Farnborough House
Berkshire Copse Road
Aldershot, Hants GU11 2HH

Tel: 01252 510300
www.aaib.gov.uk

AAIB
Air Accidents Investigation Branch

AAIB Bulletin S1/2025 *SPECIAL*

Accident

Aircraft Type and Registration:	Rockwell Commander 112 TCA, N4698W	
No & Type of Engines:	1 Lycoming TO-360-C1A6D piston engine	
Year of Manufacture:	1978 (Serial no: 13724)	
Date & Time (UTC):	23 December 2024 at 1135 hrs	
Location:	Kinglassie, Fife	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Fatal)	Passengers - N/A
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	50 years	
Commander's Flying Experience:	187 hours (of which 92 were on type) Last 90 days - 19 hours Last 28 days - 0 hours	
Information Source:	AAIB Field Investigation	

Introduction

Following a normal takeoff roll, on the initial climb-out the aircraft's engine lost power due to water ingestion in the carburettor. The aircraft was observed to depart from controlled flight and it struck an area of rising ground, fatally injuring the pilot. Investigation of the aircraft's fuel system revealed significant water contamination that had not been removed during the pre-flight inspection.

This Special Bulletin contains preliminary information on the accident and highlights that it is possible that an entire fuel sample tube of water, drained from the fuel system, can still produce an odour of AVGAS when smelled.

History of the flight

N4698W was based at Fife Airport, near Glenrothes, and was owned by the pilot. On the day of the accident, CCTV footage showed the pilot arriving at the airport at 1100 hrs and walking to N4698W, parked at the south-western end of the apron. The view of N4698W on the CCTV was obscured by parked aircraft, so it was not possible to clearly observe the pre-flight actions of the pilot. A witness reported that the aircraft's engine was running whilst parked on the apron for approximately 20 minutes before CCTV recorded it taxiing at 1128 hrs.

On seeing N4698W taxiing, a witness in another aircraft called on the radio to check the pilot's intentions. The pilot told him that he intended to depart the circuit for a brief local flight before returning. N4698W was then seen entering the runway, backtracking to the threshold of Runway 24, and stopping. The witness recalled the engine running at high power for about 20 seconds before the takeoff run, which began at 1133:18 hrs.

CCTV recorded N4698W climbing out to the south-west until 1134:20 hrs, when it appeared to depart abruptly from controlled flight, possibly entering an incipient spin. At approximately the same time, CCTV in the village of Kinglassie, one mile south-west, recorded the sound of an engine misfiring, followed by images of N4698W striking rising ground nearby. The witness at the airport reported hearing a brief MAYDAY call from the pilot.

Airport responders arrived quickly at the scene and found local residents already present. They secured the aircraft by turning off the ignition and fuel. Police arrived on scene at 1155 hrs. The pilot was fatally injured in the impact.

Accident site

N4698W struck an area of rising ground to the north of Kinglassie, with low forward speed and a high rate of descent. The left wing was more damaged than the right wing, indicating that the aircraft was in a shallow left roll attitude at impact. The landing gear was in the up position. The propeller was in fine pitch and had stopped with one blade folded rearwards, beneath the nose, with the other two blades intact without any impact marks, consistent with the propeller windmilling whilst not being driven under power by the engine at impact. No fire had occurred. It was not possible to reliably determine the pre-accident positions of the magneto switch and fuel selector valve.

The left wing fuel tank was ruptured and no fuel remained within the tank. Approximately 20 litres of fuel was recovered from the right wing.

Aircraft information

The Rockwell Commander 112 TCA is a four-seat light aircraft powered by a single turbocharged four-cylinder piston engine, driving a three-bladed constant speed propeller. The aircraft has one fuel tank in each wing and each tank has a useable capacity of 34 US gallons. Two fuel sump drain points are provided for each wing tank, one at the inboard end of the tank and a second inboard of the main landing gear wheel well, close to the fuselage side.

