AAIB Bulletin 5/2025

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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.

Accident

Aircraft Type and Registration:	ATR 72-212 A, G-CMJM
No & Type of Engines:	2 Pratt & Whitney Canada PW127M turboprop engines
Year of Manufacture:	2017 (Serial no: 1464)
Date & Time (UTC):	31 October 2023 at 0917 hrs
Location:	On departure from Edinburgh Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 55
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fractured nose landing gear axle
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	9,530 hours (of which 150 were on type) Last 90 days - 148 hours Last 28 days - 54 hours
Information Source:	AAIB Field Investigation

Synopsis

Whilst taking off from Edinburgh Airport the right wheel from the nose leg gear detached from the aircraft. The detachment was not observed by the airfield operations department and the flight crew were unaware of the loss of the wheel. They continued the flight and landed at Belfast City Airport without any abnormal indications or adverse aircraft performance. The wheel was first noticed missing as the aircraft taxied onto stand at Belfast. A failure of the wheel axle caused by bearing overheat was identified as the cause of the wheel detachment. A number of potential contributing factors were identified, but the cause of the bearing overheat could not be positively determined.

History of the flight

On its return flight from Edinburgh Airport (Edinburgh), the aircraft performed an ILS approach and landing on Runway 04 (Rwy 04) at Belfast City Airport (Belfast). The flight crew reported that everything appeared normal until after the aircraft had parked, when the ground crew informed the commander that a nosewheel was missing.

After the commander informed ATC, both airports carried out runway inspections, and local police searched the area under the approach path. The nosewheel was found beside the runway at Edinburgh.

The flight crew and Edinburgh ground crew reported noticing nothing unusual about the aircraft during its turnaround in Edinburgh.

Accident site

Edinburgh Airport

The nosewheel separated from the aircraft during takeoff from Edinburgh Runway 06 (Rwy 06) (Figure 1). It would not have been easily visible to persons in the control tower and was evident on the surface movement radar for only a couple of seconds before traversing off the side of the runway.

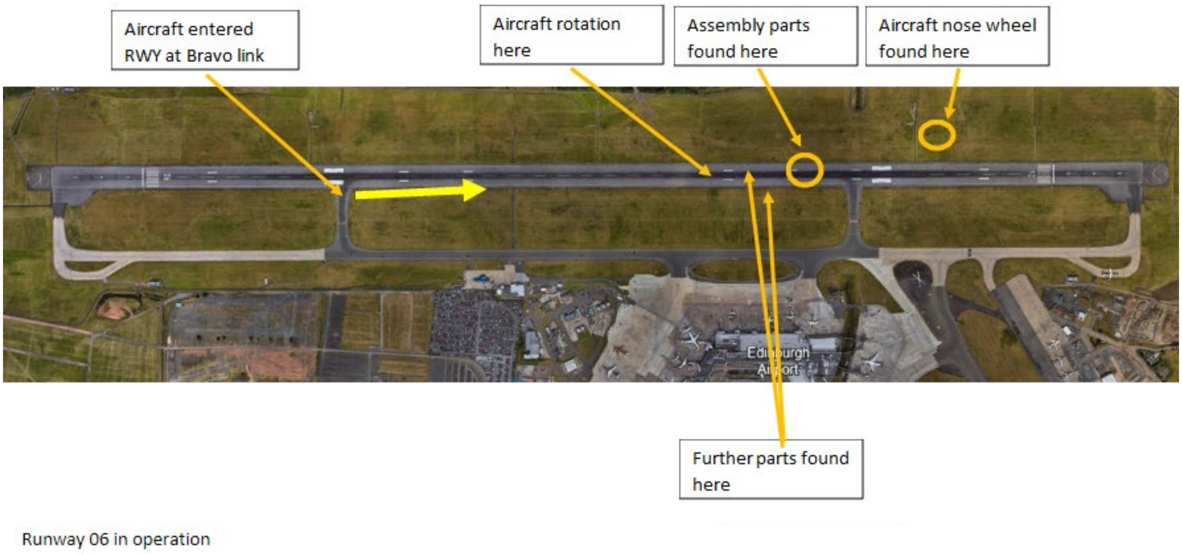

Figure 1

Location of recovered nosewheel components

All components related to the detached nosewheel including the wheel axle nut were recovered. The locations at which the detached components were found at Edinburgh are as shown (Figure 1). There was no damage to the airport infrastructure reported.

