AAIB
Air Accidents Investigation Branch

AAIB Bulletin 4/2025

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The sole objective of the investigation of an accident or incident under these Regulations is the prevention of future accidents and incidents. It is not the purpose of such an investigation to apportion blame or liability.

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CONTENTS

SPECIAL BULLETINS / INTERIM REPORTS

Rockwell Commander 112 TCA	N4698W	23-Dec-24	3

SUMMARIES OF AIRCRAFT ACCIDENT ('FORMAL') REPORTS

None

AAIB FIELD INVESTIGATIONS

COMMERCIAL AIR TRANSPORT

FIXED WING

ATR 72-500 (72-212A)	LY-JUP	12-Aug-24	13

ROTORCRAFT

None

GENERAL AVIATION

FIXED WING

Extra EA-200	G-EEEK	13-Jul-24	26

ROTORCRAFT

None

SPORT AVIATION / BALLOONS

None

UNMANNED AIRCRAFT SYSTEMS

None

AAIB CORRESPONDENCE INVESTIGATIONS

COMMERCIAL AIR TRANSPORT

Airbus A320-214	G-EJCI	30-Jul-23	37
Airbus A320-214	G-EZGY	19-Jun-24	50

GENERAL AVIATION

Just Superstol	G-SSTL	4-Jul-24	63

CONTENTS Cont

AAIB CORRESPONDENCE INVESTIGATIONS Cont

SPORT AVIATION / BALLOONS

None

UNMANNED AIRCRAFT SYSTEMS

UAS Boresight BQ400 Raider LR	n/a	6-Feb-25	75

RECORD-ONLY INVESTIGATIONS

Record-Only Investigations reviewed	January - February 2025	79

MISCELLANEOUS

ADDENDA and CORRECTIONS

Marquart MA5 Charger	G-BHBT	15-Sep-24	83

List of recent aircraft accident reports issued by the AAIB 85

(ALL TIMES IN THIS BULLETIN ARE UTC)

AAIB Special Bulletins / Interim Reports

AAIB Special Bulletins and Interim Reports

This section contains Special Bulletins and Interim Reports that have been published since the last AAIB monthly bulletin.

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

Footnote

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

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 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.

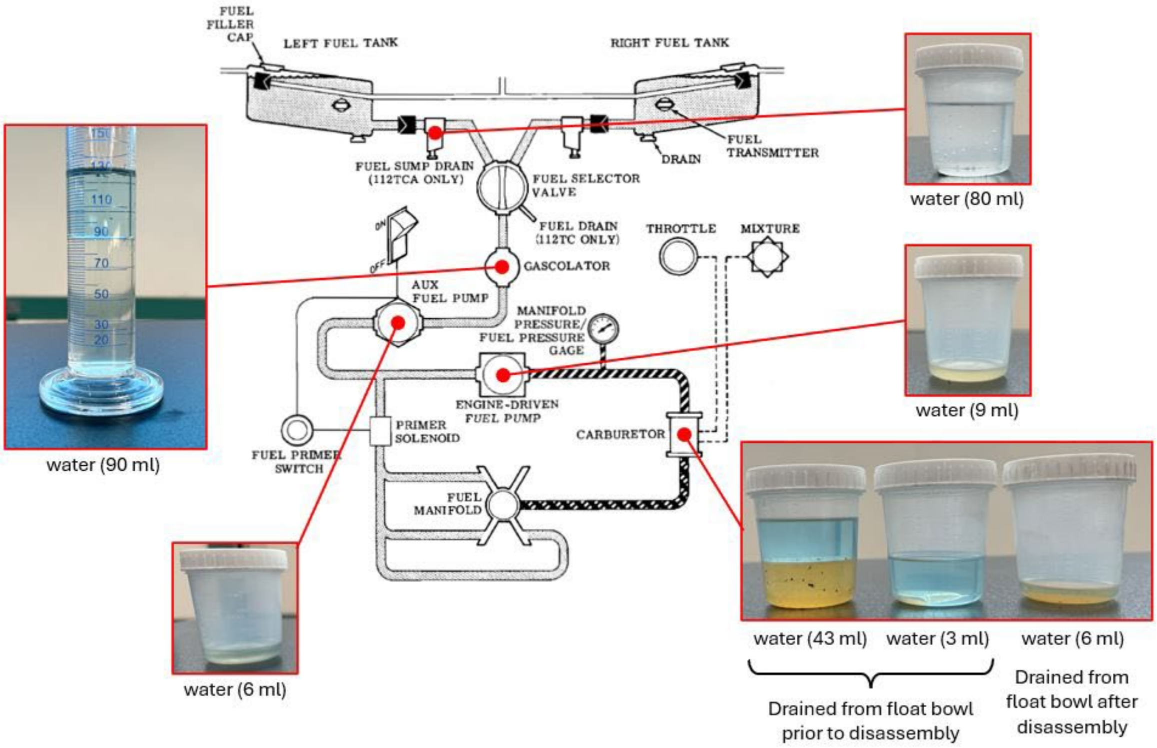


Figure 1

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:

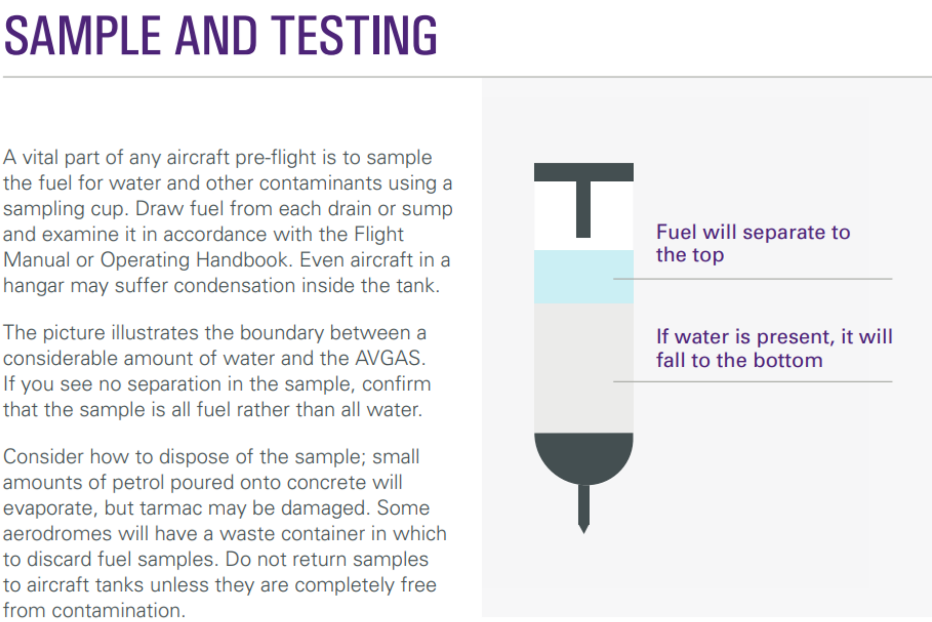
> ***'Fuel filters and Drain Valves***
>
> *…Prior to the first flight of the day, the wing tank sumps, gascolator, and wheel well sumps should be drained to check for the presence of water or sediment in the fuel system. If water is found in the gascolator, there is a possibility that the wing tank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



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

Footnote

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

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.

AAIB Field Investigation Reports

A Field Investigation is an independent investigation in which AAIB investigators collect, record and analyse evidence.

The process may include, attending the scene of the accident or serious incident; interviewing witnesses; reviewing documents, procedures and practices; examining aircraft wreckage or components; and analysing recorded data.

The investigation, which can take a number of months to complete, will conclude with a published report.

Serious Incident

Aircraft Type and Registration:	ATR 72-500 (72-212A), LY-JUP
No & Type of Engines:	2 Pratt and Whitney PW-127F turboprop engines
Year of Manufacture:	2007 (Serial no: 747)
Date & Time (UTC):	12 August 2024 at 0842 hrs
Location:	Guernsey Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 52
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	10,360 hours (of which 4,805 were on type) Last 90 days - 151 hours Last 28 days - 34 hours
Information Source:	AAIB Field Investigation

Synopsis

On approach to Runway 27 at Guernsey Airport, the crew of LY-JUP continued to descend below the approach ban altitude[1] despite the reported Runway Visual Range (RVR) being below that required. After passing through approach minima, and at around 70 ft agl, a go-around was initiated. After the power levers were advanced the aircraft remained between 61 and 78 ft agl for 15 seconds before a climb was established. The flight diverted to Southampton Airport where it landed without further incident.

Although both crew members were aware of the approach ban, it was not discussed before or during the approach. As the aircraft passed the decision altitude for the approach, there was confusion and miscommunication between the crew which resulted in the aircraft remaining more or less level with the gear down.

The operator has taken a number of safety actions to improve the selection and training of crews as well as to introduce a Flight Data Monitoring (FDM) programme.

History of the flight

The aircraft was operating a scheduled service from Southampton Airport to Guernsey Airport on behalf of a UK operator. The aircraft had started the day with a flight from Guernsey to

Footnote

[1] The approach ban as applied in both EASA and UK regulations prohibits a crew from continuing an approach below 1,000 ft above the aerodrome elevation if the governing RVR for that approach is not met.

Southampton; arriving at 0645 hrs. On arrival in Southampton, the crew uplifted fuel for the return leg and the passengers boarded for the flight. At the time the aircraft had departed from Guernsey, fog was already developing on the airfield although the RVR was more than 1,500 m. Examining the TAF and METARs, the commander considered that it was likely that the weather would improve sufficiently at the expected time of arrival at Guernsey. The aircraft departed at 0715 hrs.

During the flight the crew received several updates on the weather conditions and reduced their speed in order to delay their arrival. The RVR was variable, although rarely above the required 550 m for the available CAT 1 approach. The crew entered the hold at the GUR VOR to wait for an improvement before they could begin their approach. Having completed a number of holding patterns the crew were in the process of considering returning to Southampton when ATC notified them that the RVR had improved to 550 m. The crew decided that they could now begin their approach to the ILS on Runway 27.

Having checked that they had sufficient fuel for the approach and any subsequent diversion back to Southampton if required, the crew elected to make an approach. ATC provided radar vectors and descent clearance to the crew and the flight began its final approach. The RVR had decreased from the reported 550 m when the crew first began the approach and although it was variable, it never increased above 450 m during the period of the final approach and go-around.

ATC kept the crew informed of the RVR during the approach and having established themselves on final approach the crew were cleared for the ILS and handed over to the tower frequency as the aircraft began its descent on the ILS. When they contacted tower, they were informed, as they passed 1,750 ft amsl, that the touchdown RVR was 325 m and the stop end 400 m. ATC again reported the RVR as the aircraft passed 1,540 ft amsl as 325 m (touchdown), 375 m (stop end). Despite the RVR being below that required for the CAT1 ILS, the approach was continued below 1,000 ft aal (1,336 ft amsl).

Figure 1

LY-JUP approach to Guernsey Airport from FDR data

ATC provided two further RVR updates during the remainder of the approach. As the aircraft approached the decision altitude (536 ft amsl), both the commander and co-pilot gained the required visual references to land but there was some confusion between the crew in communicating this. This resulted in the co-pilot calling for a go-around. The commander began the go-around, calling for the flaps to be retracted one stage and selecting go-around power. For the next 15 seconds the aircraft did not climb with the pitch attitude remaining around that for level flight with the aircraft at a radio altitude of between 61 and 78 ft. Having travelled approximately 750 m the aircraft began to climb, and the go-around was completed before the flight returned to Southampton where it landed without further incident.

Aircraft information

LY-JUP has an automatic flight control system (AFCS) which includes an autopilot (AP) and flight director (FD). These are controlled through the AFCS control panel fitted on the centre panel in the flightdeck. Above this control panel is the Advisory Display Unit (ADU) which displays, along with other information, the armed and captured modes of the AFCS. This mode information is also repeated on the top of the Electronic Attitude Director Indicator (EADI). The EADI also displays the FD command bars which display the computed commands to capture and maintain the desired flightpath. These commands are satisfied by the FD bars being centred on the EADI. On the external side of each power lever are the go-around push buttons.

When either of these go-around push buttons are pressed, go-around mode is selected. Go-around mode is an FD only mode so the AP will automatically disengage. All engaged or armed FD modes will also disengage and the FD will engage laterally in heading hold (which holds the heading at engagement) and vertically in a pre-determined safe pitch attitude (which is a function of flap setting). For the flap setting selected when the go-around mode was engaged (Flap 15) the FD would be set at 7.1° nose up. The engagement of go-around mode is annunciated on both the ADU and the EADIs.

Recorded information

The serious incident was reported to the AAIB at 1230 hrs on the day after the event. During the elapsed time, the aircraft flew more than 2 hours which meant the CVR recording was overwritten. The FDR was provided to the AAIB by the operator and recorded radar and radio transmissions were provided by Guernsey ATC along with the recorded RVR data. The data sources were combined to establish the sequence of events.

The aircraft first contacted the Guernsey Tower frequency at 0841:23 hrs, when just over 6 nm from the Runway 27 displaced threshold, descending through a pressure altitude of 1,800 ft[2]. At the time, the autopilot was engaged and the glideslope and localiser captured. The aircraft was cleared to land and passed wind conditions and RVR readings of 325 m at the touchdown point and 400 m at the stop end. Two further transmissions were made from Guernsey Tower during the approach with reported RVR below 550 m.

Footnote

[2] The FDR recorded pressure altitude to a datum of 1013 hPa which has been corrected to the Guernsey QNH of 1009 hPa.

At 0843:30 hrs, the recorded pressure altitude reduced below the decision height[3] of 536 ft amsl when the aircraft was just over 0.5 nm from the Runway 27 displaced threshold (point A, Figure 2). The approach continued and the autopilot was disconnected seven seconds later at 475 ft amsl and 131 KIAS (point B).

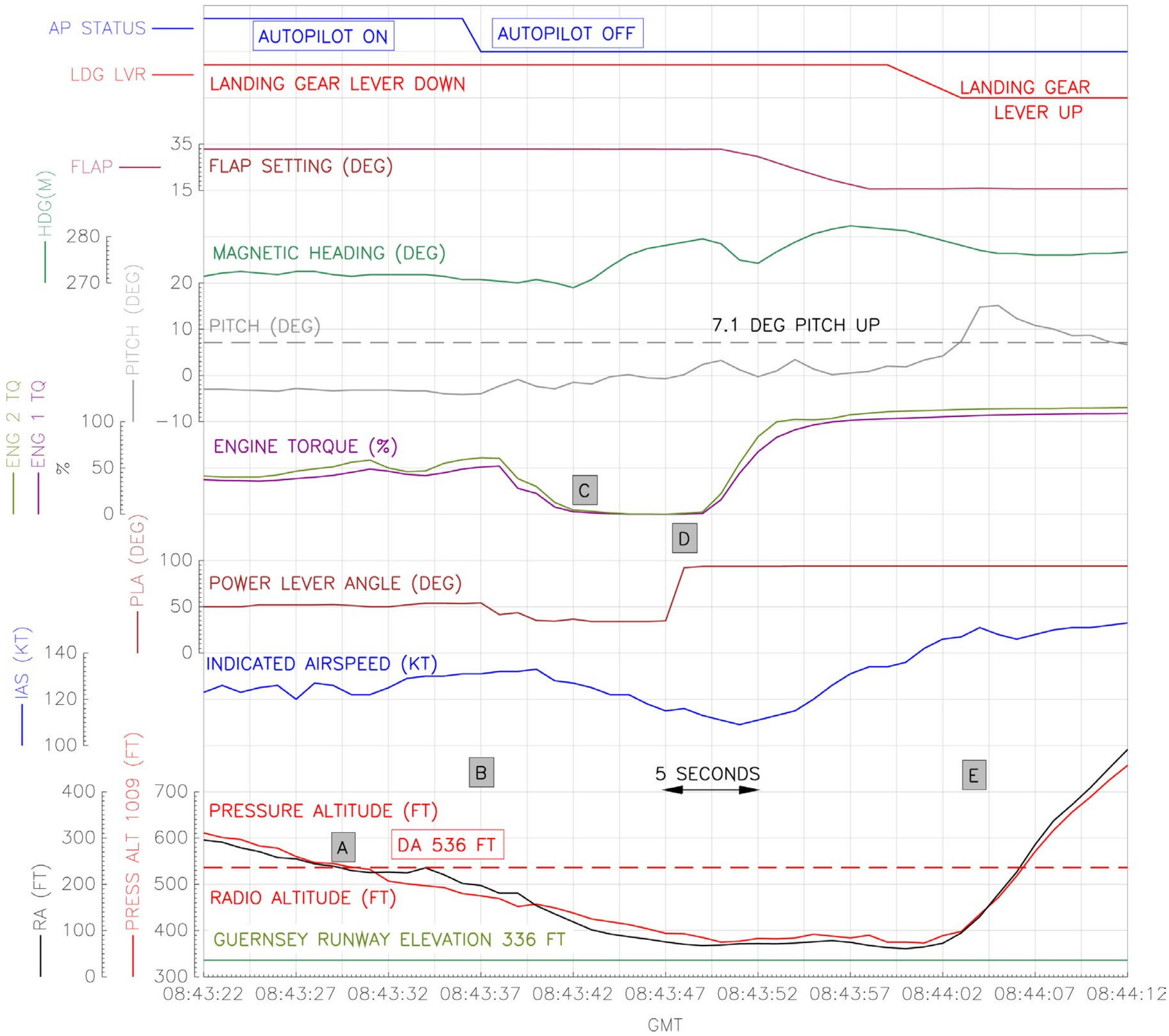


Figure 2

LY-JUP FDR data during approach and go-around

Engine power was then reduced to flight idle and the aircraft pitched up (point C). Just after crossing the displaced threshold, the power levers were advanced to full power when the aircraft was at a radio altitude of 70 ft agl and 116 KIAS (point D). The selection of the go-around pushbuttons on the power levers and the FD were not recorded parameters on the FDR. At the time, the recorded selected heading was 269°.

Footnote

[3] Decision height is 200 ft above the threshold elevation. Guernsey Airport Runway 27 threshold elevation is 336 ft amsl.

Engine power increased, flap setting was reduced to 15° and the indicated airspeed increased. The landing gear remained down, and pitch attitude remained below the 7.1° for 15 seconds after the power levers were advanced. The aircraft remained at a radio altitude of between 61 to 78 ft agl and recorded GPS position showed a deviation to the right of the runway (Figure 3). The recorded position showed that the aircraft came within 40 m laterally of the Runway 27 DME transmitter whilst at 375 ft amsl (top of the DME transmitter is 348 ft amsl).

At 0844:03 hrs, pitch attitude increased above 7.1° and the landing gear lever was selected to the UP position (Figure 2 Point E). The aircraft climbed and pitch attitude continued to increase to a maximum of 15.8° before then reducing as the aircraft continued to climb. At 0844:22 hrs, the aircraft made a radio transmission that it was going around and diverting to Southampton.

