel was present in both fuel filter bowls and in the starboard engine injector system divider unit; it was not possible at that stage to check the contents of the port engine divider. The fuel filters were clean. The port cockpit fuel selector was found to be positioned between the main and the auxiliary tank detents and the starboard selector was in the auxiliary tank detent. It was established that undercarriage and flaps were retracted at impact.

1.12.2 *Engines and propellers*

The port engine was intact with no visible major damage. The starboard engine sump casing had been fractured by the impact, the exhaust pipes being flattened against the broken sump. The blades of both propellers were within the normal pitch range and all were bent rearwards, the port propellers showing less severe damage than the starboard. The starboard engine was dismantled and found to be free from mechanical failure or damage not consistent with the impact and subsequent salt water immersion. The sparking plugs in both engines were found to be slightly corroded but not fouled.

1.12.3 *Fuel system*

Examination of the aircraft fuel system showed that almost all the associated pipework had been recovered. The missing sections related to parts of structure that had either separated completely or had been severely disrupted. All joints were found to have been correctly tightened, the pipework showed no signs of pre-accident damage and there were no signs of blockage. During dismantling, more than two weeks after the accident, fuel was found in several parts of the fuel system.

Samples of fuel from the wreckage were analysed together with bulk samples from the supply tank used on the last occasion the aircraft was refuelled. The bulk supply was found to be up to specification and the samples from the aircraft fuel system were similar to the bulk sample except for water contamination and dissolved chemicals of types usually found in seawater. The structure supporting the flexible fuel tanks showed pronounced deformation indicative of fuel surge on the panels under the starboard wing tanks with similar though less pronounced indications under the port wing tanks. The port auxiliary tanks showed a smaller distortion due to fuel surge than the other fuel tanks. There was no indication of foreign object blockage in any of the intact fuel cells.

A closer examination of the fuel cocks showed that the operating bell cranks of both were in the MAIN position. Radiographic examination showed both ball valves controlling the main tank fuel flows to be open and all other ball valves to be closed or nearly so. The mechanisms between the fuel selectors and the cams operating the ball valves were found to be intact.

It was concluded that structural deformation resulting from the impact damage had caused movement of the fuel selectors from MAIN to the positions in which the selectors were found. Crash damage precluded the positive establishment of the auxiliary fuel pump switch positions.

1.12.4 *Flying controls*

The flying controls were examined and no evidence of pre-accident damage or failure was found.

1.13 Medical and pathological information

A full autopsy examination was undertaken on the pilot. No evidence of disease was found and tests for ethanol and drugs were negative; there was no evidence of cockpit contamination by carbon monoxide before the crash. The pilot died from lacerations to the brain due to fracturing of the skull. Death would have been instantaneous.

1.14 Fire

There was no fire.

1.15 Survival aspects

In the event, the accident was not survivable. Both front seats were equipped with lap straps only as safety harness. That on the left-hand seat remained intact and retained the body of the pilot; the harness on the right-hand seat remained intact but the outboard attachment tore away from the structure under impact loads.

1.16 Tests and research

1.16.1 The port engine was installed in a test bed after the products of corrosion had been cleaned from the air side of the injector pump diaphragm and from the magnetos and the sparking plugs. Small traces of fuel were found in the injector unit and there was no sign of contamination in the filter. A fractured induction pipe elbow was also replaced.

Rotation of the engine initially caused corrosion products from the cylinder walls to foul the sparking plugs but when this was cleared the engine started and ran on three cylinders. Investigation showed the nozzle of the fourth cylinder to be blocked by internal salt water corrosion and this was replaced. The engine then functioned satisfactorily, giving power output and other figures within specification, while the engine-driven fuel pump proved capable of drawing fuel from a tank located 7 feet below and 30 feet from the engine, during full-throttle operation.

The port engine was then fitted with the fuel pump, magnetos, injector pump and other associated equipment from the damaged starboard engine after these had been cleared of the products of corrosion. The engine started and ran although some difficulty was experienced with fuel nozzles becoming blocked; slightly reduced power was obtained at full throttle. It was considered that persistent blocking of the fuel injector nozzles was consistent with the known state of corrosion of the injector pump filter and the consequent contamination of the whole system.