Belfast Airport

Following an ILS approach (which overflies the city of Belfast) to Rwy 04, the aircraft taxied uneventfully to its normal operational stand. Whilst the aircraft remained stable, additional support was provided to the nosewheel to provide increased support against the wind (Figure 2).

Figure 2
The aircraft as quarantined at Belfast City Airport

Aircraft examination

The nose leg gear axle was sheared off and showed evidence of heat damage (Figure 3). Extensive checks of the aircraft nose landing gear bay showed no signs of other damage or fluid leakage. A detailed inspection of the aircraft structure and engines revealed no damage due to the release of the nosewheel. There was no hard landing or abnormal runway contact reported by flight crews during the flight when the wheel was lost or on previous flights.

Figure 3
G-CMJM fractured nose landing gear axle

Aircraft information

The aircraft had the nose landing wheels changed by the line maintenance organisation on 11 October 2023 as part of a standard work package. There were no issues reported with the nose landing gear (NLG) in the sectors prior to the accident flight.

Further tests and research

The nosewheel, the other associated components recovered from Edinburgh and the NLG shock assembly were sent to the manufacturer for further inspection and analysis.

Inspection of NLG wheel assemblies

Right NLG Wheel

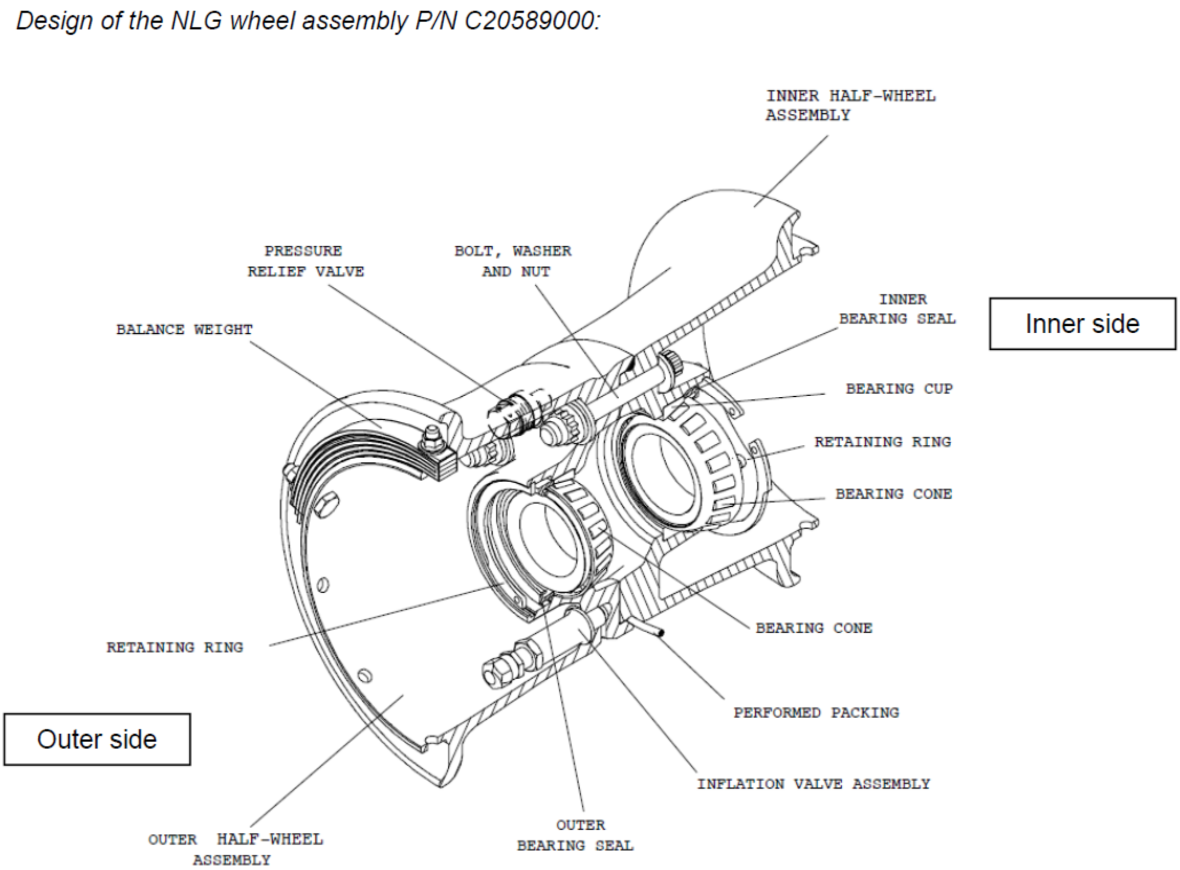

Figure 4

Design of the NLG wheel assembly (Image used with permission)