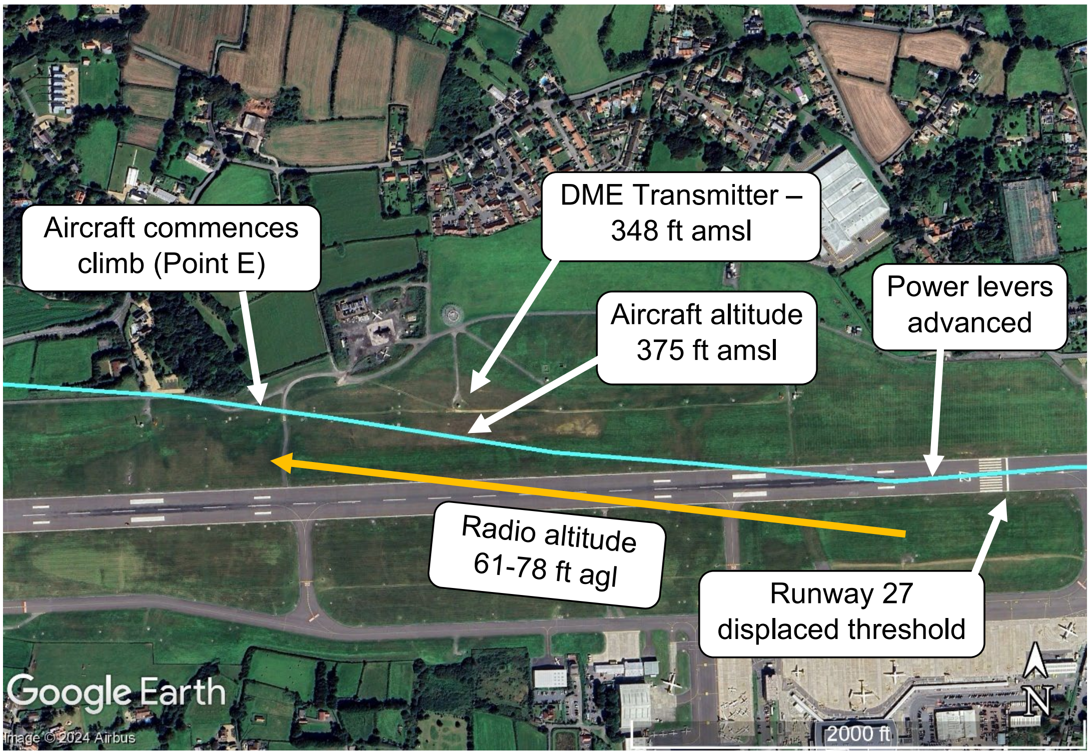


Figure 3

LY-JUP ground track during approach and go-around

Meteorology

General synopsis

A southeasterly airflow covered the Channel Islands on 12 August 2024 bringing mostly settled and dry conditions with light winds. The conditions brought some mist and fog to the western areas of the Channel Islands which spread east during the morning before clearing. There were some isolated showers of rain and the chance of thunderstorms developing later in the day. Outside of the mist and fog, the visibility was excellent.

The position of the Channel Islands can generate some notable characteristics to the weather, including the arrival of fog in seemingly warm and/or windy conditions. This is coastal sea fog which is the result of warmer air moving over the cool surface of the sea. Any wind can then blow the sea fog over the Channel Islands and is especially likely in spring and summer months. It usually clears rapidly once over land, especially if the temperatures are warm.

Forecasts and observations at Guernsey Airport

The crew were rostered for the flights to Southampton and back reporting at 0455 hrs. The crew were able to review the forecast and actual weather before they departed Guernsey as well as before their departure from Southampton using their tablets. The overnight forecast showed that there was 40% probability of there being fog between 0600 hrs and 1200 hrs. At 0457 an updated TAF was issued which delayed the time of the possible fog to 0700 hrs. This TAF was subsequently amended at 0657 hrs to show fog with visibility of 100 m with a 40% probability of an improvement between 0600 and 1200 hrs to a visibility of 3000 m. The TAF suggested that the weather would clear from 0800 and 1100 hrs. The TAF was further amended at 0804 hrs. The timing and contents of the TAFs and METARs are shown at Table 1 with the information provided on fog in bold italics.

Time (UTC)	TAF or METAR	
0155	TAF	1203/1212 11014KT CAVOK PROB30 TEMPO 1208/1212 -SHRA SCT100CB BECMG 1203/1205 18008KT BECMG 1204/1206 26010KT 3000 BR BKN003 ***PROB40 TEMPO 1206/1212 0400 FG BKN000***=
0450	METAR	20012KT CAVOK 20/18 Q1008=
0457	TAF	1206/1215 16012KT CAVOK BECMG 1206/1207 26012KT 3000 BR BKN003 ***PROB40 TEMPO 1207/1212 0400 FG BKN000 PROB30*** TEMPO 1208/1212 -SHRA SCT100CB BECMG 1213/1215 9999 SCT005=
0520	METAR	26007KT CAVOK 19/18 Q1008=
0550	METAR	26010KT ***0100 R27/P1500D FG OVC000*** 18/18 Q1008=
0620	METAR	27010KT ***0050 R27/0225N FG OVC000*** 18/18 Q1009=
0650	METAR	28010KT ***0100 R27/0250N -SHRA FG OVC000*** 18/18 Q1008=
0657	TAF	***1206/1215 27011KT 0100*** FG OVC000 PROB40 TEMPO 1206/1212 3000 BR FEW000 SCT001 BKN002 PROB30 TEMPO 1206/1214 9000 SHRA SCT090CB BECMG 1208/1211 9999 SCT005=
0720	METAR	28009KT ***0100 R27/0250N -DZ FG OVC000*** 18/18 Q1009=
0750	METAR	28011KT ***0150 R27/0250N -DZ FG OVC000*** 18/18 Q1009=

Time (UTC)	TAF or METAR	
0804	TAF	***1209/1218 27011KT 0100 FG OVC000 PROB40 TEMPO 1209/1213 3000 BR FEW000 SCT001 BKN002*** PROB30 TEMPO 1209/1214 9000 SHRA SCT090CB BECMG 1209/1212 9999 SCT005=
0820	METAR	28011KT ***0200 R27/0275D -DZ FG BKN000*** 18/18 Q1009=
0850	METAR	28011KT ***0300 R27/0550U -DZ FG BKN000*** 18/18 Q1009=

Table 1

Forecast and observations for Guernsey Airport

The crew arrived in Southampton at 0645 hrs and were able to gather some more up to date information on the weather in Guernsey. The commander did ask ATC to contact Guernsey for the latest RVR information, but they were unable to supply it. The commander, together with the co-pilot and the operator, decided on the basis of the forecast and observations that the weather was good enough for the flight to depart but that he would load some extra fuel for any required holding and that they would carry fuel for a return to Southampton where the weather was good. The fog dissipated, and the visibility improved to in excess of 10 km between the METAR observations at 0950 and 1020 hrs.

RVR readings

The airport at Guernsey has two RVR reading stations – the touchdown and the stop end. The figures for these were recorded every minute during the approach to Runway 27. A plot of the touchdown readings from the time the aircraft departed from Southampton until the time of the go-around is shown in Figure 4.

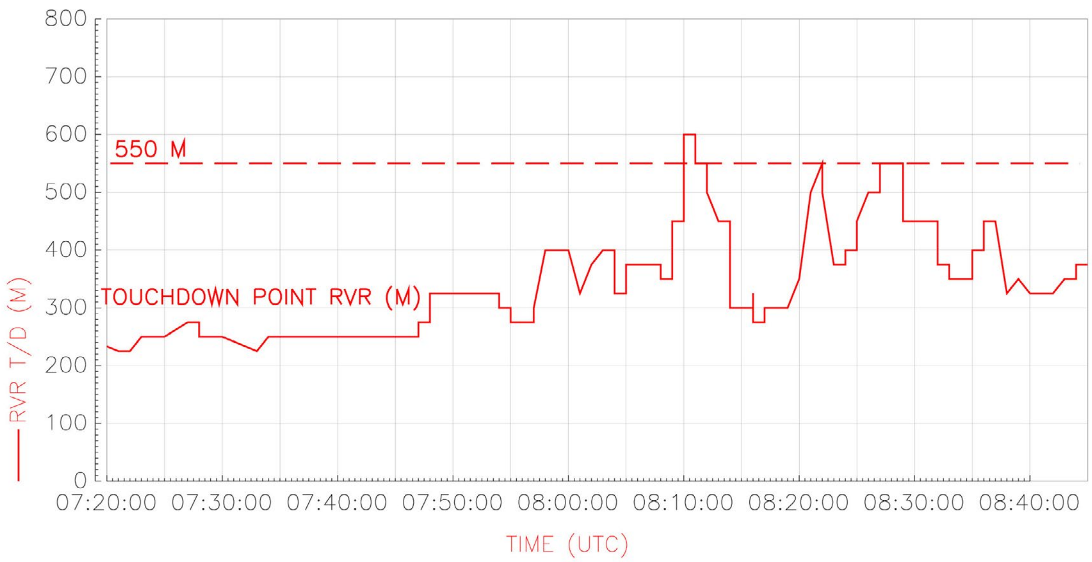


Figure 4

Runway 27 touchdown point recorded RVR

Airfield information

Guernsey Airport has a single runway orientated east-west. The airfield is equipped for CAT 1 approaches only with an ILS/DME available at both ends. The runway in use on the day of the flight was Runway 27 which is equipped with a high intensity approach lighting system with a length of 895 m and five crossbars, high intensity runway lights and centre line lights as well as a set of PAPIs. The runway has a landing distance available of 1,463 m with an elevation (also that of the threshold of Runway 27) of 336 ft.

During the period of the serious incident, the DME was out of service as it was being replaced as part of a long-term maintenance plan at the airport. This was notified to the crew as a NOTAM and was included in the pre-flight briefing pack. As a result of this ATC would transmit distances from the threshold for the crews at certain relevant points on the approach.

The airport is equipped with CCTV, stills of which were provided showing the view of the Runway 27 touch down zone. The stills show the weather around the time of the approach and on the subsequent day when there was no fog.

Figure 5

Airport CCTV images looking south over the Runway 27 touchdown zone (times are BST)

Personnel

Background

Both the commander and the co-pilot had significant flying experience. The commander had over 4,600 hours on the ATR as well as experience on the B757, 767 and 777. The co-pilot had over 760 hours on the ATR with over 2,000 hours total flying time. They had joined the operator in March and January 2024 respectively and had completed an operator conversion course. This course included a Crew Resource Management (CRM) refresher, simulator training, line training and a line check. The operator's training records showed no significant areas of concern. The commander had received positive comments on his CRM and crew support. There was one comment that reminded him that the ATR is a multi-pilot aircraft. The co-pilot had received very few comments at all during his training although the training captain who conducted his line check did suggest to him that he should not hesitate to offer help to the PF.

Commander and co-pilots recollection of events

Both pilots recall that an approach brief was conducted by the commander in accordance with the operator's Standard Operating Procedures (SOPs). The approach brief did not include any conversation about the approach ban or which altitude it would apply into Guernsey although they discussed the CAT 1 minima for the approach. The approach was flown with the autopilot engaged. There was no discussion about the RVR as the approach progressed. The aircraft passed the approach ban altitude without comment from either crew member despite the RVR being given which was below the 550 m they required. The commander stated that he was working to what he described as 'old rules' where you could continue down to the minima. The commander was not challenged by the co-pilot despite him being aware of the requirement.

As the aircraft approached the decision altitude (536 ft amsl) the commander recalled that he could see the runway lights and had the required visual references to continue. He recalls the co-pilot calling "Minimums" and that he replied "Contact, Land" as per the SOPs. He disconnected the autopilot in preparation for landing. He was surprised then when he heard the co-pilot call for a go-around. The SOPs require a go-around to be flown should either crew member call it, so he recalled immediately calling "Go-around, set power, flaps one notch" and noted the co-pilot retracted the flaps as requested. He then called for the gear to be retracted but the co-pilot seemed to be unresponsive. He recalled calling at least three times for the gear to be retracted but the co-pilot either wouldn't or couldn't retract the gear. The commander reached over and raised the gear lever before climbing away.

The co-pilot recalls calling "Minimums" and hearing nothing in reply from the commander. With nothing in response, he called for the go-around as he assumed that the commander was not visual with the lights. The commander then began a go-around by advancing the power levers. The co-pilot retracted the flaps as requested when the commander called for them, but the aircraft did not begin to climb away despite the application of power. The commander kept asking for the gear to be retracted but the aircraft did not have a positive rate of climb, so he was unable to comply with the request. He recalls prompting the commander to climb; to pitch the aircraft up and explaining why he could not retract the landing gear, but the commander did not respond to these prompts. Eventually he pulled on the control column himself in order to establish a climb. The commander retracted the landing gear.

Having completed the go-around, the flight returned to Southampton where it landed without incident. Having refuelled and with the weather improved in Guernsey, the crew conducted the flight from Southampton to Guernsey, landing just before 1200 hrs.

Non-technical skills (NOTECHs)

The aviation industry used a set of non-technical skill categories to assess flight crews and provide feedback to improve performance and safety. EASA provides a list of four areas which are to be assessed and provides more detailed elements as well as examples of behavioural markers which must be graded by operators during pilot checking and training. The EASA framework[4] lists cooperation, leadership and managerial skills, situational awareness, and decision-making as its four categories. Whilst it does not have a specific category for communication, this skill is at least partially assessed into all four categories. The operator uses this EASA framework for assessing their crews.

Other operators both within EASA and elsewhere do include communication as a specific fifth category. This allows direct assessment of behaviour markers such as active listening, the ability to convey messages in clear, accurate and timely fashion, and confirmation that the recipient is ready and able to receive information. Communication provides information, helps establish relationships between team members as well as ensuring that the management of resources (such as time and workload) are effective. Good communications are an essential requirement for safe operations and without it can come confusion and a lack of coordination. The operator's crews come from a variety of backgrounds and nationalities for whom English is not their native language. All crew are assessed and must have an approved level of competence in the operational language, but the challenges of good communication can be increased in such situations. In this flight neither crew member spoke English as a first language. Beyond the use of English, they did not share a common language.

Regulations

Approach ban

The objectives of the 'approach ban' are to prevent the situation where a pilot arrives at a decision altitude or height with insufficient visibility to adequately control the aircraft for landing and to reduce the rate of missed approaches from minimas. The idea is to minimise the chance of an aircraft being manoeuvred at low level in poor visibility with the risk of uncontrolled ground contact.

Footnote

4 AMC3 ORO.FC.115 Crew resource management (CRM) training https://www.easa.europa.eu/sites/default/files/dfu/Consolidated%20unofficial%20AMC&GM_Annex%20III%20Part-ORO.pdf [Accessed November 2024].

The idea of the approach ban first made its appearance in Annex 6 to the convention on International Civil Aviation on Operation of Aircraft, Part 1 International Commercial Air Transport, section 4.4.1.2 in 1969. It became part of the European regulations as part of the Joint Aviation Regulations Operations 1, 1.405 sometime in the early 2000s. It remains a UK, EASA and international regulation.

The approach ban as applied in both European and UK regulations prohibits a crew from continuing an approach below 1,000 ft above the aerodrome elevation if the governing RVR for that approach is not met. If the governing RVR should fall below the required value once the crew have passed that 1,000 ft point above the aerodrome elevation, they are permitted to continue down to the minima.

The operators Operating Manual Part A (OMA) states:

> *'The Commander or the pilot to whom conduct of the flight has been delegated may commence an instrument approach regardless of the reported RVR.*
>
> *If the reported RVR is less than the applicable minimum the approach shall not be continued:*
>
> *below 1 000 ft above the aerodrome; or*
>
> *If, after passing 1.000 ft above the aerodrome, the reported RVR falls below the applicable minimum, the approach may be continued to DH.'*

Organisational information

The operator was on contract to another UK Air Operators Certificate (AOC) holder. This wet lease operation had progressed through an approval process by the UK CAA and by the Director of Civil Aviation Guernsey. The process for approval is a formalised one which is used by many operators with UK AOCs.

The operator did not have an FDM programme, nor were they required to have one.

Analysis

Approach ban

Both crew members were aware of the approach ban but it was neither mentioned nor included in the approach brief. The commander may have reverted to a previous understanding of the regulations which he understood to permit him to continue down to the minimums before making a decision to land or go-around based on what he saw. The co-pilot did not challenge this understanding either before the approach or as they passed the approach ban point.

Crew performance

Without a CVR it is not possible to know exactly what communication occurred between the crew before and during the approach or after the aircraft passed the decision altitude. Any discussion of the communications that took place therefore relies on the recollection of the commander and co-pilot.

During the flight to Guernsey, neither pilot discussed the approach ban or whether it might apply to their subsequent approach. They did discuss what they would do if the weather was below minimums, and what their subsequent actions for the diversion would be. Once the aircraft was established on the glideslope, neither pilot can recall there being any further discussion about the RVR although they were given the information on several occasions by ATC.

As the aircraft passed decision altitude the commander recalls seeing the required visual references and hearing the co-pilot call 'minimums' to which he called 'Contact, Land' as per the SOPs. The co-pilot does not recall hearing any response to his call of 'Minimums' and as a result assumed that the commander was not visual with the lights. The commander was surprised when the co-pilot called for a go-around. Ineffective communication meant that neither pilot was sure what the other was doing or planning. As a result, there was confusion about the go-around. Neither pilot was fully aware of the other pilot's intentions or the situation. They did not share a common picture of where the aircraft was or what they were trying to achieve. Despite this when the co-pilot did call for a go-around, the commander immediately complied by pressing the go-around button on the power lever.

Once the go-around button was pressed and the flaps retracted as required at the commander's request, the FD would have indicated a 7.1° pitch up as per the aircraft design. During the next 15 seconds although the aircraft pitch did vary, it did not increase to a steady positive pitch that would have resulted in the aircraft climbing away from the ground. Despite the lack of climb and the commander not responding to his prompts, the co-pilot made no attempt to take control to correct the flight path. The commander did not try and climb the aircraft despite the lack of landing gear retraction and the perceived lack of response from the co-pilot.

The lack of a shared mental model between the pilots had the result that neither was aware of how close to the ground and obstacles they were for an extended period of time.

Operator's non-technical skills

The operator used the EASA framework for their non-technical skills assessment, but this did not include a specific category for communications. Communications are partially covered by different parts of the framework but there was no standalone assessment of those behaviours. This meant that there was no specific effort by the operator to assess, train and improve the communication skills of their crews, despite the diversity of their nationalities and native languages.

Conclusion

The flight continued the descent below the approach ban altitude whilst on an approach to Runway 27 at Guernsey Airport despite not having the required RVR. The commander may have been reverting to a previous understanding of the regulations, and this was not challenged by the co-pilot at any point. When the aircraft passed the approach minima, confusion and miscommunication between the crew resulted in a go-around being called and selected, but the pitch remained at around that required for level flight. The aircraft flew over the airfield between 61 – 78 ft agl for 15 seconds before interventions from both crew members resulted in a climb. The flight was diverted to Southampton Airport where it landed without further incident.