1.16.2 Ground tests were made on a similar Twin Comanche to assess the result of an inadvertent wrong fuel selection.

Both engines were run at 1,500 rpm with fuel selectors set to AUXILIARY. As nearly simultaneously as possible, both fuel selectors were selected to OFF and take-off power applied. The left engine cut in 5 seconds while the right continued to run at full power. On a second attempt both engines cut together in 20 seconds, and on a third attempt both cut in 10 seconds.

It was further established in the course of the tests that with the fuel selectors set to a position between the positive detents the engines would continue to run so long as fuel was present in each tank.

2. Analysis and Conclusions

2.1 Analysis

2.1.1 The evidence of witnesses indicates that both engines lost power simultaneously a short time after take-off while the aircraft was in a gentle right turn at a height of probably not more than 200 feet. The damage to the aircraft structure was consistent with it having struck the water at a relatively low speed in a shallow dive, banked to starboard and with the engines delivering no power.

The nature of the simultaneous loss of power from both engines points to either an electrical failure of the ignition system or to fuel starvation.

2.1.2 Such an electrical fault could only have happened if all four magnetos (two per engine) failed simultaneously or the four ignition switches became earthed simultaneously.

When the engines were examined the magnetos were found to function despite their immersion in sea-water and the positioning of the electrical terminal wiring behind the instrument panel is such as to render this latter fault most unlikely. Had it occurred, both engines would certainly have lost power suddenly but it is hard to reconcile this type of failure with the two spluttering sounds heard from the engines immediately before the aircraft struck the water. An electrical failure of this nature would not have permitted intermittent operation of the engines.

2.1.3 The presence of fuel in the areas of the fuel cocks, starboard fuel injector pump and port divider unit suggests that fuel was available to both engines although it does not confirm that the systems were fully primed. The surge indications in the fuel tanks support structure, the freedom from damage and blockage of pipework and vents, the open position of the fuel cocks and the performance under test of the two engine-driven fuel pumps give no reason to believe that sufficient fuel flow to the engines could not have been maintained once the systems were primed.

The lack of pre-crash contamination of those samples of fuel found in the aircraft fuel system suggests that the fuel available was suitable, this being confirmed by analysis of a sample taken from the bulk supply used for refuelling at Glasgow.

2.1.4 Examination and tests conducted on the engines and associated components demonstrated that they were prevented from normal functioning only by obvious impact damage or the products of salt-water corrosion.

It is concluded that there was no mechanical or electrical failure that would account for the engines not developing power at the time of impact. The fuel state and fuel selections at the time of impact were such as to have permitted full-power operation of the engines provided the fuel selectors had been in the positions as found for more than approximately 30 seconds before impact.

2.1.5 The aircraft was refuelled to capacity at Glasgow prior to its flight to Connel. It is estimated that 11 imperial gallons of fuel would have been used on this flight. Whilst it is theoretically possible for this amount of fuel to have been drawn from one of the 12½ imperial gallon capacity auxiliary tanks leading to both engines losing power simultaneously shortly after take-off from Connel due to fuel starvation, this is considered improbable. It would have required most unusual fuel selections to have been made at Glasgow and for the fuel selectors to have been left in the same positions for the last take off. In addition, during the flight from Glasgow the increasing lateral out-of-trim of the aircraft would also have been a constant reminder of fuel asymmetry.

The aircraft was parked overnight in the open on an unguarded airfield. It would thus have been possible for the tanks to have been drained although this would have entailed syphoning from the over-wing filler caps.

The quantity of fuel necessarily involved to have produced a hazard to the aircraft was substantial in terms of carriage alone. There were some 64 gallons of petrol in the tanks so several receptacles of jerrycan size would be needed. This in turn would presuppose a vehicle parked nearby for some time. In a country area this might well have been observed and have produced comment. No such vehicle was observed.

It is known that if an engine is selected to a tank which becomes exhausted there is a tendency for power surge to occur before lack of fuel causes the engine to stop. The lack of evidence of surging is therefore not consistent with the possibility of the engines being selected to tanks containing insufficient fuel.

Examination of the wreckage of the wings produced evidence of characteristic deformation of the fuel tanks supporting structure under the impact inertia loads of fuel cells containing significant quantities of fuel.

2.1.6 The pilot had the reputation of being meticulous in his use of check lists for whatever aircraft he was flying. This reputation was gained not only from flying instructors and check pilots but also from friends with whom he flew regularly. His characteristic thoroughness was also reflected in the neat documentation which was retrieved from the wreckage.