The right NLG wheel (design shown at Figure 4) was inspected and dissembled with the following main findings:

- The right NLG wheel assembly was found assembled with all tie bolts loose.
- No balancing weights were found fitted on either the outer or inner half-wheel sections[1].
- The outer half wheel hub was found fractured.
- There was an interposition product found on the mating faces of the two half-wheels (Figure 5); this product is not allowed in this area[2] as it can lead to micro displacements of the two faces and tie-bolt loosening.
- Evidence of bearing grease indicated over-greasing of both bearings.

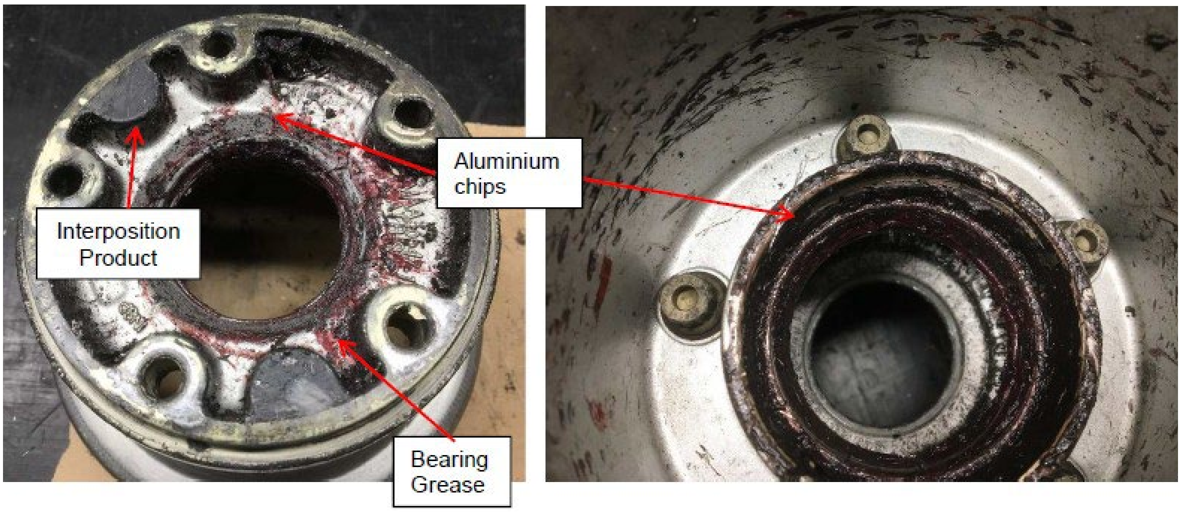

Figure 5

Inner half wheel condition (image used with permission)

- Outer bearing assembly. The outer bearing assembly cone was completely deformed due to the heat generated during the bearing failure (Figure 6). The cage, outer bearing seal and retaining ring were missing. There was evidence of material transfer on the internal diameter and only one roller, which was damaged, was present.

Footnote

[1] Component Maintenance Manual reference CMM 32-49-43 states the weights are not installed if the remaining imbalance is not more than 7,35 g.m (10.4 oz.in).

[2] The manufacturer advised that this interposition product should only be used on mainwheels not nosewheels as per CMM 32-49-43.

Figure 6

Outer bearing cone heat damage (image used with permission)

- Inner bearing assembly. The rollers, cage, circlip, grease and seal were all missing due to the heat damage. Roller marks were observed on the bearing race (Figure 7), which is an indication that the rollers were not aligned properly.