Safety actions

As a result of this incident, the following Safety Action was taken by the operator of LY-JUP:

- Implemented an FDM programme which will enable the early identification of issues and help prevent future occurrences via preventive actions whenever negative trend is identified.
- Revised and enhanced the recruitment process in regard to the psychological assessment of pilots.
- Revised and amended simulator profiles to require co-pilots to actively challenge commanders' decisions when deviations, errors or violations are noticed.
- Issued guidance to instructors in training and checking activities on areas of emphasis aimed at improving crew coordination and collaboration.
- Provided guidance for instructors to increase the written feedback provided to trainees after a training or checking activity.
- Conducted an internal assessment of adding the category of 'communications' as a standalone NOTECH assessment area.

Published: 27 February 2025.

Accident

Aircraft Type and Registration:	Extra EA-200, G-EEEK
No & Type of Engines:	1 Lycoming AEIO-360-A1E piston engine
Year of Manufacture:	2006 (Serial no: 1034)
Date & Time (UTC):	13 July 2024 at 1142 hrs
Location:	Spanhoe Airfield, Northamptonshire
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:	65 years
Commander's Flying Experience:	At least 4,076 hours (of which approximately 1,100 were on type) Last 90 days – at least 225 hours Last 28 days – at least 81 hours
Information Source:	AAIB Field Investigation

Synopsis

After flying to Spanhoe Airfield, Northamptonshire, the pilot of G-EEEK pitched the aircraft into a vertical climb and completed a manoeuvre from which the aircraft entered an upright flat spin to the left. The aircraft was not recovered before it struck the ground, and the pilot was fatally injured.

The investigation was unable to establish why the pilot flew such manoeuvres, unapproved and at low level. It was not possible to exclude a control restriction or a pilot incapacitation for the lack of sufficient recovery before the aircraft struck the ground.

History of the flight

The pilot had flown the aircraft from Fowlmere Airfield, Cambridgeshire to Spanhoe Airfield, Northamptonshire to meet a friend. On arrival at the airfield, the pilot flew a fly past before pitching up to the vertical during which he performed a number of aileron rolls. At the apex of the climb, the aircraft was manoeuvred, entering a flat spin to the left from which it was not recovered before it struck the ground by the entrance track to the airfield. The pilot was fatally injured.

Accident site

The aircraft struck the ground in a wooded area approximately 170 m to the south of Runway 09-27, adjacent to the airfield access road. The compact nature of the accident site, lack of ground impact marks away from the aircraft wreckage and relative lack of distortion to the fuselage's welded steel frame showed that the aircraft had struck the ground at low speed in an approximately level pitch and roll attitude (Figure 1). Three-phase electrical cables directly above the aircraft wreckage were intact, apart from minor fire damage, indicating that the flight path prior to impact was not vertical to the ground and that the aircraft had a low degree of forward speed at impact. The low forward speed was further confirmed by the lack of significant forward displacement of debris from the main aircraft wreckage.

Figure 1
G-EEEK accident site

An intense post-impact fire had occurred, consuming the majority of the flammable material of the aircraft's structure, and it was not possible to determine if the aircraft had been rotating in yaw at impact.

Examination of the aircraft wreckage at the accident site confirmed that all major airframe structural elements, control surfaces, canopy, landing gear, engine and propeller were present. Damage to the aircraft's three-bladed wooden propeller showed that the propeller had been rotating under power at impact. The pilot was sitting in the rear seat, with the steel buckle of the seat harness present in the rear cockpit, however the seat belt straps had been consumed by fire. The accident was not survivable.

Witnesses

There were few witnesses who saw the final part of the flight although a number of others at the airfield heard the aircraft as it passed over. Witnesses reported seeing the aircraft pass low over the airfield before pulling into a vertical climb. During the climb the aircraft rotated about the vertical axis a number of times. At the top of the climb the aircraft was seen to 'fall' into a descent with a rotation to the left. A witness familiar with the aircraft described seeing it in a flat spin to the left. All the witnesses reported that the aircraft noise was loud and that they could hear the engine running at high power.

CCTV supported the witness recollection and allowed the final manoeuvres to be assessed although the aircraft was a significant distance away from the CCTV camera. The aircraft is seen to pitch up into the vertical, completing at least four aileron rolls to the right whilst in the climb. At the top of the climb the aircraft is seen to complete some kind of ballistic manoeuvre which results in a flat spin to the left. The aircraft is seen on the CCTV to complete at least four turns in the spin before it is lost to sight behind trees.

Recorded information

Two different CCTV cameras captured G-EEEK during the arrival and manoeuvres at Spanhoe. Images from one CCTV camera showed the aircraft approaching the airfield boundary. Analysis of the CCTV showed that the aircraft was flying at approximately 140 kt ground speed and at around 500 ft agl as it passed through the camera's field of view.

The second CCTV camera showed the aircraft during the final manoeuvres. Only limited analysis of this CCTV was possible due to the distance of the camera from the aircraft and the camera lens optics. This analysis combined with the witness evidence suggested that the maximum possible height that G-EEEK reached during the vertical climb was 1,200 ft agl.

Aircraft information

The Extra EA-200 is a two seat fully aerobatic aircraft, designed for unlimited aerobatics. The fuselage is built from welded tubular-steel construction, and the wings, rudder and landing gear are made from composite materials. The aircraft has a 200 hp engine driving a three-bladed, constant-speed propeller.

The aircraft is fitted with a fuel tank in each wing and a centre/aerobatic tank fitted in the fuselage, in front of the main wing spar. Each interlinked wing tank has a capacity of 43 litres, with the centre/aerobatic tank containing a maximum of 36 litres. With the centre/aerobatic tank selected, the fuel system has a full negative g capability.

Aircraft examination

Fire damage to the aircraft's flying controls prevented a complete assessment of their condition immediately prior to the accident. Control continuity of the rudder controls, comprised of multi-strand steel cables and swaged fittings, was confirmed from both sets of rudder pedals rearwards to the rudder surface and no anomalies were identified.

The aileron and elevator control system consists of a steel torque tube between the front and rear control columns that is connected to a series of aluminium alloy pushrods and bellcranks that move the aileron and elevator control surfaces. The intensity of the post-impact fire had caused most of the pushrods to melt, leaving only steel rod-end bearings attached to the bellcranks. The aileron circuit bellcranks are made from aluminium alloy and these had also melted. Where aileron and elevator control circuit components were identified, their condition was assessed at the accident site and no pre-accident defects were found.

The aircraft's fuel selector valve had melted, leaving only the steel selector rod remaining. It was therefore not possible to determine whether the wing tanks or the centre/aerobatic fuel tank was selected when the accident occurred.

The aircraft's engine was disassembled which confirmed mechanical continuity of the valve train and pistons to the crankshaft. Apart from heat damage from the post-impact fire, the internal components of the engine were in good condition.

The aircraft's logbooks and technical records were examined. These showed that an annual inspection had been carried out on 1 April 2024, at 2,337 flying hours, in accordance with the aircraft's approved maintenance programme. A subsequent 100-hour inspection had been carried out on 20 June 2024, at 2,426 flying hours. The aircraft had a current Airworthiness Review Certificate and at the time of the accident the total flying time recorded in the aircraft's logbook was 2,455 hours. The engine logbook recorded that the engine had completed 1,200 hours since major overhaul.

There were no current aircraft defects recorded when the aircraft departed Fowlmere Airfield on the accident flight. As the aircraft was not recorded on SSR during the accident flight, a review of previous flights was undertaken to determine when the transponder had last been recorded. The last record of a transponder return from the aircraft in flight was on 24 March 2024, 72 flights prior to the accident flight. The aircraft operator stated that they were not aware that the transponder may have been unserviceable.

Weight and balance

The aircraft type is designed for the pilot in command to be in the rear seat. With only one occupant sitting in the rear seat, the weight and balance would have remained within the centre of gravity envelope throughout the flight regardless of the fuel load on takeoff from Fowlmere. The aircraft type also has a takeoff weight limit for aerobatics for both single and dual pilot configurations. With the estimated fuel load at Fowlmere and a single occupant, the aircraft was below the maximum takeoff weight for aerobatics at departure.

Aircraft performance

Fuel

It was not possible to be conclusive about what fuel remained in the aircraft when it reached Spanhoe as anything still present had been consumed in the fire. The aircraft departed from Fowlmere with an estimated 76 litres of fuel (20 litres in each wing tank and 36 litres in the full centre/aerobatic tank). The manufacturer recommends the fuel selector be set to the centre/acrobatic tank for takeoff. It would then be the pilot's usual practice to use the wing tanks for the flight from Fowlmere to Spanhoe which would have likely used around 10 litres. This would have left around 15 litres in each of the wing tanks with the centre/aerobatic tank nearly full. When the aircraft is to be used for aerobatics the wing tanks must be empty. Fuel in the wing tanks can move around with significant force during aerobatic manoeuvres causing possible damage to the internal structure of the tanks, as well as generating additional gyroscopic forces.

Aerobatics

The Extra EA-200 is described as ideal aircraft on which to teach aerobatics. It is light on the controls and is stressed to +/- 10g. The POH lists the aircraft stall speed with a single pilot at the acrobatic maximum takeoff weight as 53 KIAS at 0° angle of bank and 75 KIAS at 60° angle of bank. Spins, including flat spins, are regarded as part of the aerobatic manoeuvres the aircraft is designed to perform.

The Extra EA-200 is designed to be able to spin both upright and inverted, and flat with and without power. Recovery is conventional and described as rapid. The pitch characteristics of a flat spin is with the aircraft either flat or the nose just above the horizon. A flat spin with power will tend to have a higher nose attitude and a reduced rate of descent compared to one without power due to the effects of the airflow from the propeller over the tail. With a Lycoming engine, a flat spin to the left with power would produce the slowest rate of descent which the aircraft manufacturer estimated to be between 100 - 200 ft per turn. In an upright flat spin, it is not possible to see the ground in an Extra EA-200 as there is no transparent floor panel.

Entering directly into a flat spin inadvertently is highly unlikely. Entry requires positive control inputs on the rudder, aileron and elevator. Inadvertently entered spins tend to be normal spins that may develop into flat spins. Recovery from a spin in an Extra EA-200 requires the application of opposite rudder, the power to idle with neutral ailerons and the stick to a neutral elevator position. The Pilot Operating Handbook for the aircraft states that using this technique the aircraft should recover within half a turn. Comments from pilots who have flown the aircraft type suggest a minimum of 800 ft would be required to recover from an idle power flat spin to a climb. This might be reduced if the power was on during the recovery. Information from the manufacturer estimated that a recovery using the recommended procedure from an intentional aerobatic category spin must assume a height loss of around 600 to 800 ft for the pull-out.

Meteorology

The weather situation on the day of the accident was generally settled with a light westerly or northwesterly wind with good visibility. There had been some lower cloud earlier in the day at both Fowlmere and Spanhoe which had gradually lifted. The cloudbase at Spanhoe at the time of the accident was between 3,000 and 5,000 ft amsl.

Airfield information

Spanhoe is a former second world war airfield which now operates as an unlicenced private airfield. The pilot of G-EEEK was very familiar with the airfield, having operated from there many times previously.

Several witnesses reported that it was not unusual for aircraft to conduct low flypasts or aerobatic manoeuvres over the airfield. The pilot was a member at the airfield and therefore was not required to obtain prior permission for the flight and the airfield operator was not aware that he was coming. The pilot did not have permission or approval to conduct an aerobatic display at Spanhoe.

Pilot

The pilot of G-EEEK was very experienced both in aerobatics and in the aircraft type. He was a qualified aerobatics instructor and had also competed in aerobatic competitions. He had also previously held a display authorisation. He had flown G-EEEK many times over several years.

The pilot was described by colleagues and former students as very safety conscious and thorough. They felt that it was out of character for him to attempt any low level manoeuvres outside of approved competitions or displays. They reported that he was not of a character who wished to 'show off' his aircraft or his skills. He acted as the flying school safety manager at Fowlmere.

He was travelling to Spanhoe to meet with a friend with whom he owned another aircraft. This was a reasonably regular meeting as the aircraft was kept at another airfield and they would often meet at Spanhoe to go flying either together or solo. The arrangement was usually that the friend would fly the aircraft over from its home base to Spanhoe so that they could fly it, although there was no set time arranged. It was reported that it was unusual for the accident pilot to fly to Spanhoe rather than drive over as he lived locally, and he would be required to pay for the hours on the aircraft. The pilot had been at Fowlmere during the morning to supervise a solo student and was due back to instruct that afternoon.

Possibility of incapacitation

The post-mortem did not show any evidence of any significant underlying natural disease and there was no indication of a potential medical incapacitation event. Temporary incapacitation such as that caused by positive g-forces will not leave any signs that can be seen post-mortem. The effects of positive g-forces can vary by many factors and can cause only partial incapacitation or a temporary loss of consciousness. The pilot did pull up to the vertical which would have resulted in a positive g load, this was followed by some sort of manoeuvre before the aircraft entered a spin to the left. This manoeuvre could have caused some negative g which also could have affected the pilot. Recovering from even a partial incapacitation can be disorientating.

Analysis

The aircraft struck the ground in an approximately level pitch and roll attitude, with very little forward speed. This is consistent with the aircraft either still in a flat spinning attitude, or in the very early stages of a recovery from a flat spin.

The intensity of the post-impact fire indicated that fuel was present in the aircraft's fuel tanks, although it was not possible to determine which fuel tank was selected. The propeller was rotating under power at impact, and examination of the engine did not reveal any evidence of a mechanical failure although a complete assessment of the engine was not possible due to accident damage. The severe fire damage to the aircraft's flying controls also prevented a complete assessment of their condition and continuity immediately prior to the accident. It is therefore not possible to exclude the possibility of a restriction of the flying controls.

Both the aircraft type and the pilot were capable of performing the manoeuvres seen by witnesses had there been sufficient height to allow for the recovery. CCTV analysis indicated that the height achieved during the vertical manoeuvre was a maximum of 1,200 ft agl. With between 600 and 800 ft being required to recover from the spin, this maximum height left little margin for the pilot.

The pilot had been flying aerobatics and instructing for several years and was very experienced on the aircraft. It would seem at odds with the pilot's experience to perform such manoeuvres unapproved and at a low altitude. Witnesses who knew the pilot well suggested aspects of the flight to be unusual and seemingly out of character. As an experienced pilot on type, he would have known that flying aerobatics with fuel remaining in the wing tanks was unapproved and presented additional risks to the aircraft and to any recovery. His colleagues reported that any operation outside of the regulations or aircraft approved envelope was not something they had ever observed in him.

Despite the lack of findings at the post-mortem it is possible that the pilot was incapacitated in some way which reduced his ability to make decisions or fly the aircraft either during or after the pull up. Although some deliberate movement of the controls is required to enter a flat spin in the aircraft type, it is possible that a pilot who regularly flew such manoeuvres could have completed the control movements whilst not fully conscious. The pull up to begin the manoeuvre would also have exposed the pilot to positive g-forces, followed by some negative g, either or both of which might have affected his level of consciousness.

Conclusion

It has not been possible to establish a likely cause for the accident although a number of possible causes were identified. Due to the extensive damage to the aircraft in the subsequent fire the possibility of a restriction in the controls that prevented or limited the recovery cannot be ruled out. It is also possible that any fuel in the wing tanks may have made the recovery more difficult.

Although there was no evidence found in the post-mortem, it is possible that the pilot was incapacitated to some degree which prevented him recovering the aircraft from the spin in sufficient time. Although he was an experienced aerobatic pilot, the effects of positive g and negative g he may have experienced in the manoeuvre could have diminished his level of consciousness. It was not possible to establish why he chose to perform some aerobatic manoeuvres at low level, without approval which left insufficient height to recover.

Published: 6 March 2025.

AAIB Correspondence Reports

These are reports on accidents and incidents which were not subject to a Field Investigation.

They are wholly, or largely, based on information provided by the aircraft commander in an Aircraft Accident Report Form (AARF) and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

Serious Incident

Aircraft Type and Registration:	Airbus A320-214, G-EJCI
No & Type of Engines:	2 CFM56-5B4/3 turbofan engines
Year of Manufacture:	2011 (Serial no: 4581)
Date & Time (UTC):	30 July 2023 at 1653 hrs
Location:	After departure from Toulouse-Blagnac Airport, France
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 176
Injuries:	Crew - None Passengers - None
Nature of Damage:	None reported
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	16,488 hours (of which 12,992 were on type) Last 90 days - 132 hours Last 28 days - 32 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, interviews and investigation reports

Synopsis

This investigation was delegated to the AAIB by the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) of France.

During pre-flight preparations, both pilots completed a takeoff performance calculation from intersection N2 of Runway 32R at Toulouse-Blagnac Airport in France. During taxi, the aircraft was cleared to line up and take off from intersection N2 with 2,300 m takeoff distance available. However, the crew entered the runway via the N4 intersection, reducing the takeoff distance available by approximately 500 m. The Tower Controller did not monitor the aircraft visually and did not notice the error. The aircraft rotated with 500 m of runway to go and passed the upwind end of the runway at a height of 180 ft.

The operator, Toulouse ATC and the Direction des Services de la Navigation Aérienne (DSNA)[1] implemented safety actions to strengthen their respective procedures to prevent reoccurrence.

Footnote

[1] The Direction des Services de la Navigation Aérienne is the agency in charge of air traffic control, communication and information for France

History of the flight

The aircraft was making a return flight to London Gatwick Airport from Toulouse-Blagnac Airport having arrived at Toulouse 1 hour 30 minutes behind schedule. The passengers were disembarked and the crew prepared the aircraft for its return flight for which the commander would be the pilot flying.

On completion of the walkaround, the co-pilot returned to the flight deck to prepare for departure while the commander monitored activity in the cabin. When the commander returned to the flight deck, the crew discussed the choice of takeoff points on Runway 32R referencing the operator's FlySmart+ application, which presented two options: full length (N1) and the intersection N2. The crew checked the displayed takeoff distance against the Airport Ground Chart (AGC) (Figure 1 left) and selected intersection N2 as the distance was sufficient at 2,300 m. Both pilots completed the performance calculations from this intersection.

The crew carried out a performance validation of critical data and a takeoff data crosscheck, following which they conducted a departure briefing. They discussed the taxi routing and noted that it was short and uncomplicated. However, they did not discuss the location of the N2 intersection and it was not visible from stand V10 (Figure 1 right). The operator provided a '*Threat Matrix*' to assist crews in identifying potential threats, but it did not include intersection departures as an example of a potential threat.

The turnaround took 38 minutes. The weather was reported as CAVOK.