It is considered therefore that pre-flight operation of the fuel tank water drains probably took place prior to start-up — as specified in the check lists. Additionally as the aircraft was parked in the open for only 24 hours with an airspace in the tanks of less than 15 per cent of the total fuel capacity, it is considered that condensation would not have presented a significant hazard on the accident flight even if the water drains had not been used.

2.1.7 The fuel tank selectors were, in all probability, on MAIN tanks at impact and the fuel lines downstream of the selectors were found to contain fuel. This points to adequate fuel being available; the total fuel on board at take-off should have been about 64 gallons, sufficient for some 4 hours flying at normal cruise settings.

The engines were heard to stop less than half-a-mile beyond the up-wind end of the airfield. From its position at that time, it can be deduced that some 35 seconds must have elapsed from the start of the take-off run to the time the engine noise was heard to stop.

Normal fuel management in the PA 30 calls for starting and taxying on AUXILIARY tanks with the run-up and take-off being made on MAIN tanks, thus proving adequate fuel flow from all tanks. It is possible that on this occasion the pilot was distracted from his normal routine because on this particular take-off no taxying was involved since the aircraft, in its parked position, was almost aligned with the runway used for take-off. In such an event the engine run-up could have been made on AUXILIARY tanks with the selectors being set to OFF immediately prior to take-off instead of MAIN. The spluttering noises produced by the engines are consistent with the pilot attempting to restore power after a simultaneous loss of power from both engines by selecting other tanks. However there is no evidence that this sequence of actions was followed by the pilot.

The fuel selectors, which are situated on the floor between the two front seats, are difficult to see when both these seats are occupied and to check visually their position requires a pilot to lean forward and look down.

A pilot might position them by feel and thus inadvertently select OFF (outboard from AUXILIARY) instead of MAIN (inboard from AUXILIARY). The owners handbook for the Twin Comanche warns in Section III, Fuel Management, that the fuel-injected engines take 'an appreciable length of time to start after fuel starvation' and recommends against emptying a fuel cell to depletion. Should this occur, it warns the pilot to 'be prepared to wait a while for the engine to start after changing to a fuel cell with fuel in it'. In this event from the low altitude at which the engines of G-ATYR lost power there would have been insufficient time to restore the fuel supply before the aircraft struck the water.

Although the operating instructions for the aircraft specifically prohibit the use of AUXILIARY tank fuel in other than level flight, cases have been known where through oversight the take-off has been made with these tanks selected. No engine malfunction has resulted.

It must remain a matter for conjecture why the steep right turn was initiated immediately before impact with the water. While it is possible that the pilot was attempting to turn back towards the airfield it is equally possible that while flying the aircraft with his left hand and looking for and operating the fuel selectors on the floor to the right of his seat he allowed the bank angle to increase unwittingly. Or he may simply have tried to avoid flying into a steep cliff-face by turning rapidly to avoid it.

2.1.8 It is possibly noteworthy that in 1974 the National Transportation Safety Board of the United States issued a special general aviation accident study containing recommendations to both Government and industry for a joint effort to reduce fuel starvation accidents substantially.

The study of fuel starvation - insufficient fuel flow to the engines even though the aircraft still carries enough fuel for normal operation - stemmed from the NTSB's 1973 engine failure study. This showed that nearly 20 per cent of 4,310 engine failure accidents in 1965-69 had been caused by fuel starvation.

2.2 Conclusions

(a) *Findings*

(i) The aircraft's documents were in order. It had been maintained in accordance with an approved maintenance schedule and it was properly loaded for the flight, including an adequate quantity of fuel.

(ii) The pilot was properly licensed, medically fit and adequately experienced for the flight.

(iii) The aircraft suffered a sudden and complete power loss on both engines shortly after take-off.

(iv) Two distinct spluttering noises were heard from the engines prior to the right wing striking the water while the aircraft was in a steeply banked turn.

(v) Subsequent ground running checks on one of the aircraft's engines complete and also with the fuel and electrical system components of the second engine showed no reason for the power loss. The second engine, which was not in a suitable condition to be run, was stripped and closely examined. No mechanical cause for the power loss could be found.

(b) *Cause*

The accident was caused by a complete loss of power from both engines simultaneously shortly after take-off. The right wing subsequently struck the water while the aircraft was in a steeply banked turn. The power loss probably occurred as a result of fuel starvation but there is insufficient evidence to establish why this happened.

G C Wilkinson
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

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