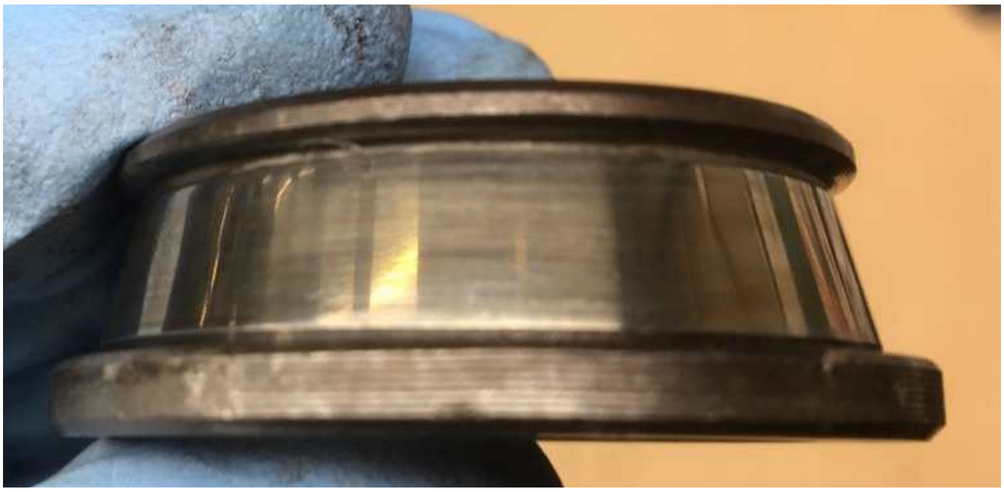

Figure 7

Inner bearing cone circumferential marks (image used with permission)

Left NLG Wheel

The left NLG wheel assembly was inspected and all the tie bolts holding the half-wheels together were found loose. An interposition product was found between the two half-wheels, and the balancing weights were not fitted on the NLG wheel. The bearings (Figure 8) were in better condition but also showed signs of over greasing and heat damage.

Figure 8

LH NLG wheel bearing (image used with permission)

Metallurgy

Inspection of the failed components indicated exposure to high temperatures which were consistent with a wheel bearing failure event. Laboratory analysis for the failed axle did not identify the precise region of crack initiation but the metallurgical analysis of the axle indicated that the thermal shock and evidence of cadmium liquid metal embrittlement both likely contributed to the complete fracture of the axle.

Bearing overheat causes

Whilst it was not possible to identify one single cause of the bearing overheat and subsequent failure, the manufacturer of the NLG highlighted a number of factors that can contribute. These factors can occur during aircraft line maintenance or at component Maintenance Repair Organisations (MRO) and are grouped below:

- Aircraft Line Maintenance
  - An incorrect bearing preload (preload obtained by the tightening of the NLG wheel axle nut).
  - An incorrect bearing installation (which can be caused by an improper torque operation (wheel not rotated) allowing rollers to move radially).
  - A misalignment of the rollers, which causes roller metal fracture and discoloration, as well as cage wear and rupture.
- MRO Component Overhaul
  - Incorrect lubrication on the inner and outer bearings.
  - The presence of an interposition product between the two half-wheels, which is not allowed on this area for the NLG wheels, which has an impact on the tightening and could lead to the tie bolts becoming loose.
  - The lack of wheel balancing weights, which can lead to a misalignment of the real rotation axis of the bearing. This can lead to damage of the rollers and then contribute to a bearing failure.

Maintenance practice

As well as the Aircraft Maintenance Manual (AMM) and Component Maintenance Manual (CMM) procedures, the manufacturer of the NLG issues advice on the management of the wheel assembly and bearings to maintainers via its support portal. The manufacturer of the NLG also conducts visits with MROs that overhaul wheels to discuss good maintenance practices and had, together with the Operator, visited the MRO that overhauled the nosewheels on G-CMJM prior to the accident, and they carried out a follow up visit in May 2024.

Analysis

Operations

There were no indications to the flight crew during the flight that the nosewheel had detached from the aircraft, and it was not easily detectable in Edinburgh because it came to rest away from the runway surface. Communications by airport staff meant any debris was located promptly.

Aside from risks inherent to debris on active runways, had the nosewheel detached during the approach at Belfast, it could have fallen on an urban area.

Cause of the wheel loss

The right NLG wheel detached from the aircraft because the axle on which it is located fractured. The axle fractured due to overheating of the bearing in the wheel which caused a combination of thermal shock and liquid cadmium embrittlement. The cause of the bearing overheating could not be positively determined, but inspection of the failed components identified a number of factors that could have contributed. These included over greasing of the inner and outer bearings, the lack of wheel balancing weights and the application of an interposition product between the mating faces of the two half-wheels which can cause the tie bolts to loosen. The manufacturer of the nose leg gear assembly highlighted the importance of adherence to the AMM and CMM by aircraft maintainers and component repair/maintenance facilities respectively to ensure safety. As well as providing access to the aircraft and component technical publications for wheels and brakes on the ATR 72, the manufacturer's maintenance portal also contains in-service experience advice for operators and MROs.