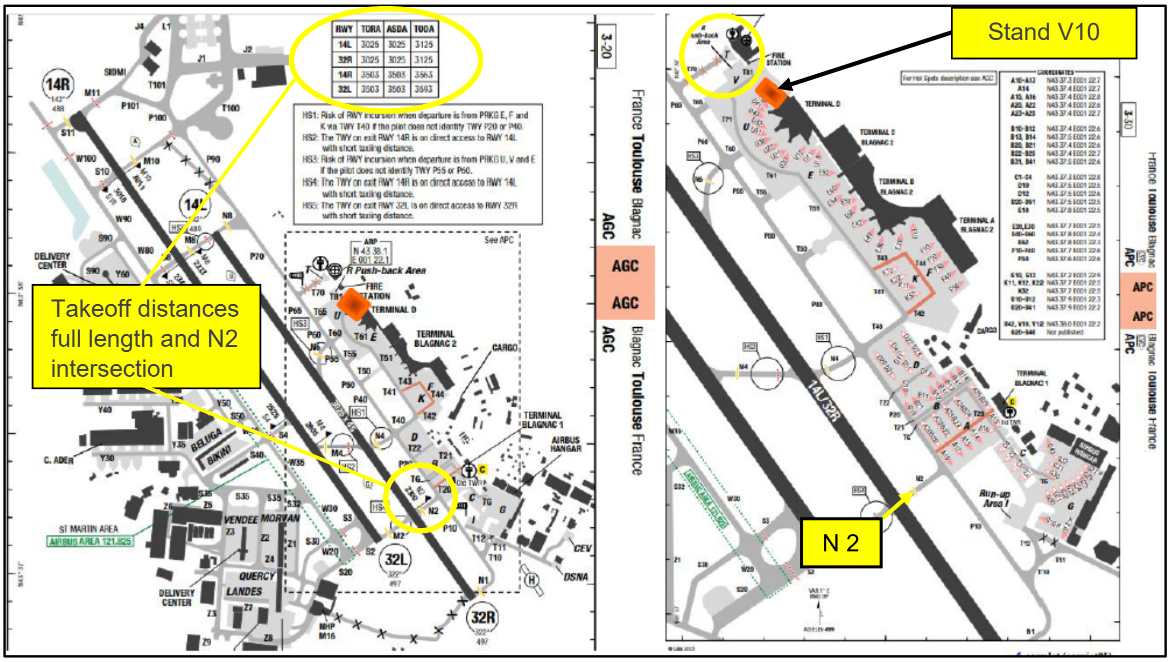


Figure 1

Toulouse AGC and Airport Parking Chart (used with permission)

The ATC Ground Controller cleared the aircraft to pushback and start[2] at 1652 hrs and, at 1657 hrs, for taxi to holding point N1 for Runway 32R. As the aircraft approached the apron exit point of T65, the commander asked the co-pilot to inform Ground that they could accept the intersection N2 for departure in accordance with their departure brief and performance calculations. Ground cleared the aircraft to N2 and instructed them to contact the Tower when ready at N2. The aircraft was on the main taxiway, paralleling Runway 32R. Following a control check the crew performed a PEDS brief[3] from memory, the first part of which is '*performance*', where the pilot monitoring stated the actual takeoff position to be used and the computed takeoff position. However, there was no discussion of where N2 was in relation to their position on the taxiway and it was not a requirement of the checklist in the Operations Manual. The crew could not recall if the commander had the Toulouse AGC displayed on his Electronic Flight Bag (EFB) device but believed it likely that a Standard Instrument Departure (SID) chart was selected in anticipation of the short and non-complex taxi routing.

Following the PEDS brief the co-pilot informed Tower that they would be "READY FOR DEPARTURE UPON REACHING N2" (Figure 2). Tower replied, "BONJOUR FROM N2 2,300 M CLEARED FOR LINE UP TAKE OFF 32R WIND 310 DEGREES 12 KT". As the co-pilot read back the takeoff clearance the aircraft was approaching the N4 intersection where the commander turned the aircraft right, towards the holding point N4 for Runway 32R.

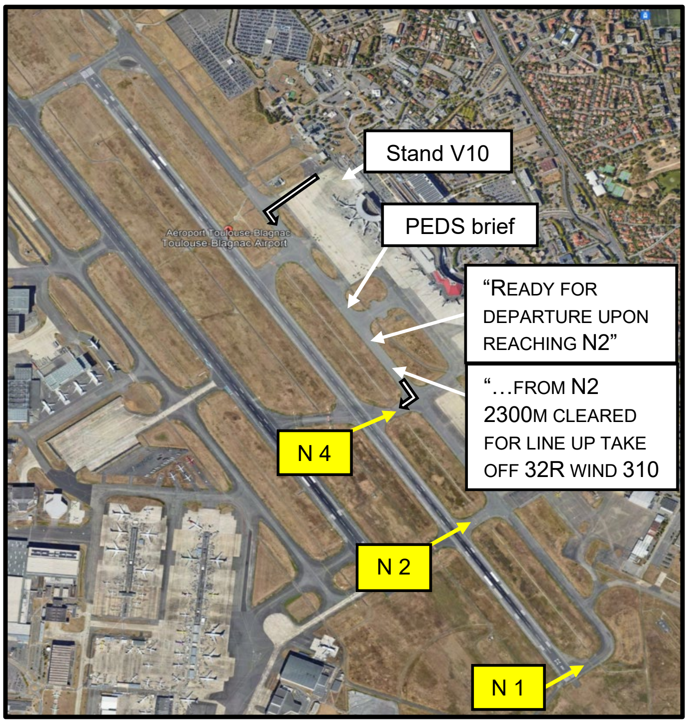


Figure 2

Toulouse-Blagnac Airport showing relevant intersections and actions taken by the crew and ATC

Footnote

2 Both engines were started during the pushback.
3 The PEDS brief normally precedes the taxi checks and comprises: Performance, Engine-out standard instrument departure, Departure runway and routing, Stop altitude and departure clearance.

The crew completed the line-up flow, part of which requires that *'each pilot silently verifies takeoff intersection'*. This was followed by the line-up checklist as the aircraft entered Runway 32R via N4. Runway signage and guard lights ('wig-wags') were installed on both sides of the taxiway at the N4 holding point for runway 32R, as shown in Figure 3.

Figure 3

Holding point N4 for Runway 32R at Toulouse-Blagnac Airport

The line-up checklist requires both pilots to '*confirm that the line-up is performed on the intended runway/intersection and confirm the ATC clearance received'*. The commander declared, '*cleared for takeoff, runway 32R, N2, 2,300 m'*, then initiated the takeoff run, rotating with approximately 500 m of runway length remaining. During the climb phase of flight, the crew discussed the remaining runway length observed during the takeoff and reviewed their performance calculations and taxi routing. They concluded that the takeoff had been initiated from N4 instead of the planned and cleared N2. The distance available from N4 was approximately 1,800 m.

FlySmart+ application design

The FlySmart+ application uses data drawn exclusively from the operator's fleet. When an intersection is selected it is displayed on a graphic (Figure 3) which will only display takeoff options available to the operator's aircraft: for Runway 32R at Toulouse, full length (N1) and intersection N2. The position of intersection N2 in relation to intersection N4 is not displayed as N4 is not available for use by the operator's aircraft. Departures from intersection N4 on Runway 32 R are prohibited for turbojets over 7 tonnes.

Figure 4

FlySmart+ takeoff application (used with permission)

Flight crew

Both flight crew held valid licences and medicals to operate the A320. Their total flight hours and recent experience are shown at Table 1.

Hours	Commander	Co-pilot
Total time	16,488	347
On type	12,992	135
Last 90 days	132	135
Last 28 days	32	15

Table 1

Flight crew experience

Fatigue

The commander was familiar with Toulouse but had not been there recently. He considered the operational environment at his home base as “demanding”, with significant delays occurring on most duties, perceived as being due to a reduced availability of ground staff. He believed this had become accepted as the “new normal” and had led to a desire to be “efficient” to “keep the operation flowing” where possible. The co-pilot described the pace of operations as “quicker than expected from training”. He completed his Line Check earlier in July and was on his eighth sector of operational flying. He had operated to Toulouse once during line training and had not flown with the commander previously. Neither pilot felt that the challenging operational environment had produced a culture of taking shortcuts or rushing.

Both pilots believed they were current and well rested prior to the flight. The operator conducted a fatigue risk management analysis of the crew and assessed that for the commander the risk of roster-related fatigue was medium; the risk for the co-pilot was assessed as low. The analysis concluded that '*fatigue was not a direct cause for the crew having a loss of situational awareness and the aircraft taking off from the incorrect intersection*'.

Crew resource management

The co-pilot reported that the combination of the short taxi distance and early takeoff clearance required the aircraft checks to be conducted in a compressed timescale. This resulted in him being "heads down" for much of the time, cross-checking relevant checklist items. He believed that his mental capacity was fully engaged with this task and could not recall seeing the runway sign boards as they crossed the N4 holding point. His high workload as the aircraft entered the runway meant that his response to the commander's line-up checklist declaration was "disjointed".

The commander reported that as their pushback was late by over an hour, he was trying to be "efficient". He believed that the conduct of the checks "flowed promptly" but were not unduly rushed. He recalled that the first point he was aware that the co-pilot might be task saturated was when he asked for the taxi checks promptly followed on by the line-up checks. He reported not seeing the runway sign boards, possibly due to his monitoring of the actions of the co-pilot.

The operator stated that all its pilots are trained to manage risks associated with workload management by using a '*traffic light'* risk model. This includes '*discussion of the risk associated with each traffic light level and how to recognise what level they are in. It then discusses how to return to the green from amber or red levels, by communicating their situation with their colleagues; buying more time; reducing workload and changing the plan'*. They concluded that although the co-pilot recognised he was in the amber ('*feeling overwhelmed'*) he did not communicate this to the commander. His relative inexperience was cited as a likely contributing factor to the outcome.

Investigation by operator

An investigation conducted by the operator concluded that the operational environment at the home operating base at the time of the occurrence could be considered '*challenging*'. This was attributed to a combination of the application of calculated takeoff times and a perceived shortage of ground staff adding pressure to meet scheduled departure times. However, this '*did not result in unsafe shortcuts or inappropriate rushing but did result in an expeditious mindset for the commander'*.

Additional factors that influenced the outcome were identified as:

- **Mental model** - the crew calculated and correctly inserted performance figures for intersection N2. A focus on finding the correct numerical value for the intersection on the AGC for performance calculations, in combination with the depiction of the runway layout on the FlySmart + application showing only one intersection for Runway 32R, may have contributed to the inaccurate mental model that there was only one runway intersection.

- **Briefing** - Using the Threat Matrix for the departure briefing, the crew did not identify the non-complex taxi routing as a potential threat that required to be discussed in detail. Addressing the taxi routing visually was effective on briefing how to leave the apron but as the terminal building blocked the view of the airport layout, it was not effective in identifying the location of N2.

- **Time pressure and workload** - The time from taxi to takeoff was recorded to be 3 minutes, 55 seconds during which the co-pilot was mainly '*heads-in*' to focus on tasks as the crew completed SOPs for taxi and takeoff. This workload reduced his situational awareness. The commander '*plausibly*' had the SID displayed on his EFB during taxi instead of the AGC as the routing was not identified as being complex. However, as the aircraft approached the perceived correct intersection, not having the AGC displayed may have reduced his situational awareness.

- **CRM** - as the co-pilot completed his tasks in accordance with SOPs, the commander did not notice the increase in his workload. By not verbalizing the perceived increase in workload and reduced situational awareness ("feeling overwhelmed") to the commander, the co-pilot '*did not enable the crew to reduce the pace of actions*'.

- **Lack of explicit position confirmation** - the PEDS brief was performed from memory, which involved a verbal confirmation that the crew had calculated performance for N2 and were cleared to taxi to N2. It did not involve a confirmation of where N2 was in relation to the aircraft's actual position, and SOPs do not require this.

- **Confirmation bias from ATC clearance** – following the early clearance from ATC, completing the taxi checklist through to the line-up checklist as the aircraft approached N4, entered the intersection and passed the runway holding point, resulted in the crew not observing the external runway signage. The increased workload reduced the effectiveness of confirming the actual intersection and increased the likelihood of the crew being vulnerable to confirmation bias.

Air traffic service information

Investigation

An analysis of the serious incident was conducted by the DSNA and interviews of ATC personnel were conducted by the BEA. The analysis found that when the shift was manned at 1700 hrs there would normally be five personnel on duty to cover the positions of Ground, Tower, Tower Assistant, Approach and Tower Supervisor. However, at the time of the incident only three were at their stations covering Pre-flight and Ground combined, Tower and Approach combined and the Tower Supervisor. There was no Tower assistant on duty due to the expected low traffic volume.

After starting, the aircraft was cleared to N1 (full length) which was a standard procedure at Toulouse for Runway 32R. It is not unusual for aircraft to request a departure from N2 as there is 2,300 m of runway available from this intersection. When the aircraft lined up on the runway there were two other aircraft on the approach frequency so traffic density was very light. The Tower Supervisor was engaged on a phone call with Marseilles Approach. The Ground Controller requested that the crew contact the Tower on reaching N2, believing they were being helpful in expediting the departure, but did not then follow the taxiing aircraft visually. This was reported as being in part due to the low density of traffic observed on displays[4] in the Tower control room, and a belief that the crew knew where they were going. When the Tower Controller issued the clearance to line up and take off from N2, stating that the remaining distance was 2,300 m, the aircraft was approaching the N4 intersection. The controller did not visually follow the aircraft so missed the opportunity to observe that it entered the runway via the wrong intersection. The controllers attributed this to a lack of concentration at the beginning of a shift and low traffic density rather than being fatigue induced. Mitigations cited by controllers were that the Ground Controller's position in front of the Surface Movement Guidance & Control System radar screen could obscure the view of N4. They recommended that the addition of a controllable stop bar at N4 could assist with preventing a future runway incursion.

The controllers only became aware of the event when the BEA contacted them following the operator filing an Air Safety Report.

The DSNA's analysis concluded that the serious incident was caused by a '*lack of effective verification by the crew of the line-up intersection*'. The lack of visual monitoring of the taxiing aircraft by controllers was recorded as a contributing factor due to,

- a lack of concentration at the start of the shift;
- this was the first occurrence of this type of routing error at Toulouse-Blagnac, and
- the controllers' confidence placed in the crew knowing where they were going and the need for '*traffic fluidity*'.

Footnote

[4] The Collaboration Human Machine Interface display provides a graphical interface in the control room for flight planning, air traffic flow and capacity management, and airspace management.

The DSNA proposed the distribution of the following information note to controllers at Toulouse:

> *'following the event of July 30, 2023… it is strongly recommended to the Ground controllers at Blagnac to adopt the following measures: wait at the N - 1 ramp before transferring the pilot in frequency to the TWR controller or if for operational reasons he cannot apply this procedure, the Ground controllers are reminded of the importance of maintaining particular attention on the progress of this aircraft throughout the taxiing phase. The Global Action Plan for the Prevention of Runway Incursions (GAPRI)[5] is expected to rule on this situation in the near future. The operations manual will then be amended accordingly and the [Toulouse] Blagnac controllers will be informed'.*

Additionally, the DSNA requested that the airfield operator consider installing controllable stop bars at N4.

Previous BEA investigation

The BEA carried out an investigation into a serious incident at Bordeaux-Merignac airport in 2022 in which a controller issued a landing clearance onto an occupied runway. It was concluded that high controller workload, an absence of supervision in the control tower and, probably, insufficient awareness of the risk posed by an inadequate number of controllers contributed to the event.

Following its investigation, the BEA recommended that the DNSA took action to monitor the number of controllers on duty at ATC units and use the information to ensure the adequacy of staffing levels. See Appendix A for more detail of the Safety Recommendation made by the BEA.

Tests and research

The operator analysed the performance calculations used by the crew for a departure from the N2 intersection of Runway 32R and the actual takeoff position of N4. The analysis concluded that in the event of a rejected takeoff above the calculated V_1 speed of 134 kt and below the V_R speed of 142 kt, a runway excursion was a likely outcome.

Analysis conducted by the aircraft manufacturer confirmed that G-EJCI was at a height of approximately 180 ft at the end of Runway 32R. Had an engine failure occurred at $V_{1,}$ the continued takeoff profile would have ensured a clearance of at least 45 ft from obstacles. With an accelerate stop distance available of 1,780 m, a rejected takeoff at V_1 could have resulted in an overrun of 102 m for an all engines operative condition, and 93 m with one engine inoperative.

Footnote

5 Global Action Plan for the Prevention of Runway Incursions (GAPPRI) superseded the European Action Plan for the Prevention of Runway Incursions (EAPPRI) in December 2023.

Discussion

Analysis of the serious incident at Toulouse-Blagnac Airport conducted by the DSNA and the operator revealed several interconnected factors that led to the crew initiating takeoff from an incorrect intersection. These factors can be broadly categorized into three main areas:

- High Workload and expeditious mindset.
- Limited attentional capacity and suboptimal situational awareness.
- Confirmation bias[6].

The crew was operating with the background of a challenging operational environment for the operator which likely created an expeditious mindset. Perceived pressure to "keep the operation flowing" can leave crews vulnerable to incorrect management of priorities and task saturation, potentially causing task overload.

A high mental workload is a significant stressor in aviation that can negatively affect situational awareness through attentional tunnelling. When the volume of information and/or number of tasks becomes overwhelming, pilots may focus only on a subset of that information resulting in incomplete or erroneous perception and integration of information.

For the crew of G-EJCI, the high workload conditions led to limitations in attentional capacity, which in turn resulted in suboptimal situational awareness. This manifested as an inability to process all relevant environmental information and a failure to perceive and respond to external runway intersection signage. It is probable that the incomplete intersection information presented to the crew on the FlySmart+ app contributed to an inaccurate mental model of the runway layout.

The development of an inaccurate mental model, combined with high workload, made the crew vulnerable to confirmation bias. This bias was reinforced by the early takeoff clearance from ATC that was delivered at a point where it appeared consistent with their shared mental model of the location of the N2 intersection. It was therefore likely that the crew would focus on confirmatory information that aligned with their existing beliefs. Additionally, by ATC not visually monitoring the progress of the aircraft from the tower, an important barrier to prevent the aircraft from lining up at the wrong intersection was rendered ineffective.

Footnote

[6] Confirmation bias is the tendency to pay attention to information that fits prior experience or expectation and to disregard information that does not fit.

Safety action

As a result of this serious incident, the following safety action was taken:

The operator:

- Formed a working group to review the risk of runway incursions and related flight crew procedures.
- Updated the Operations Manual Part A – Ground Operations Procedures to require all taxi intentions to be announced by the PF to the PM.
- Published a Safety Focus to all company pilots to highlight the risks associated with intersection takeoffs.
- Amended the Company and Crew Information route manual entry for Toulouse Blagnac to include a note that a number of intersections are not available for takeoff.
- Updated the Threat Matrix to include the risk of using intersections for takeoff.
- Undertook to automatically and appropriately share the overall context of Fatigue Safety Reports with company lead investigators to more effectively assess any broader impact of psychosocial factors in safety events.
- Undertook to include within the scope of future EFB project developments a review of the design of the FlySmart+ takeoff module to include representation of all runway intersections.

Toulouse ATC published a 'Safety Flash Broadcast' on 25 August 2023, which reminded controllers that:

- Controllers must constantly monitor the manoeuvring aircraft by visual observation, as per ICAO DOC 4444.
- The Ground Controller's responsibility for monitoring the progress of aircraft via the correct taxiways extends to the holding points.
- The Tower Controller only gives alignment or takeoff clearance when the aircraft is at or nearing the runway holding point, as per EAPPRI V3 – 1.5.2.h.
- The radar screen at the assistant position can obscure the view of the intersection N4/32R from the Tower Controller's position.

Additionally, in recognition of the 'lack of clarity' on the staffing of ATC positions, Toulouse ATC Launched a working group to consider ATC workforce requirements and roster patterns.