The wing tanks are connected by fuel lines to a fuel selector valve in the cockpit where fuel can be selected by rotation of the valve. The selected positions vary between OFF, LEFT, BOTH, RIGHT and OFF, with the actuation of a sprung metal tab required to select either of the OFF positions to prevent their inadvertent selection. The Pilot's Operating Handbook requires the selector to be set to BOTH for takeoff and landing. Fuel flows downstream from the selector valve to a gascolator[1] mounted on bottom of the firewall. The gascolator can be drained by pulling a handle beneath an access panel on the right side of the upper engine cowling. After the gascolator, fuel flows to an electric boost pump and then onwards to the engine-driven mechanical fuel pump before reaching the carburettor. Fuel is permitted to enter the carburettor float bowl through a float valve that opens in response to downward movement of the carburettor float. Fuel leaves the carburettor float bowl via a power jet orifice located in a slightly raised section of the bottom of the float bowl. The carburettor meters this fuel into a main nozzle in response to throttle lever demand. The main nozzle exhausts into a venturi in the induction airflow, providing a fuel to air mixture for induction into the cylinders.

Each wing fuel tank has a single filler cap that is secured in place by a quick-release twist fastener. The fastener engages with a hinged flap immediately beneath the fuel filler aperture. The hinged flap provides an anti-syphon function in case the filler cap releases in-flight. When the twist fastener is engaged in the hinged flap, the fuel cap is pulled downwards against a rubber seal around the fuel filler aperture, to seal the filler cap. The twist fastener shaft has two O-ring seals that compress when the filler cap is locked, to provide sealing between the fastener's shaft and the filler cap.

Maintenance history

An annual maintenance inspection was completed on 7 March 2024, at 2,245 airframe hours. In July 2024 the pilot requested a maintenance organisation to investigate several defects, which were subsequently rectified. The defect list included the pilot reporting finding water in the fuel tanks. Inspection of the fuel filler caps revealed that the twist fastener O-ring seals were in poor condition. All four O-ring seals were replaced and the sealing of the filler caps, when locked, was checked by pouring small amounts of water onto the caps. No water was visible beneath the filler caps and the aircraft was released to service on 26 July 2024. The maintenance provider stated that he reminded the pilot to check for the presence of water in the fuel tanks on every pre-flight inspection.

Further maintenance work took place in late October 2024, following a flight on 19 October 2024 when the aircraft's engine stopped unexpectedly during rollout after landing. All eight sparkplugs were of a "sooty" appearance. They were inspected, cleaned and tested before being reinstalled in the engine, apart from the bottom sparkplug on the No 3 cylinder that was worn beyond permissible limits and was replaced with a new plug. The engine's fuel to air mixture was adjusted by ½ turn of the carburettor mixture adjusting screw in the lean direction, to lean the mixture. Following successful ground runs, the aircraft was released to service on 30 October 2024. The pilot then flew the aircraft on

Footnote

[1] A gascolator is a fuel filter usually fitted at the lowest point of a fuel system.

2 November 2024 for 10 minutes and stated to the maintenance organisation that the aircraft was performing well, with no recurrence of the engine stoppage fault. No further flights took place between this flight and the accident flight and the aircraft was parked outside, on the parking apron, during this seven-week period. The aircraft had a cover over the cockpit area but no covers over the wings.

The aircraft had accumulated a total of 2,281 hours when the accident occurred. The engine had accumulated 341 hours since overhaul in 2010, and the propeller had accumulated 150 hours since new.

Aircraft examination

Examination of the aircraft's engine did not reveal any pre-accident mechanical defect that could cause the engine to run roughly or lose power. The engine's ignition system was examined in detail and found to function correctly.

Testing of fuel recovered from the right wing confirmed it met the specification for AVGAS 100LL. Examination of the aircraft and engine fuel system revealed significant water contamination throughout the system downstream of the fuel selector value and also in the left wheel well sump drain (Figure 1). The volume of water recovered from the carburettor float bowl was sufficient to cover the power jet inlet port in the bottom of the bowl, proving that it was possible for water, rather than fuel, to be drawn into the main nozzle and carburettor venturi.