Appendix A

Previous serious incident involving ATC staffing levels in France

Summary of the event

On 31 December 2022 a serious incident occurred between an Airbus A320, registered OE-INE, and a Robin DR400, registered F-GTZY, on 31 December 2022 at Bordeaux-Merignac airport.

The A320 was cleared to land while the DR 400 was lined up at the runway threshold. The pilot of the DR 400 felt that the situation was abnormal and called the controller who immediately ordered the A320 to go around. The lowest point of the A320 trajectory was at a height of 103 ft, at a distance of approximately 290 m from the runway threshold. The A320 then flew over the DR 400 at a height of 178 ft. The conflict had not been detected by the ATC staff.

The BEA identified the following factors that had contributed to the issuance of a landing clearance on an occupied runway:

- *'The reduction in the on-duty staff leading to the grouping of positions, thereby creating a high workload for the controller on position; this situation led the controller to forget the presence of the DR400 on the runway;*
- *The absence of supervision in the control tower by the 'supervisor', who was also performing the role of TWR assistant;*
- *A probably insufficient awareness of the risk posed by an inadequate number of controllers present at their workplace, especially in the case of an unexpected traffic increase'.*

BEA Safety Recommendation

In its report, the BEA concluded that,

> *'The situation that caused the incident in Bordeaux on 31 December 2022 was made possible by the latitude implicitly given to tower supervisors to manage staffing levels without complying with the duty roster, and without any means of outside verification by management.*
>
> *A social consensus, which has been in place for many years at the DSNA, has allowed a situation to persist in which the teams of controllers organise for a number of staff to be present that is generally lower than the number theoretically determined as necessary. This situation, which is outside of any legal framework but known of and implicitly tolerated, is such as to bar any official collection of information that would lead to the identification of safety issues generated by these differences.*

> *These practices, are widespread at national level, have been in place for many years and are implicitly tolerated in the quest for social peace, mean that it is not possible to rely on a declaration system to reliably determine the manning of the control positions and the controller's presence at work'.*

Therefore, the BEA recommended that:

> *'The DSNA equips the Air Traffic Control centres with an automated and nominative system for recording the presence of controllers on position and at the workplace, and ensures that this information can be used by the ANSP services, particularly to ensure the adequacy of staffing and to enable the analysis of safety events.' (Safety Recommendation FRAN-2023-023, issued on 19/12/2023)*

Status of the safety recommendation

The DSNA informed the BEA that they are going to take the necessary actions to implement the principles stated in the BEA safety recommendation, and that work is ongoing.

Serious Incident

Aircraft Type and Registration:	Airbus A320-214, G-EZGY	
No & Type of Engines:	2 CFM56-5B4/3 turbofan engines	
Year of Manufacture:	2018 (Serial no: 8,385)	
Date & Time (UTC):	19 June 2024 at 1955 hrs	
Location:	Kerkira Airport, Corfu	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 174
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	40 years	
Commander's Flying Experience:	5,303 hours (of which 5,047 were on type) Last 90 days - 213 hours Last 28 days - 77 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

Following a stable approach flown by the co-pilot, the aircraft drifted high on short finals leading to a deeper than expected landing. The commander took control and applied full power to initiate a baulked landing go-around before realising the co-pilot had engaged reverse thrust when the mainwheels touched down. The Airbus A320 Flight Crew Techniques Manual (FCTM) directs pilots '*must not initiate a go-around after the selection of thrust reversers.*' Having unwittingly commenced a go-around after reverse thrust selection, the commander experienced startle and surprise. This led to hesitation in deciding whether to continue or reject the go-around. During this period of startle and surprise the commander cycled the thrust levers between full power (TOGA[1]), maximum reverse thrust (REV MAX) and back to TOGA before finally reselecting REV MAX and maximum manual braking to reject the go-around.

The aircraft came to a halt approximately 340 m before the end of the runway.

After precautionary maintenance action for a possible heavy landing, the aircraft was released back to service. The Hellenic State Investigation Authority (HARSIA) later delegated the Serious Incident investigation to the AAIB.

Footnote

[1] Takeoff and go-around thrust setting.

History of the flight

The aircraft was configured with FLAPS FULL for a night landing on Runway 34 at Kerkira Airport, Corfu (CFU). Following a stable approach flown by the co-pilot, the aircraft drifted high on short finals due to an early and protracted flare which led to a deeper than expected landing at the end of the touchdown zone (TDZ). The co-pilot reported that darkness, coupled with the lack of runway centreline lighting made it more difficult to judge the final approach and to discern TDZ markings during the flare. Nonetheless, assessing that the landing would occur within the designated zone he selected REV IDLE when he felt the mainwheels touch down.

The commander's assessment differed; he judged the aircraft passed the last TDZ marker at a very late stage in the flare. The operator's policy was that a go-around should be flown if an aircraft's mainwheels were not on the runway before the end of the TDZ. Accordingly, the commander called "I have control" and selected TOGA thrust to initiate a baulked landing go-around. At the point when he took control and instinctively selected TOGA, the commander was unaware the co-pilot had already selected reverse idle thrust (REV IDLE)[2]. By the time he realised he had advanced the thrust levers from REV IDLE, rather than IDLE[3], they were already at the TOGA stop.

The Airbus A320 FCTM directs pilots '*must not initiate a go-around after the selection of thrust reversers.*' Aware of the FCTM direction but having already selected TOGA, the commander experienced startle and surprise leading to hesitation as to whether to continue with the go-around or reject the takeoff. His level of startle and surprise was further raised when the master warning[4] tone sounded because TOGA had been selected while full flap was still deployed. During this period of startle and surprise he briefly cycled the thrust levers from TOGA to maximum reverse thrust (REV MAX) and back to TOGA. There was a further brief thrust reduction on both levers before the commander finally reselected REV MAX and applied maximum manual braking to reject the baulked landing go-around.

The co-pilot stated that he did not sense any significant aircraft acceleration after the commander had selected TOGA for the second time. He became rapidly and increasingly concerned that there was insufficient runway remaining to take off and called "stop." He then independently applied maximum manual braking. While he could not recollect doing so, the recorded data showed he also applied a nose-down input on the side stick at the same time. This input was nulled because the commander kept his sidestick priority button pressed after taking control.

The co-pilot's "stop" call was approximately coincident with the commander also calling "stop", making a final selection of REV MAX and applying maximum manual braking.

Footnote

2 Airbus standard operating procedures do not include a requirement for Pilot Flying (PF) to make a callout when reverse thrust has been selected.

3 Likely because of tactile feedback from the thrust levers as they moved out of the reverse thrust detent.

4 Takeoff configuration warning.

The aircraft came to a halt on the runway, approximately 340 m before the end. Following an external inspection of the aircraft by the emergency services it was taxied to stand under its own power.

The commander assessed the touchdown had been firmer than normal but after an engineering check procedure for a possible heavy landing, the aircraft was released for flight and the incident crew flew it back to the UK as planned.

Recorded information

The FDR and CVR recordings of the incident were not preserved following the incident[5]. However, flight data recordings from the Flight Data Interface Management Unit Quick Access Recorder (QAR) and the Digital ACMS Recorder (DAR) functions were available[6]. The QAR contains the same parametric data on the FDR and the DAR is a configurable data frame. The operator of G-EZGY had configured the DAR data to include parameters that identified when the sidestick pushbuttons were pressed, and which sidestick had priority.

The loss of the CVR recording meant that the investigation was reliant on the recollection of the flight crew as to what communications had occurred during the baulked landing and subsequent stopping of the aircraft.

Summary of recorded information

The approach to Runway 34 appeared normal, with FLAPS FULL selected and autobrake MEDIUM set. At about 1,800 ft aal the autopilot was disengaged. The aircraft remained stabilised on the RNP approach at an airspeed of about 138 KCAS. The recorded data during the approach showed that the wind direction was variable at less than 4 kt.

The aircraft flew over the runway threshold at a height of about 55 ft agl which coincided with the flare initiation. The pitch attitude of the aircraft gradually increased from 3° nose-up and when the aircraft was at about 20 ft agl (Figure 1 Point A) the pitch attitude was 4°, which coincided with the thrust levers being retarded to the idle position, which disengaged the auto thrust system. Further aft sidestick inputs were applied by the co-pilot and at about 10 ft agl the pitch attitude was just over 5°. The pitch attitude then started to reduce slightly but a further aft sidestick input was applied, causing the nose to pitch back up slightly (Figure 1 Point B). The pitch up commands caused the descent rate to decrease and remain stable at about 250 fpm for three seconds. The aircraft subsequently touched down at 130 KCAS and at about 660 m from the Runway 34 threshold, which was on, or just after[7], the final TDZ marker (Figure 2). The thrust levers were then quickly retarded to the REV IDLE position and the thrust reverser doors opened.

Footnote

[5] The State of Occurrence advised the AAIB approximately two weeks after the occurrence date that they would not be investigating the incident. The AAIB then became aware that the FDR and CVR had been overwritten.

[6] The QAR and DAR recordings are stored on a removeable media card fitted to the FDIMU and may be wirelessly transmitted from the aircraft.

[7] Positional data tolerances meant the exact touchdown point could not be precisely determined.

As the thrust levers had been retarded to the REV IDLE position by the co-pilot, the commander had almost simultaneously selected his sidestick priority pushbutton. This was followed by the thrust levers being quickly advanced to the TOGA position (Figure 1 Point C and Figure 2). The thrust reverser doors then closed (they had been in transit between their closed and open positions for about two seconds). The aircraft at this point had de-rotated with the weight settling on the nose gear. The thrust levers remained in the TOGA position for three seconds while the commander applied aft sidestick, stabilising the nose-up pitch at 1°.

The thrust levers were then briefly retarded to REV MAX before being quickly moved back to TOGA (Figure 1 Point D and Figure 2). This caused the thrust reverser doors to open briefly and then close. A master warning (red warning) was also activated because the aircraft was not in the takeoff configuration, with full flap still deployed.

After a further three seconds both thrust levers were again briefly retarded, with the right lever recorded as being between the flex takeoff / max continuous thrust (FLX MCT) detent and the TOGA stop, and the left thrust lever between the maximum climb (CL) detent and the idle stop. The levers were then advanced back to the TOGA position for less than one second before being fully retarded to REV MAX, and maximum manual braking was applied (Figure 1 Point E and Figure 2). The aircraft's airspeed was 129 KCAS (groundspeed 132 kt) and it was approximately 1,400 m from the runway threshold, with about 915 m of runway remaining.

As the aircraft started to de-rotate from 5° nose-up pitch, the commander had briefly moved his sidestick from a forward position to slightly aft of neutral, which coincided with the co-pilot applying forward sidestick for about two seconds (Figure 1 Point F). The commander had continued to select his sidestick priority pushbutton and therefore the simultaneous control inputs were not summed.

As the aircraft decelerated a master caution was presented, which was related to the auto thrust having been disconnected. At a groundspeed of about 50 kt the thrust levers were moved to the REV IDLE position, but maximum manual braking continued to be applied until the aircraft came to a full stop. It was about 1,970 m from the runway threshold, with about 340 m of runway remaining (Figure 2). The brake temperatures thereafter continued to increase and three minutes later a brake overheat warning occurred, with the brakes reaching a maximum temperature of just less than 500°C. The maximum recorded normal load during the landing was just less than 1.7 g and the flaps had remained in the FLAPS FULL position.

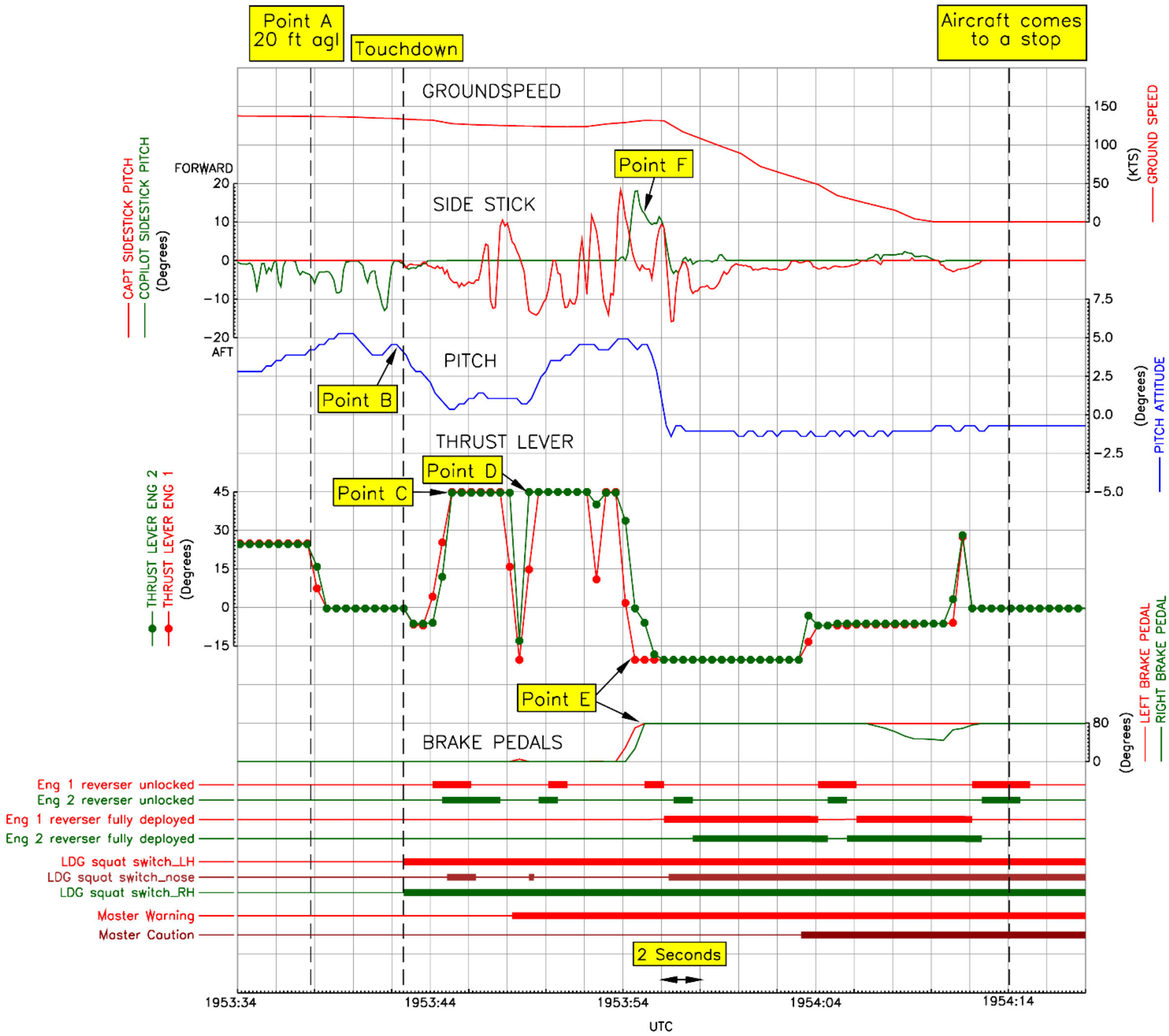


Figure 1

Touchdown and rejected takeoff

Figure 2

Overview of CFU showing key points during the landing
(Image ©2024 Airbus)

Personnel

While he had not flown a baulked landing go-around in an A320 family aircraft before, the commander had previously practised them in the A320 simulator, including ones initiated after mainwheel touchdown. He observed that on the incident flight he had likely not detected the selection of thrust reverse by the co-pilot because his attention had been focused outside on assessing whether the landing would be achieved within the TDZ.

The commander was aware of a previous Serious Incident involving CS-TNV, an A320 aircraft at Copenhagen/Kastrup Airport in 2022[8]. The commander of CS-TNV experienced significant handling difficulties resulting from asymmetric thrust reverser deployment following a baulked landing go-around initiated after the selection of reverse thrust. G-EZGY's commander considered that awareness of this as a potential risk for continuing with the go-around was an additional negative performance shaping factor during the period of surprise and startle experienced during this incident.

It is likely that the co-pilot also experienced startle and surprise following the commander's initiation of a go-around due to his own perception of a safely executed landing.

Airfield information

CFU is a coastal airfield with limited approach lighting on Runway 34 due to the final approach being largely over water (Figure 2). On Runway 34 there is only one set of TDZ markings beyond the target touchdown point whereas on Runway 16 there are two sets. The threshold on Runway 34 is inset by 59 m resulting in a total landing distance available of 2,314 m. The Runway 34 PAPIs are positioned to the left of the TDZ aiming markers, 415 m from the runway threshold. The end of the Runway 34 TDZ is 620 m from the threshold and is marked at night by 'S*imple Touchdown zone lights*' (Figure 3).

Footnote

[8] Serious Incident to CS-TNV (Airbus A320-214) in Copenhagen/Kastrup (EKCH) on 8-4-2022. Available at Report 2022-150 [accessed 10 March 2025].

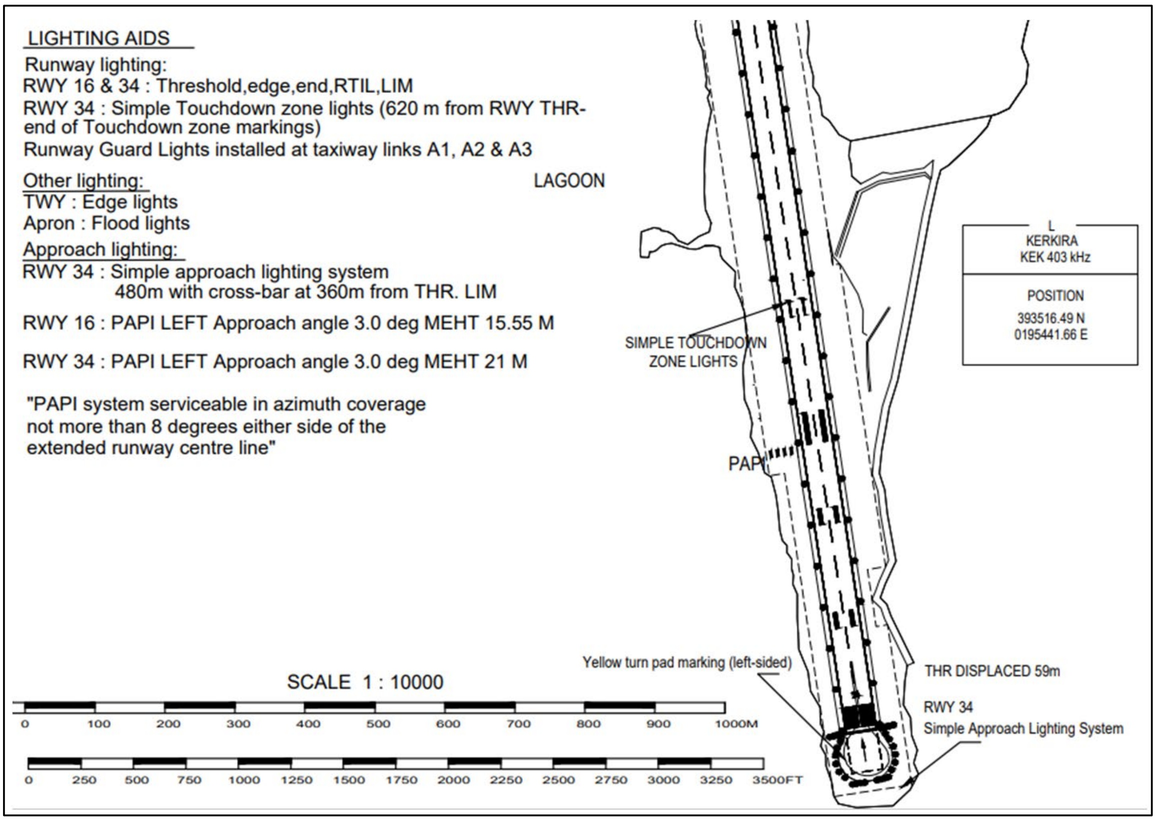


Figure 3

Extract from the LGKR airfield chart (reproduced from AIP Greece)

CFU is categorized by the operator as '*a Category B restricted airport, which is further defined as an airport with complexity and threat levels that require specified restrictions but do not require an aerodrome visit or specific training*.' Due to '*circling approaches, unusual local weather conditions* [and] *terrain*' considerations, pilots classified as '*inexperienced'* in accordance with the operator's Operations Manual are not permitted to operate into CFU. Both pilots exceeded the operator's minimum experience level requirements to operate into CFU. The Threat and Error Management (TEM) section of the operator's guidance to pilots (CCI[9]) operating into CFU described a higher risk of deep landings on Runway 34 due to displaced touchdown aiming point markers and only one set of markings beyond the TDZ aiming point (Figure 4).

Footnote

[9] Company and Crew Information.

RWY EXCURSION

- Both QFU have a displaced Threshold. PAPI have also been reported difficult to see, refer to AOI.
- RWY34 has displaced touchdown aiming point markings, after the aiming point markings the next markers are the end of the touchdown zone. This gives a higher risk of deep/long landings. Please review the picture in the supplementary section of this CCI.
- In addition, the end of the TDZ marking RWY34 (last marker) has 2 lights only visible by night.
- RWY34: All approaches are offset.
- RNP RWY16: offset final approach, 3.5 deg FPA, PAPI 3 deg.

Supplementary Information

Non standard touchdown zone aiming point markings on RWY34. Yellow circle shows the TDZ aiming point markings, red circle is the end of the TDZ.

Figure 4

Extract from the operator's CCI TEM guidance for pilots operating into CFU
(Reproduced from the operator's internal safety report)

Aircraft performance

Computations using the manufacturer's standard performance calculation software, based on a landing weight of 61,400 kg and using the reported wind of 290°/3 kt[10], indicated the factored stop margin[11] using medium autobrake would have been approximately 700 m. Using the same calculation parameters but assuming maximum manual braking gave a calculated stop margin of approximately 1,100 m. During their pre-landing preparation, the flight crew used a combination of more pessimistic inputs of wind component and landing weight, giving estimated stop margins with medium autobrake of between 380 and 515 m.

At the investigation's request the aircraft manufacturer conducted a 'what if' scenario analysis to determine what obstacle clearance might have been achieved had the go-around not been cancelled. The manufacturer's modelling used the prevailing parameters from the point at which maximum braking was applied and assumed the standard operating procedures (SOP), of rotating the aircraft at V_{APP}[12] and selecting FLAP 3 once safely airborne, were followed. Their modelling indicated the aircraft would have lifted off approximately 600 m from the end of the runway and would have cleared the first relevant obstacles on the go-around flight path by approximately 250 ft.

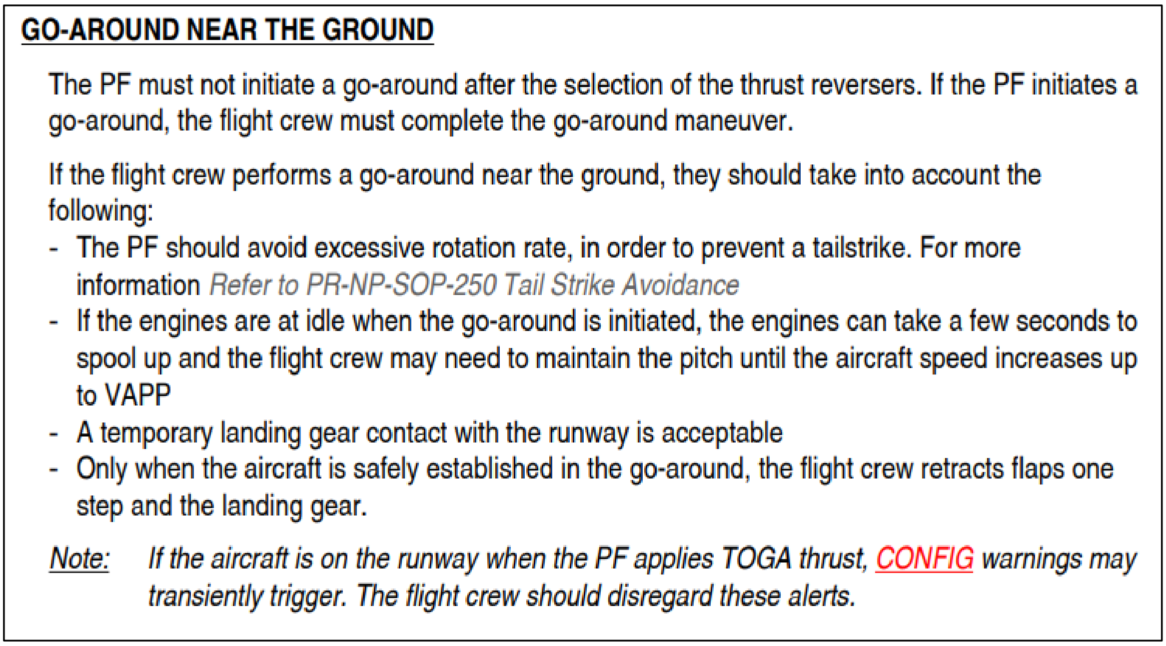
Footnote

10 LGKR 191950Z METAR recorded 3 minutes before G-EZGY touchdown.
11 Total landing distance available minus 115% of the calculated landing distance required.
12 Approach speed.

Other information

Airbus operational procedures

Guidance for the conduct of go-arounds in the Airbus A320 family of aircraft is contained within the Flight Crew Operating Manual (FCOM) and the FCTM. The FCOM directs that a normal go-around is initiated by PF calling '*GO AROUND – FLAPS*' at which point Pilot Monitoring (PM) selects one stage less flap. For the incident approach that would have meant reducing flaps from FLAPS FULL to FLAPS 3. Airbus advised the investigation that a baulked landing go-around, otherwise referred to as a '*go-around near the ground*,' should follow the same basic procedure as for a normal go-around, albeit the reduction in flap setting should only be made when '*the aircraft is safely established in the go-around*' (Figure 5). The FCTM also directs flight crew to disregard transient configuration warnings if the aircraft is on the runway with TOGA selected.



GO-AROUND NEAR THE GROUND

The PF must not initiate a go-around after the selection of the thrust reversers. If the PF initiates a go-around, the flight crew must complete the go-around maneuver.

If the flight crew performs a go-around near the ground, they should take into account the following:

- The PF should avoid excessive rotation rate, in order to prevent a tailstrike. For more information *Refer to PR-NP-SOP-250 Tail Strike Avoidance*
- If the engines are at idle when the go-around is initiated, the engines can take a few seconds to spool up and the flight crew may need to maintain the pitch until the aircraft speed increases up to VAPP
- A temporary landing gear contact with the runway is acceptable
- Only when the aircraft is safely established in the go-around, the flight crew retracts flaps one step and the landing gear.

Note: *If the aircraft is on the runway when the PF applies TOGA thrust, CONFIG warnings may transiently trigger. The flight crew should disregard these alerts.*

Figure 5

Airbus FCTM extract outlining the considerations for a go-around near the ground

The operator's Operations Manual Part B (OMB)[13] includes modified procedure callouts for a baulked landing (Figure 6) of, '*I HAVE CONTROL*,' followed by '*TOGA'* and finally '*GO AROUND FLAPS*' once safely established in the initial climb.

Footnote

[13] OMB2.3.20.1.

BALKED LANDING PROCEDURE
The balked landing procedure is flown by the Commander.

"I HAVE CONTROL" .... ANNOUNCE
The Commander takes/keeps control and must press & hold the takeover push button.

This is a confirmation to the other pilot that the Commander has control.

"TOGA" .... ANNOUNCE
This is a confirmation to the other pilot that the Commander is initiating a balked landing procedure.

THRUST LEVERS .... TOGA
PITCH .... ADJUST
Adjust Pitch in order to establish climb away from ground.

This may mean holding the attitude or de-rotating to achieve an adequate pitch.

CAUTION: No configuration change (Gear/Flaps) until "Go Around" initiated.

GO AROUND .... ANNOUNCE
When the aircraft is safely established in the initial climb, the Commander calls "GO AROUND FLAPS" and the crew apply the normal go around procedure.

Note:
1. Below 50 ft, due to Flight Control Laws, TOGA power may provide a pitch-up effect. Do not attempt to soften the (potential) second touchdown by increasing the pitch attitude.
2. If the aircraft is on the runway and in FULL configuration when the PF applies TOGA thrust, a CONFIG FLAPS NOT IN T.O CONFIG ECAM alert is triggered. The flight crew should disregard this alert.

Figure 6

Baulked landing procedure extracted from the operator's OMB

Organisational information

While the State of Occurrence was Greece, HARSIA delegated the investigation to the AAIB because the UK was the State of Registration.

Operator's safety intent

After this Serious Incident the operator intended to take the following action:

- To liaise with CFU on the siting of the Runway 34 PAPI lights and TDZ aiming point markings and to enquire whether these could be repositioned 300 m from the threshold, '*as per EASA regulation*.'
- To review the CFU airport risk assessment and re-assess whether sufficient mitigations are in place to manage the runway excursion risk associated with the non-standard position of the aiming point markers on Runway 34.
- To review the company's baulked landing procedure.
- To share details of the event with its pilot community through the medium of safety publications.

Manufacturer's safety communications

The aircraft manufacturer's '*contribution'* report to the investigation contained links to three resources relating to the handling and risks associated with go-arounds after thrust reverser selection. The first resource was an article[14] highlighting the '*risk of non-availability of maximum thrust on one or more engines, if the associated reversers do not stow*.' The second was an article[15] highlighting that '*the SOP for landing states that as soon as the flight crew selects reverse thrust, they must perform a full-stop landing*' and that '*in-*

Footnote

[14] Available at Safety First magazine - issue 14 [accessed 27 February 2025].
[15] Available at Thrust Reverser Selection is a Decision to Stop | Safety First [accessed 27 February 2025].

service data shows that there is still a risk exposure with flight crews deciding to perform a go-around after the thrust reversers were selected.' The third resource was a video[16] focusing on go-arounds, which included a reminder about the risk associated with a go-around after reversers selection.

Analysis

This baulked landing go-around rapidly developed into a Serious Incident due to startle and surprise leading to hesitation in deciding whether to reject or continue the go-around. The lack of CVR data meant the described sequence of calls between commander and co-pilot during the incident was based on individual recollection and could not be definitively aligned with the QAR/DAR data. While it was not possible to determine precisely where the aircraft's mainwheel touched down, it was likely on or just after the final TDZ marker.

In the final moments of the approach the commander and co-pilot made different assessments of their position relative to the TDZ. The co-pilot believed that touchdown had occurred within the designated zone but the commander assessed the aircraft as still being airborne passing the last TDZ markings. This lack of a shared mental model likely contributed to the initial startle and surprise for both pilots.

In following the operator's OMB procedure, calling "I have control, TOGA" and pressing his sidestick priority button, the commander ensured a clear and unambiguous takeover of the controls. The co-pilot understood the commander's intent to go-around but later called STOP because he thought the engines were not responding fast enough to assure it. By keeping his sidestick button pressed when lowering the nose, the commander nulled the co-pilot's corresponding pitch down input, likely preventing a heavier nosewheel touchdown.

When the commander took control and selected TOGA to initiate the go-around he had a firm plan in mind. With his hand already committed to the action of rapidly advancing the thrust levers, tactile feedback as the levers came out of the reverse thrust detent alerted him too late to the co-pilot's earlier selection of REV IDLE. The commander found himself unwittingly in contravention of FCTM guidance for go-arounds near the ground. He was faced with conflicting choices, accept the FCTM divergence and commit to the go-around or cancel it with reducing distance ahead within which to stop. While the configuration warning could have been expected on the runway with TOGA and full flap selected, it was nevertheless a negative performance shaping factor during the period of startle and surprise. During this time, the commander instinctively reacted by selecting REV MAX before cognitively restoring TOGA to continue the go-around.

Having re-committed to the go-around, the risk of asymmetric thrust reverser deployment[17] caused the commander to question whether the risk of continuing with the go-around was greater than the risk of runway excursion if he rejected the takeoff. With that risk in mind and concerned that the engines were not spooling up fast enough to guarantee a successful takeoff, he made a final decision to cancel the go-around. This was approximately contemporaneous with the co-pilot calling STOP and applying the brakes himself.

Footnote

16 Available at airbus-win.com/wp-content/uploads/2023/09/go-around-v3-en-1.mp4 [accessed 27 February 2025].

17 As experienced in the CS-TNV incident.

Analysis by the manufacturer indicated it was likely the aircraft would have cleared close-in obstacles by at least 250 ft if the takeoff had been continued.

Conclusion

After a stabilised approach, a protracted flare resulted in the aircraft touching down around the end of the TDZ. Each pilot had a different appreciation of where the touchdown occurred, leading to startle and surprise for both parties when the other's actions were not as expected. While this confusion introduced hesitation and uncertainty into the decision-making process, the pilots' mental models re-aligned when the lack of perceivable acceleration caused them each to question the viability of continuing with the go-around. Almost contemporaneously both pilots called "stop" while initiating maximum braking and the aircraft came to a full stop within the runway length remaining ahead.

Accident

Aircraft Type and Registration:	Just SuperStol, G-SSTL
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2016 (Serial no: LAA 397-15377)
Date & Time (UTC):	4 July 2024 at 1900 hrs
Location:	Near Romsey, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Landing gear detached and airframe distortion
Commander's Licence:	PPL(A)
Commander's Age:	67 years
Commander's Flying Experience:	315 hours (of which 4 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	Enquiries by the AAIB

Synopsis

The aircraft Permit to Fly had recently been revalidated after a period of non-flying and following various general husbandry tasks which included the replacement of the fuel system pipes.

The pilot had started the aircraft and taken time to bring the engine oil temperature to the correct limit before taxi and brake testing on the runway. He then took off with the intention of carrying out a couple of circuits before embarking on a short local flight. Soon after becoming airborne the engine appeared to lose power. A few seconds later it picked up and then again lost power. The pilot decided to carry out a forced landing in a field 45° to the left of the runway. As the aircraft touched down it rolled into a ditch and through a hedge. The pilot was injured, and the aircraft was severely damaged. The exact cause of the loss of power could not be determined but may have been due to a combination of fuel system installation features which did not fully conform to the aircraft and engine bay fuel system installation advice in the build manual or system recommendations more recently published in Rotax Service Bulletin 912-079-R1 (Appendix A).

History of the flight

The pilot, assisted by his friend, had removed the aircraft from its hangar at the private airstrip where it was based. The aircraft had not been flown since May 2024. The pilot's intention was to carry out a thorough pre-flight inspection followed by engine warm up checks, then a high speed taxi and brake test along the runway. If all the checks were to his satisfaction, his plan was to takeoff and fly two circuits and, if content after that, carry out a short proving flight in the local area. On completion of his pre-flight checks, he started the engine and spent approximately 15 minutes running the engine to bring the oil temperature up to the prescribed level. He then carried out a taxi and brake test on the runway. This was to his satisfaction and he indicated to his friend that he would takeoff and fly the circuits.

His friend (the only witness present) moved further along the runway and stood to the side to observe and video the takeoff. He heard the aircraft power increase and watched as the aircraft accelerated along the runway and the tail lift as normal. The aircraft became airborne and started to climb away. He then noticed that the aircraft appeared to level, the engine note changed, and the aircraft sank a small amount before appearing to climb again. The witness immediately thought that the climb was not normal. The pilot's recollection was the same, the engine power appeared to stagnate before picking up again then lose power a second time. The pilot decided to carry out a forced landing in a field to his left (Figure 1).

The witness observed the aircraft change heading before "gently floating down, wings level". It touched down at the edge of the field about two metres from a drainage ditch. It rolled down into the ditch at which point the landing gear collapsed and detached. The aircraft carried on through a hedgerow which brought it rapidly to a stop. The pilot sustained serious injuries during the accident and had to be extracted from the wreckage by the emergency services who had been called by the witness.

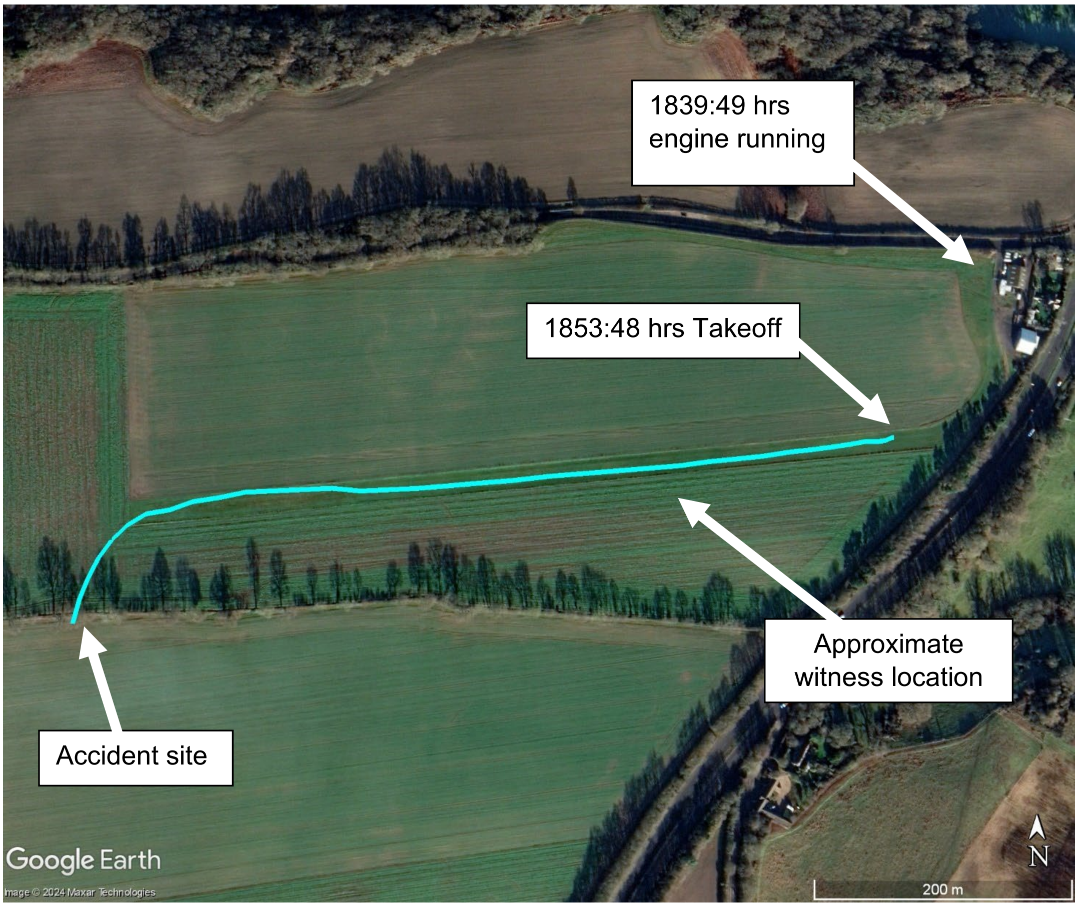


Figure 1

G-SSTL GNSS Position data

Airfield information

Pauncefoot Farm Airstrip is a private unlicensed airstrip near Romsey, Hampshire. It consists of a single grass 650 m 26/08 runway. There is a small hangar in which the accident aircraft was kept along with a supply of UL91 AVGAS held in a standard oil drum. As well as General Aviation, model and drone flying is also carried out at the airfield from two specially prepared areas on the runway. The runway was firm, well drained and the grass had been cut by the witness just prior to the takeoff.