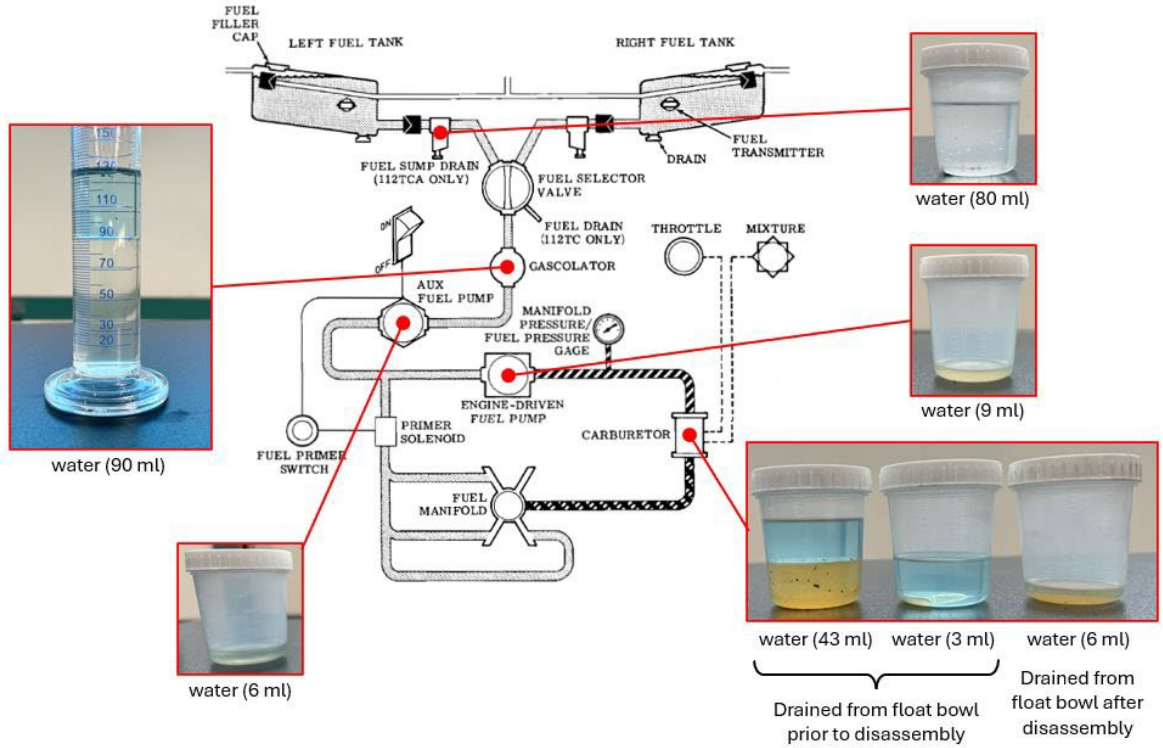


Figure 1

Water recovered from the aircraft's fuel system
(fuel system diagram courtesy of Commander Aircraft Corp)

Pre-flight fuel sampling

Pilot's Operating Handbook

The Pilot's Operating Handbook describes items to be checked in the pre-flight inspection, and lists the actions required for five fuel system drains:

- Right wing fuel tank sump – '*DRAIN SAMPLE. Check valve closed*'.
- Right wheel well fuel drain – '*DRAIN SAMPLE. Check valve closed*'.
- Fuel gascolator – *'DRAIN'.*
- Left wheel well fuel drain – *'DRAIN SAMPLE. Check valve closed'*.
- Left wing fuel tank sump – '*DRAIN SAMPLE. Check valve closed'*.

In the description of the fuel system, the following advice is provided:

> *'**Fuel filters and Drain Valves***
>
> *…Prior to the first flight of the day, the wing tank sumps, gascolator, and wheel well sumps should be drained to check for the presence of water or sediment in the fuel system. If water is found in the gascolator, there is a possibility that the wing tank sumps or the wheel well sumps may contain water. Therefore, the wing tank sumps and wheel well sumps should be redrained as necessary'.*

In a later section on fuel contamination it advises:

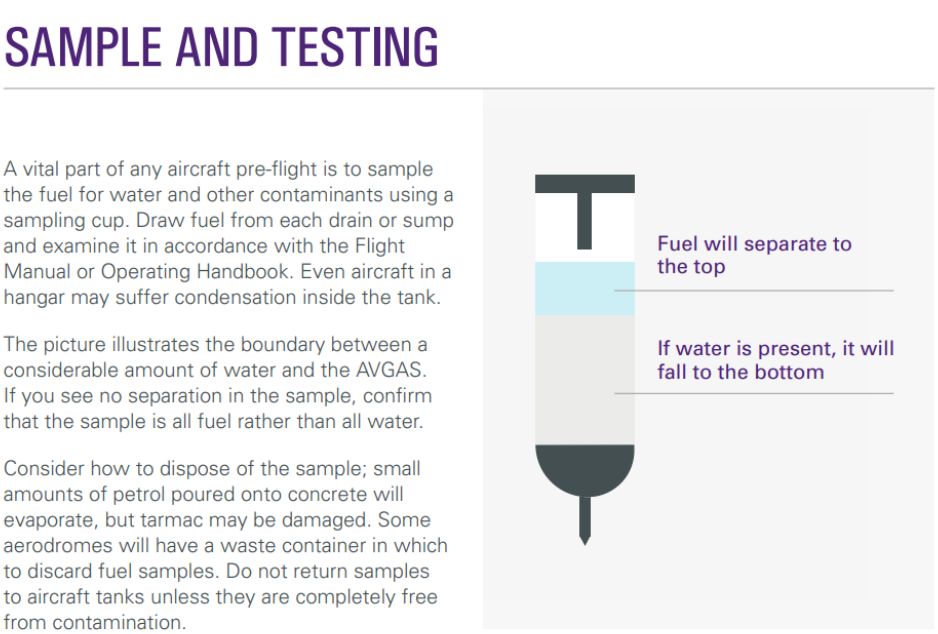
> *'If water or sediment is present in the fuel sample, continue to drain fuel until all traces of water or sediment are removed from the system'.*

CAA Safety Sense Leaflet

The CAA's Safety Sense Leaflet 28[2] provides guidance for fuel handling and storage. This document includes information on pre-flight fuel sampling and testing (Figure 2).

Footnote

[2] www.caa.co.uk/publication/download/14496 [Accessed 12 February 2025].



SAMPLE AND TESTING

A vital part of any aircraft pre-flight is to sample the fuel for water and other contaminants using a sampling cup. Draw fuel from each drain or sump and examine it in accordance with the Flight Manual or Operating Handbook. Even aircraft in a hangar may suffer condensation inside the tank.

The picture illustrates the boundary between a considerable amount of water and the AVGAS. If you see no separation in the sample, confirm that the sample is all fuel rather than all water.

Consider how to dispose of the sample; small amounts of petrol poured onto concrete will evaporate, but tarmac may be damaged. Some aerodromes will have a waste container in which to discard fuel samples. Do not return samples to aircraft tanks unless they are completely free from contamination.

Figure 2

Extract from CAA Safety Sense Leaflet 28

A fuel sample tube found in the aircraft was used in photographs recording differing fuel and water samples held against two different backgrounds (Figure 3). The fuel sample tube has a capacity of 34 ml. It was noted that the 100% water sample, using the sample tube straight after it had been filled with AVGAS 100LL, retained an odour of AVGAS, although it was not as strong as when the tube was filled with AVGAS.

(a) 100% AVGAS 100LL (b) 100% water (c) 50% AVGAS 100LL, 50% water

Figure 3

Fuel and water samples photographed against two different backgrounds. Fuel sample tube from N4698W used

Analysis

Water contamination

The engine's rough running and loss of power was caused by ingestion of water into the carburettor float bowl, leading to water being fed into the main nozzle. Significant water contamination was present throughout the fuel system downstream of the fuel selector valve and also in the left wheel well sump drain. The cause of water ingress into the fuel system is subject to ongoing investigation.

Pre-flight inspection

The pre-flight inspection was not effective in removing all the water present in the aircraft's fuel system. It could not be determined what actions were performed on the pre-flight inspection, due to the limitations of the CCTV footage. Given the significant volume of water recovered from the fuel system after the accident, it is possible that a full sample tube of water may have been drawn from one or more of the sump drains, and that this may have been assessed as clean fuel, rather than water.

Conclusion

The loss of engine power after takeoff was caused by water ingestion into the carburettor's main nozzle, due to significant water contamination of the aircraft's fuel system. The pre-flight inspection was not effective in removing all the water present in the fuel system and the investigation has not been able to determine which pre-flight checks were completed prior to the flight.

The presence of a significant quantity of water in an aircraft's fuel system is a serious safety hazard. In such cases it is possible that an entire fuel sample tube, drained from the fuel system, may contain only water yet still produce an odour of AVGAS when smelled.

Further investigation

The investigation will continue to examine the cause of the water ingress into the fuel system and the possible reasons why the engine lost power approximately 26 minutes after being started, but not beforehand. The existing guidance for pilots on identification of water in aircraft fuel systems will be reviewed. The investigation will also consider the handling of the aircraft following the loss of engine power.

Published: 10 March 2025.