Meteorology

The conditions at the airfield during the late afternoon and early evening were generally settled with initially no cloud below 5,000 ft, with lower patchy cloud later on. The surface wind and air temperatures were similar to those reported at Southampton Airport. This was light to moderate westerly winds with gusts to 22 kt at 1820 UTC. CAVOK[1] conditions were reported from 1620 UTC through until 1850 UTC. The temperature and dewpoint were approximately 20°C and 6°C.

Accident site

The aircraft had landed approximately 100 m from the end of the runway diagonally left of the runway centre line. A pair of wheel marks were present in a wheat crop at the edge of the field. The landing gear was partially detached and caught in the drainage ditch. During the impact the engine had been bent slightly downward in its mounts and one of the propeller blades had broken at its root and bent rearwards. The aircraft had broken through a substantial hazel bush in the hedge row denting the leading edge of the left wing and causing the aircraft to rotate through approximately 90° (Figure 2). The right wing had pivoted slightly forwards about its main spar mounting bolt. The rear spar attachment bolt had been pulled sideways out its hole.

Footnote

[1] CAVOK - Ceiling and visibility OK.

Figure 2
Accident site and aircraft damage

Aircraft description

G-SSTL was a single engine high wing monoplane of steel tubular frame construction with a fabric covering. The wing form and lift augmentation devices allow low speed flight and enable it to carry out short takeoffs and landings. The landing gear was fitted with tundra 'balloon tyres' so the aircraft can be operated from uneven and unprepared surfaces. It was powered by a four cylinder normally aspirated Rotax 912 ULS engine driving a fixed pitch propellor via a reduction gearbox. The engine was fitted with two Bing variable choke carburettors. Fuel was supplied from two wing tanks feeding into a collector tank. Fuel was drawn from the collector tank via an in-line gauze filter and shut off valve and Gascolator, by a diaphragm fuel pump driven from the reduction gearbox. Excess fuel was delivered back to the collector tank via a return line. The aircraft was not fitted with an electric back -up fuel pump and so fuel delivery relies on gravity feed to the diaphragm fuel pump alone.

The aircraft instruments included two tablet displays configured to show flight and navigational information from an application. In addition, an engine display was fitted, displaying oil temperature and pressure, cylinder head temperature (CHT), manifold pressure (MAP) and engine speed in rpm. When this display is setup, it is configured for the engine type which also sets alarm and warning thresholds. When these thresholds are exceeded, the display will indicate this to the pilot.

Normal engine operating limits

The engine operating limits set out on the Pilot's Operating Handbook (POH) are as follows.

	Limits
Max take off power	100 hp
Time limit at full power	5 minutes (5,800 rpm)
Max rpm (no time limit)	5,500
Idle rpm	1,400
Maximum cylinder head temperature at pick point	150°C
Oil temperature Normal Maximum Minimum	 90 °C – 110 °C 140 °C 50 °C

The engine rpm upper alarm is set for 5,800 rpm with MAP alarm set for 27.5 InHg. When an alarm threshold is exceeded, the display background turns red. Once below the alarm threshold, the parameter will be marked with an exclamation mark to remind the pilot of the exceedance.

Recorded information

The flight planning and navigation application provided a time history of GNSS altitude and position which allowed calculation of groundspeeds. The engine display recorded to an internal memory at 5 Hz for the last 12 minutes of operation. Recorded parameters were those displayed, and no throttle position was recorded. The engine display recorded time from power on, not UTC and the two data sources were aligned using the application of takeoff power as a reference.

The engine display started recording at 1839:49 hrs, believed to be just after engine start as the oil and CHT temperatures were both low. Just over 7 minutes later, the aircraft taxied towards the westerly runway and performed a high-speed taxi up to approximately 40 kt. It then turned around and taxied back to the start of the westerly runway and waited while the engine oil temperature increased.

At 1853:48 hrs, the takeoff commenced with a recorded increase in engine rpm and MAP with oil temperature, pressure and CHT all within normal operating limits (Point A, Figure 3).

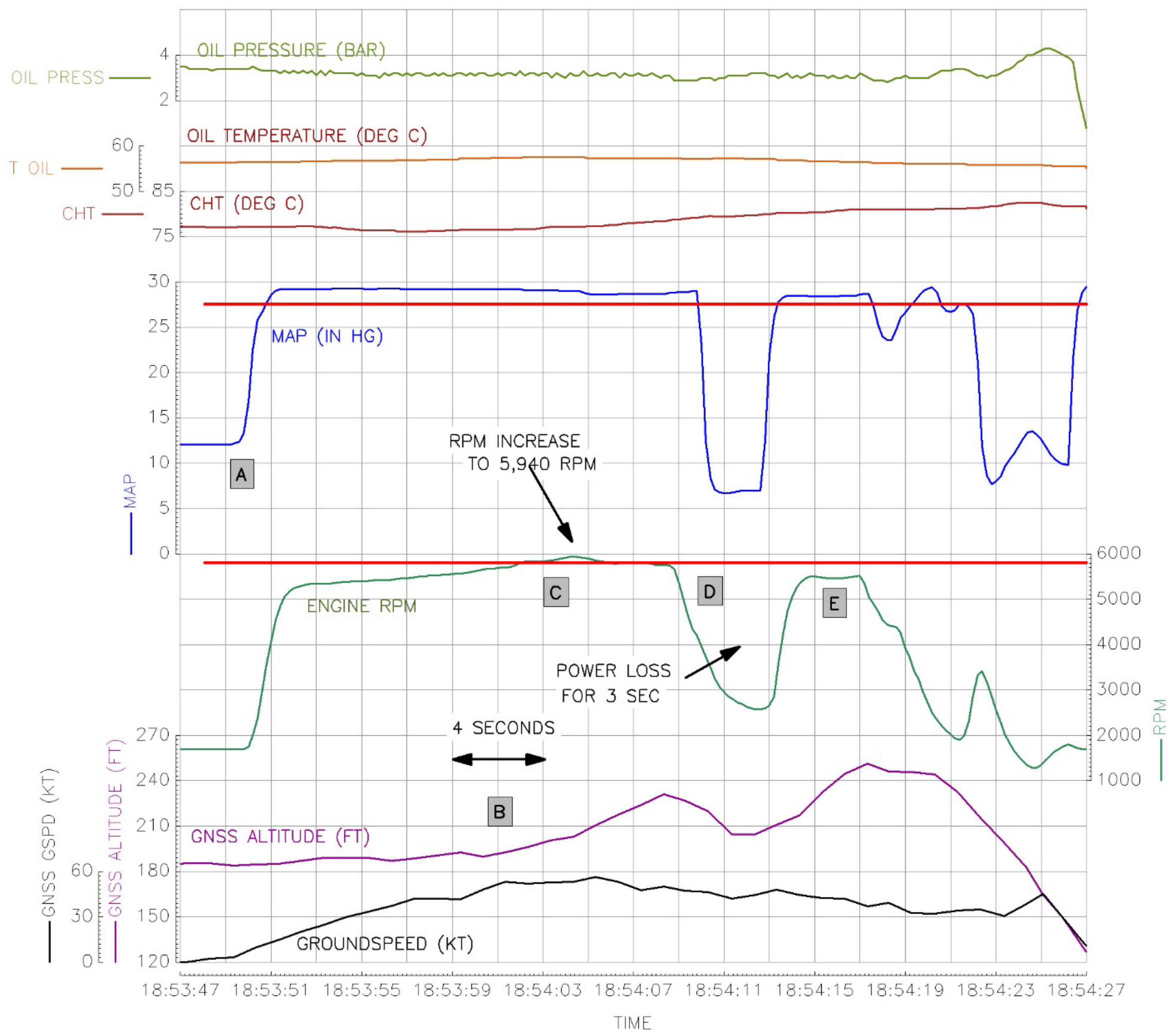


Figure 3

G-SSTL flight and engine data

The MAP rose to approximately 29 InHg, above the alarm threshold of 27.5 InHg for the engine display. The aircraft accelerated to a groundspeed of approximately 53 kt and started to climb (Point B). At the same time, the engine rpm increased and then exceeded the upper warning limit of 5,800 rpm (Point C). Maximum recorded rpm was 5,940 rpm after which a rapid decrease in engine rpm and MAP was recorded (Point D). This lasted for three seconds before power was restored for a further four seconds (Point E). After this point, there was a reduction in engine power with reducing / fluctuating rpm and MAP. The aircraft descended and hit the ground at approximately 1854:27 hrs.

A previous takeoff was identified in the engine display recorded data. At the application of full power, MAP rose to 29.8 InHg and rpm to approximately 5,800 rpm.

Maintenance history

The aircraft was built in 2016 operated under a Light Aircraft Association (LAA) Permit to Fly and had undergone a permit revalidation inspection on 3 May 2024. As part of that inspection several maintenance tasks had been carried out. The fuel pipes were replaced throughout, and this was followed by carburettor setting and balancing. At the same time a non-return valve was fitted in the return line to prevent fuel from syphoning out of the header tank. The aircraft had not been flown since that work was carried out.

Aircraft examination

The aircraft sustained severe damage during the accident. There was no fire and no fluid leakage. The pilot had been wearing a four-point harness which had been cut by the emergency services. The pilot's seat(left) seat pan and sub frame was distorted. Despite the damage to the aircraft, it was in a very good almost 'new' condition.

Fuel was present in both tanks and the fuel valve was set to ON and fuel was present in the pump, its supply and return lines and the carburettor float bowls. The choke was off and push/pull throttle handle was fully forward at full power. However, during the impact the engine mounting frame had been distorted, and the engine had moved forward and downwards. This had put the throttle cables under enough tension to pull them from the throttle linkage pinch bolts. The right carburettor had been dislodged from its rubber inlet manifold flange adaptor. The engine instrument wiring loom had been put under tension and several wires had been pulled from their terminal connectors.

The fuel suction pipe was routed from the Gascolator upwards along the top of the engine block to the pump. Figure 4 shows the fuel pipe location looking from above. There was no thermal insulation on the fuel pipes.

The lower part of the suction pipe near the fire wall was found to be in proximity to the right rear cylinder exhaust down pipe and was attached to part of the engine bearer frame by a cable tie and rubber collar. There was also evidence that the cable tie contacted the down pipe whilst it was hot. However, this may have occurred during the impact sequence as the engine mounting frame distorted. Measurements taken between the fuel pipe and the exhaust downpipe accounting for the distortion, suggest an original clearance of approximately 30 mm (Figure 5).

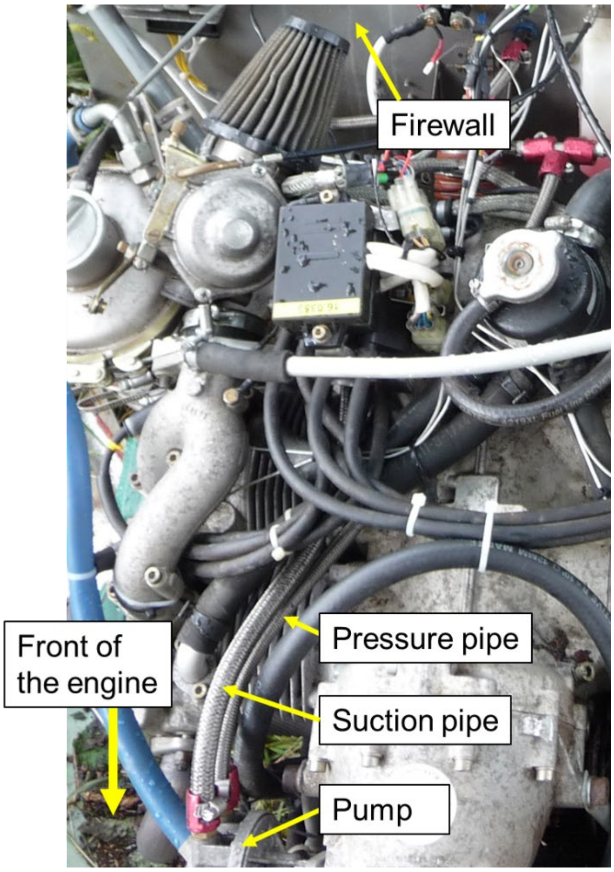


Figure 4

Fuel suction and pressure pipe location

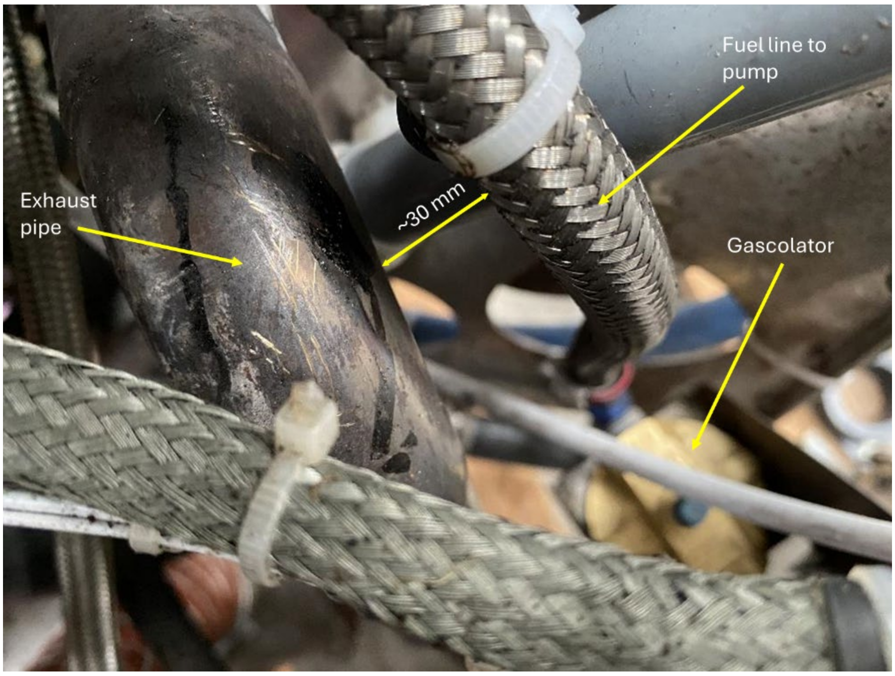


Figure 5

Suction pipe position in relation to exhaust downpipe

Tests and research

Both carburettor float bowls were removed and the internal components examined. The fuel valves operated correctly and were clear; the floats were of the type annotated 'R' introduced under mandatory Rotax SB-912-074. The needle valve and carrier pistons operated correctly and the fuel jet was clear. The spark plugs were examined and indicated normal combustion.

The recently replaced fuel lines were examined. The pipes, filter and non-return valve within the airframe were in an as new condition as was the braided fuel pipe assembly between the pump and carburettors. However, the suction pipe from the Gascolator to the gearbox driven pump was discoloured grey rather than bright silver braiding. The tube within the braiding showed signs of degradation and appeared to be leaching through and between the braiding weave. Figure 6 shows the apparent pipe degradation.

Figure 6
Suction pipe condition

The degradation of the rubber compound within the braided pipe between the Gascolator and the pumps appears to be evidence that this pipe was externally heated. However, experiments were carried out to establish the effect of heat on the pipes. Blown air heating raised the surface temperature on the sample pipes to between 150°C to 160°C and this was found to have no lasting effect.

The diaphragm fuel pump was also examined and tested and operated correctly. Of note in this aircraft there is no electrical back-up fuel pump, so the system relies on gravity feed to the diaphragm pump alone. Vacuum testing was also carried out on the suction pipe with no effect apparent.

Other information

The engine installation manual refers to the installation of the fuel system in the following extract;

> **ATTENTION**
>
> **For prevention of vapor locks:**
> All the fuel lines on the suction side of the fuel pump have to be insulated against heat in the engine compartment and routed at distance from hot engine components, without kinks and protected appropriately. At very critical conditions (e.g. problems with vapor formation) the fuel lines could be routed in a hose with cold air flow.

Discussions with the LAA and other owners of Rotax powered aircraft of similar types suggest the fuel pipe routing within compact engine bays can lead to fuel flow problems. This is more so with MOGAS fuelled aircraft rather than UL 91 fuelled aircraft. However, no gasoline fuels are completely immune from vaporisation or the formation of cavitation bubbles on fuel lines which are in a hot area. The engine manufacturer recently published a revised Service Bulletin, SB-912-079 R1 dated 22 November 2024. It is a compendium of essential information regarding the installation, operation and maintenance for Rotax 912 (Series) aircraft engines and is annotated as 'Highly Recommended'. There are several specific requirements for the aircraft fuel system design set out in section 3.2 of the SB. A copy of which is at Appendix A. G-SSTL did not conform to the build advice or to some of the guidance points set out in the SB as follows:

- The SB states that fuel pipe routing within the engine bay should be away from heat sources and thermally insulated. In this aircraft, the suction line from the Gascolator to the diaphragm fuel pump is routed within 30 mm of the right rear cylinder exhaust down pipe. From there it lies under the right inlet manifold across the block lying on top of the pump outlet pressure line to the carburettors. There is no thermal insulation around the engine bay fuel lines.

- All the fuel hoses must also be sufficiently supported in order to avoid excessive vibration. The pressure and suction lines in G-SSTL lay across and were in contact the engine block which may have made them susceptible to vibration.

- In order to reduce the pressure drop along the fuel line, the use of sharp angled adapters and banjo connectors should be avoided as much as possible. G-SSTL has three right angle connectors and a banjo union in the system in the gravity feed suction side of the system.

Analysis

The start up and warm up runs appeared to have been normal with no adverse characteristics. However, the data shows that after the throttle was opened to full power for the takeoff run the engine over sped for a period of three seconds before settling down to maximum normal rpm. After 4 seconds the engine rpm and power decreased before picking up again, which was as described by the pilot. The engine power reduced for a second time at which point the pilot prepared to carry out a forced landing.

Of note there were several features in the fuel system installation which did not conform to the build advice or the guidance set out in SB 912-079-R1. It is possible the combination of these features and fuel being drawn under gravity caused intermittent fuel starvation during the high demand required for takeoff. The slight exceedance in rpm, 5,940 vs 5,800, may be indicative of a leaning of the mixture as the fuel levels in the carburettor float bowls dropped and was a precursor to further leaning and to the loss in engine power.

The possibility of carburettor icing was considered. The temperature and dewpoint at the time of day in the general area, suggested a moderate risk and the warmup running at low power followed by taxiing on a grass strip in the early evening could have increased the risk further. However, the very compact engine bay in this aircraft and the heat generated by the engine beneath the two carburettors suggests carburettor icing was unlikely.

Conclusion

The engine started and ran without any problems as the pilot went through his checks and paused to allow the oil temperature to increase to the minimum required level. However, as the demands on the fuel supply system increased for takeoff, it is possible that the fuel system features in this aircraft, which did not fully conform to the build manual or some of the advice in the SB, may have combined and resulted in a partial fuel starvation that led to engine power loss.

General observation

The fuel system components had been replaced as part of the work carried out prior to the renewal of the aircraft permit to fly. It was assumed by the person carrying out the work, that the assembly, location and routing of the original pipes and associated components was correct. They had no reason to assume otherwise as the aircraft appeared to have been flown since it was built without any problems. They are now of the opinion, "that when taking over a used kit build aircraft (or even commercially produced), not to assume everything has been installed in accordance with best practice when completing maintenance and replacing like for like rather than reviewing and questioning further".

Safety Action

During the test and research for this investigation it became apparent that there may be other Rotax powered aircraft that may not fully conform to the some of the requirements of SB 912-079-R1 regarding fuel systems. The Light Aircraft Association (LAA) has concluded that it would be useful to draw attention to this SB to other aircraft owners and LAA inspectors. Therefore, the LAA has carried out the following Safety Action:

> The LAA has published an article in the March 2025 edition of their monthly magazine highlighting the fuel system installation issues found on G-SSTL and drawing attention to the guidance set out in SB 912-079-R1.

Appendix A

Extract from Rotax SB 912-079-R1

3.2) Fuel system

3.2.1) Background information

Requirements of the fuel system:

The fuel system is a complex and important subsystem of an aircraft engine installation. The fuel system must be designed to ensure that the engine is supplied with sufficient fuel at the correct pressure in every operational situation. Any deviation from the installation manual and maintenance manual may result in a non-standard operation.

Carburettor synchronization and maintenance:

Regular synchronization of the carburettors greatly improves smoothness of engine operation.

Air-to-fuel ratio:

The air-to-fuel ratio (mixture) heavily influences the whole combustion process. Especially lean conditions may have negative effects and can be caused by various factors. Several occurrences of vibrations and power losses have been identified to be caused by restricted fuel supply (e.g. contamination, vapor lock, etc.) and/or inadequate ventilation of the carburettors

(e.g. blocked, inadequately routed venting lines).

3.2.2) OEM requirements

Requirements of the fuel system:

Make sure to comply with the fuel system requirements outlined in the installation manual in particular:

Fuel flow:	min. 35 l/h (9.25 gal/h).
Fuel pressure: (relative to ambient pressure)	0.15 - 0.5 bar (2.18 - 7.25 psi)
Fuel lines:	Inlet line inner diameter: min. 7.5 mm (0.3 in.) (AN-6 or 3/8").

NOTE:

- Due to the technical design and installation conditions (construction of the return line, etc.) pressure fluctuations at the fuel pump are possible. These pressure fluctuations within the specified operating limits are not considered a problem.

  Low fuel pressure indications are also possible and allowed, but the pressure must stabilize to the operating limit within 10 seconds. However, low pressure indications below 0.08 bar (1.16 psi) may only last a maximum of 1 second. If not, the cause must be determined and rectified.
- It is also advisable to route the fuel line as far away from heat source as possible and to add thermal isolation around the fuel lines, especially within the engine compartment.
- The electrical fuel pump must be positioned in order to be gravity fed from the fuel (catch) tank and the hoses between the electrical fuel pump and fuel tank must be self bleeding (No airtrap).
- Fuel line should also be routed with sufficient bending radius (Follow manufacturer recommendation) in order to prevent the pipe from kinking.
- In order to reduce the pressure drop along the fuel line, the use of sharp angled adapters or banjo connectors should be avoided as much as possible.
- The fuel hose on the suction side must be collapse resistant.
- All the fuel hoses must also be sufficiently supported in order to avoid excessive vibration of the hose, which would increase the risk of vapor lock.
- When installing other "devices" than the one specified in the Rotax installation manual on the suction side of the fuel pump, their effect on the fuel system pressure drop must be carefully investigated at all operating conditions.
- Use appropriate fuel filter (coarse/fine) and water separator/gascolator.
- For prevention of vapor locks: The length of the fuel line on the suction side of the electrical / mechanical fuel pump (between the fuel tank and the fuel pump) must be kept as short as possible to minimize vapor formation at high altitudes and high temperatures. High engine compartment temperatures increase fuel temperature and therefore facilitate vapor forma- tion of the fuel.
- Fuel temperature: The fuel system must be designed considering vapor lock depending on the ambient conditions (e.g. pressure and temperature) and the used fuel types (vapor pressure class). Should problems occur during the test period, the affected components, e.g. the sup- ply line to the fuel pumps, must be cooled. To avoid too much fuel heating at the fuel pump inlet, it is obligatory to route the fuel return line from the engine to the main fuel tank, and not to the electrical fuel pump inlet or header tank, see latest Installation Manual (IM), Chapter 73-00-00.
- Install check valves with appropriate specification (e.g. with sufficient cross section, opening pressure etc.) parallel to the electrical fuel pumps as indicated in the latest Installation Man- ual (IM), Chapter 73-00-00.
- Venting lines: The carburetor float chamber venting lines have to be routed into a ram-air and vacuum free zone or into the GENUINE ROTAX® airbox, according to the requirements and release of BRP-Rotax GmbH & Co KG. These lines must not be routed into the slipstream. If the drainage lines of the airbox are connected with the drainage lines of the drip trays or the carburetors by a T-piece, these lines must not be routed down the firewall (drainage lines of the airbox separately are allowed).
- At first installation or when doing extensive work on the fuel system or replacing fuel line, the complete fuel system should be flushed in order to remove all potential contaminant.

Accident

Aircraft Type and Registration:	UAS Boresight BQ400 Raider LR
No & Type of Engines:	4 Electric motors
Year of Manufacture:	Unknown (Serial no: 165BTDQ4001911)
Date & Time (UTC):	6 February 2025 at 1100 hrs
Location:	Throckmorton Airfield, Worcestershire
Type of Flight:	Commercial Operations (UAS)
Persons on Board:	Crew - None Passengers - None
Injuries:	Crew - N/A Passengers - N/A
Nature of Damage:	UA destroyed. Damage to rotors and rotor arms
Commander's Licence:	Other
Commander's Age:	48 years
Commander's Flying Experience:	30 hours (of which 5 were on type) Last 90 days - 2 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

When the UA was powered on, it took off and flew away. The pilot was unable to control the UA from his controller, so used a termination function to which the UA responded. The UA flew about 320 m from the takeoff location, striking the ground approximately 4 m from an uninvolved person, who was uninjured. The UA was destroyed.

The operator has taken safety action to notify businesses in the vicinity of the flying location of future trials and test flights.

History of the flight

The flight, operating in the A3 Open Category, was supporting the development of processes to test a ground-based product. The intended flight path was along one of the disused runways at Throckmorton (a disused airfield), and at least 200 m from other businesses and uninvolved persons based within the airfield perimeter. It was the operator's fourteenth flight involving this UA type, and the accident UA's first flight. All previous flights were uneventful.

The flight team consisted of a pilot and two observers. The UA was prepared for flight at the intersection of two disused runways, and the pilot reported that the UA established communication with the control system normally. There was a gentle northerly breeze, visibility of about 600m, and a temperature of 1°C. When the UA was 'armed' to enable flight, it took off and climbed to an estimated height of about 20 m; it then veered west.

The pilot made inputs using his controller, but the UA did not respond. He was able to terminate the UA using a 'disarm' function on a laptop hosting the control system, and the two observers ran towards the UA. The UA fell to the ground approximately 320 m from its takeoff location, and about 4 m from an uninvolved person.

Aircraft information

The BQ400 'Raider' is a quadcopter with a takeoff mass of 1.3 kg. It is marketed as a disposable, low-cost quadcopter target, for use in training and testing scenarios.

To act as a 'manual altitude indicator', so the pilot could fly at the height required for the test program, the operator had attached to the UA a rope about 3 m long, with a small metal weight tied at the other end. The combined weight of the rope and weight was 122 g. The operator stated that they are evaluating options for a more 'elegant' solution for future testing. Although novel, the 'manual altitude indicator' had been used without incident on previous flights, and there was no evidence to suggest it was a factor in this accident.

Regulation of UAS operations

UK Regulation (EU) 2019/947, its associated Acceptable Means of Compliance (AMC) and Guidance Material (GM) provides the regulation and policy pertaining to UAS operation.

The CAA has developed guidance document CAP 722 '*Unmanned Aircraft System Operations in UK Airspace*'[1] to assist in ensuring safe and legal UAS operation in both private and commercial activities for a variety of UAS and operational circumstances.

The pilot involved in the accident flight had a valid CAA Flyer ID, and the planned flight path's horizontal distance from residential, commercial, industrial or recreational areas of the was greater than the 150 m required for UAS operation under the A3 Open Category[2].

Conclusion

The operator believes that the cause of the abnormal flight behaviour which preceded the accident was due to a fault with the UA, which was brand new when the accident flight occurred. The root-cause of the technical fault within the UA was not determined at the time this report was published.

To further reduce risks to uninvolved persons operating at nearby business premises, the operator has taken the following Safety Action.

> The operator has started to provide advanced notification to businesses in the vicinity of the test site when UAS test flights are scheduled to take place.

Footnote

[1] CAA CAP 722 *'Unmanned Aircraft System Operations in UK Airspace'*, available at https://www.caa.co.uk/publication/download/21784 [accessed 26 February 2025].

[2] See UK Regulation (EU) 2019/947, rule UAS.OPEN.040(2), available at https://regulatorylibrary.caa.co.uk/2019-947-pdf/PDF.pdf [accessed 26 February 2025].

AAIB Record-Only Investigations

This section provides details of accidents and incidents which were not subject to a Field or full Correspondence Investigation.

They are wholly, or largely, based on information provided by the aircraft commander at the time of reporting and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

Record-only investigations reviewed: January - February 2025

24 Sep 2024 **Piper PA-31-310** **N250MD** Gloucestershire Airport

Severe vibration was felt by the pilot when the nosewheel touched down during landing. The pilot was able to maintain control until he had slowed to approximately 20 kt. The aircraft then veered to the left and departed the paved surface onto grass softened by heavy rain. The nose gear sank into the ground and collapsed, causing the aircraft to come to rest on its nose. It is likely that a nosewheel tyre puncture caused the vibration and loss of low-speed directional control.

4 Jan 2025 **Skyranger Nynja 912S(1)** **G-CHKG** Hamilton Farm Airfield, Kent

The aircraft was on the runway and power was applied for takeoff, but the nosewheel lost traction and directional control was lost. The pilot reported that the aircraft might have become momentarily airborne before he closed the throttle, and, as the aircraft ran off the side of the runway, the nose landing gear dug into rough soft grass causing the aircraft to turn over before coming to rest. The engine was shock loaded, and there was damage to the fuselage and wing.

12 Feb 2025 **Rotorsport UK MTOsport** **G-CIHH** Perth Airport

During the flare, the aircraft ballooned slightly and started to turn to the right. The student pilot attempted to correct the turn, but the aircraft crossed the runway edge. The left wheel contacted soft ground and the aircraft rolled over.

12 Feb 2025 **Jabiru UL-450** **G-CBZM** Otherton Airfield, Staffordshire

The aircraft ran off the side of the grass runway during landing, the nose landing gear dug into soft ground and the aircraft turned over.

Miscellaneous

This section contains Addenda, Corrections and a list of the ten most recent Aircraft Accident ('Formal') Reports published by the AAIB.

The complete reports can be downloaded from the AAIB website (www.aaib.gov.uk).

BULLETIN ADDENDUM

Aircraft Type and Registration:	G-BHBT
Date & Time (UTC):	15 September 2024 at 1625 hrs
Location:	Near Goodwood Aerodrome, West Sussex
Information Source:	Aircraft Accident Report Form and further enquiries by AAIB

AAIB Bulletin No 2/2025, page 34

Original text:

'During flight, the pilot noticed that the pushrod that connected the lower and upper right ailerons was streaming behind the aircraft at approximately 45°, having detached at its lower end. The pilot reported that control of the aircraft was not affected but he made the decision to immediately return to Goodwood Aerodrome, where the aircraft landed uneventfully. The pushrod had fractured in fatigue in the threaded section at the lower pushrod fork end. The cause of the crack initiation was not determined.'

Addendum text:

'During flight, the pilot noticed that the pushrod that connected the lower and upper right ailerons was streaming behind the aircraft at approximately 45°, having detached at its lower end. The pilot reported that control of the aircraft was not affected but he made the decision to immediately return to Goodwood Aerodrome, where the aircraft landed uneventfully. The pushrod had fractured in fatigue in the threaded section at the lower pushrod fork end. The cause of the crack initiation was not determined. However, as threads can act as stress raisers, replacement pushrods without threaded sections, have since been fitted.'

The online report was corrected on 14 March 2025.

TEN MOST RECENTLY PUBLISHED FORMAL REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

3/2015 Eurocopter (Deutschland) EC135 T2+, G-SPAO
Glasgow City Centre, Scotland
on 29 November 2013.

Published October 2015.

1/2016 AS332 L2 Super Puma, G-WNSB
on approach to Sumburgh Airport
on 23 August 2013.

Published March 2016.

2/2016 Saab 2000, G-LGNO
approximately 7 nm east of Sumburgh Airport, Shetland
on 15 December 2014.

Published September 2016.

1/2017 Hawker Hunter T7, G-BXFI
near Shoreham Airport
on 22 August 2015.

Published March 2017.

1/2018 Sikorsky S-92A, G-WNSR
West Franklin wellhead platform, North Sea
on 28 December 2016.

Published March 2018.

2/2018 Boeing 737-86J, C-FWGH
Belfast International Airport
on 21 July 2017.

Published November 2018.

1/2020 Piper PA-46-310P Malibu, N264DB
22 nm north-north-west of Guernsey
on 21 January 2019.

Published March 2020.

1/2021 Airbus A321-211, G-POWN
London Gatwick Airport
on 26 February 2020.

Published May 2021.

1/2023 Leonardo AW169, G-VSKP
King Power Stadium, Leicester
on 27 October 2018.

Published September 2023.

2/2023 Sikorsky S-92A, G-MCGY
Derriford Hospital, Plymouth, Devon
on 4 March 2022.

Published November 2023.

Unabridged versions of all AAIB Formal Reports, published back to and including 1971, are available in full on the AAIB Website

http://www.aaib.gov.uk

GLOSSARY OF ABBREVIATIONS

aal above airfield level
ACAS Airborne Collision Avoidance System
ACARS Automatic Communications And Reporting System
ADF Automatic Direction Finding equipment
AFIS(O) Aerodrome Flight Information Service (Officer)
agl above ground level
AIC Aeronautical Information Circular
amsl above mean sea level
AOM Aerodrome Operating Minima
APU Auxiliary Power Unit
ASI airspeed indicator
ATC(C)(O) Air Traffic Control (Centre)(Officer)
ATIS Automatic Terminal Information Service
ATPL Airline Transport Pilot's Licence
BMAA British Microlight Aircraft Association
BGA British Gliding Association
BBAC British Balloon and Airship Club
BHPA British Hang Gliding & Paragliding Association
CAA Civil Aviation Authority
CAVOK Ceiling And Visibility OK (for VFR flight)
CAS calibrated airspeed
cc cubic centimetres
CG Centre of Gravity
cm centimetre(s)
CPL Commercial Pilot's Licence
°C,F,M,T Celsius, Fahrenheit, magnetic, true
CVR Cockpit Voice Recorder
DME Distance Measuring Equipment
EAS equivalent airspeed
EASA European Union Aviation Safety Agency
ECAM Electronic Centralised Aircraft Monitoring
EGPWS Enhanced GPWS
EGT Exhaust Gas Temperature
EICAS Engine Indication and Crew Alerting System
EPR Engine Pressure Ratio
ETA Estimated Time of Arrival
ETD Estimated Time of Departure
FAA Federal Aviation Administration (USA)
FDR Flight Data Recorder
FIR Flight Information Region
FL Flight Level
ft feet
ft/min feet per minute
g acceleration due to Earth's gravity
GNSS Global Navigation Satellite System
GPS Global Positioning System
GPWS Ground Proximity Warning System
hrs hours (clock time as in 1200 hrs)
HP high pressure
hPa hectopascal (equivalent unit to mb)
IAS indicated airspeed
IFR Instrument Flight Rules
ILS Instrument Landing System
IMC Instrument Meteorological Conditions
IP Intermediate Pressure
IR Instrument Rating
ISA International Standard Atmosphere
kg kilogram(s)
KCAS knots calibrated airspeed
KIAS knots indicated airspeed
KTAS knots true airspeed
km kilometre(s)
kt knot(s)
lb pound(s)
LP low pressure
LAA Light Aircraft Association
LDA Landing Distance Available
LPC Licence Proficiency Check
m metre(s)
mb millibar(s)
MDA Minimum Descent Altitude
METAR a timed aerodrome meteorological report
min minutes
mm millimetre(s)
mph miles per hour
MTWA Maximum Total Weight Authorised
N Newtons
N_R Main rotor rotation speed (rotorcraft)
N_g Gas generator rotation speed (rotorcraft)
N_1 engine fan or LP compressor speed
NDB Non-Directional radio Beacon
nm nautical mile(s)
NOTAM Notice to Airmen
OAT Outside Air Temperature
OPC Operator Proficiency Check
PAPI Precision Approach Path Indicator
PF Pilot Flying
PIC Pilot in Command
PM Pilot Monitoring
POH Pilot's Operating Handbook
PPL Private Pilot's Licence
psi pounds per square inch
QFE altimeter pressure setting to indicate height above aerodrome
QNH altimeter pressure setting to indicate elevation amsl
RA Resolution Advisory
RFFS Rescue and Fire Fighting Service
rpm revolutions per minute
RTF radiotelephony
RVR Runway Visual Range
SAR Search and Rescue
SB Service Bulletin
SSR Secondary Surveillance Radar
TA Traffic Advisory
TAF Terminal Aerodrome Forecast
TAS true airspeed
TAWS Terrain Awareness and Warning System
TCAS Traffic Collision Avoidance System
TODA Takeoff Distance Available
UA Unmanned Aircraft
UAS Unmanned Aircraft System
USG US gallons
UTC Co-ordinated Universal Time (GMT)
V Volt(s)
V_1 Takeoff decision speed
V_2 Takeoff safety speed
V_R Rotation speed
V_{REF} Reference airspeed (approach)
V_{NE} Never Exceed airspeed
VASI Visual Approach Slope Indicator
VFR Visual Flight Rules
VHF Very High Frequency
VMC Visual Meteorological Conditions
VOR VHF Omnidirectional radio Range