Conclusion

The right NLG wheel detached from the aircraft on takeoff due to a failure of the axle onto which the wheel was located. The axle failed due to a fracture caused by overheat of the bearings in the wheel. Whilst the root cause of the failure could not be positively determined, factors were identified that could have contributed to the bearing overheat resulting from non-conformances with approved maintenance procedures. The manufacturer highlighted the importance of adherence to aircraft and component maintenance manuals.

Accident

Aircraft Type and Registration:	Cirrus SR22T, G-RGSK
No & Type of Engines:	1 Teledyne Continental TSIO-550-K piston engine
Year of Manufacture:	2023 (Serial no: 9368)
Date & Time (UTC):	26 March 2024 at 1339 hrs
Location:	Duxford Airfield, Cambridgeshire
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
Commander's Age:	58 years
Commander's Flying Experience:	115 hours (of which 16 were on type) Last 90 days - 9 hours Last 28 days - 0 hours
Information Source:	AAIB Field Investigation

Synopsis

At the end of a third circuit, which was intended to be a touch-and-go, G-RGSK bounced on touchdown. The pilot applied full power to go around but lost control of the aircraft, which turned left through approximately 90° before striking the ground. The aircraft's ballistic parachute system deployed during the impact sequence.

It was found that the aircraft had approached the stall as the nose attitude was increased for the go-around, triggering the stall warning. The tendency for the aircraft to yaw and roll left was not controlled, causing the aircraft to turn left, and the aircraft then stalled during the turn. The pilot sustained fatal injuries.

To warn and protect people who may be unfamiliar with aircraft ballistic parachute systems, such as the emergency rescue services and others, from the potential danger, two Safety Recommendations are made concerning the provision of clear, conspicuous and unambiguous markings. The UK Civil Aviation Authority has published a Safety Notice on the same topic.

Introduction

The accident involving G-RGSK highlighted a number of issues concerning the risk of injury to third parties following an accident involving an aircraft fitted with a Ballistic Parachute Recovery System (BPRS). In order to address these issues, this accident report has been written in two sections. The first will address the accident and the second the BPRS.

Section one – Aircraft accident

History of the flight

On the day of the accident, the weather reports from local airfields[1] indicated that there was a small amount of cloud cover at 4,000 ft with visibility greater than 10 km. The winds were from the south-east to south-southeast at about 7 to 8 kt.

At 1310 hrs, the pilot of G-RGSK contacted Duxford Information to request a radio check and airfield information for a circuits flight. He subsequently departed from the asphalt Runway 06R into the southerly right-hand circuit and completed three circuits, which, up until the third landing, were flown without incident.

The amount of other circuit traffic was not unusual for the location and all expected radio calls were made and responded to as normal. The final circuit immediately prior to the accident was less busy than the first two circuits and there were no potentially conflicting aircraft movements during the approaches.

While G-RGSK was on final approach for a touch-and-go, the Flight Information Service Officer (FISO) at Duxford transmitted that the wind was from 150° at 8 kt with a maximum windspeed of 14 kt.

On touchdown after the third circuit, G-RGSK was observed to bounce and full power was applied. A video taken by a witness showed the aircraft remaining low but with the nose slightly high and with a left angle of bank. The aircraft was pointing about 45° left of the runway and it continued to turn left until it was about 90° left of runway heading as the angle of bank increased to about 90° left wing low. At that point, the nose began to drop and the aircraft overbanked slightly. The left wing struck the ground first followed by the nose of the aircraft. The aircraft was severely disrupted on impact and the aircraft's ballistic parachute system was seen to deploy during the impact sequence. The pilot sustained fatal injuries.

Witness evidence

Two pilots in a Harvard T6 lined up on the parallel grass runway witnessed G-RGSK touch down. One stated that he saw the aircraft bounce about 2 ft on touchdown and that the flaps were down. The other commented that the aircraft attitude appeared higher than would be expected and that during the go-around he could "hear the propeller bite", suggesting full power had been applied. G-RGSK passed in front of the Harvard T6 and struck the ground ahead and to the left of it. Figure 1 shows the recorded final track of the aircraft.

Footnote

[1] Duxford Airfield does not issue TAFs and METARs. The weather reports from Cambridge and Stansted airports were reviewed and complemented by the winds reported by ATC to pilots in the circuit.

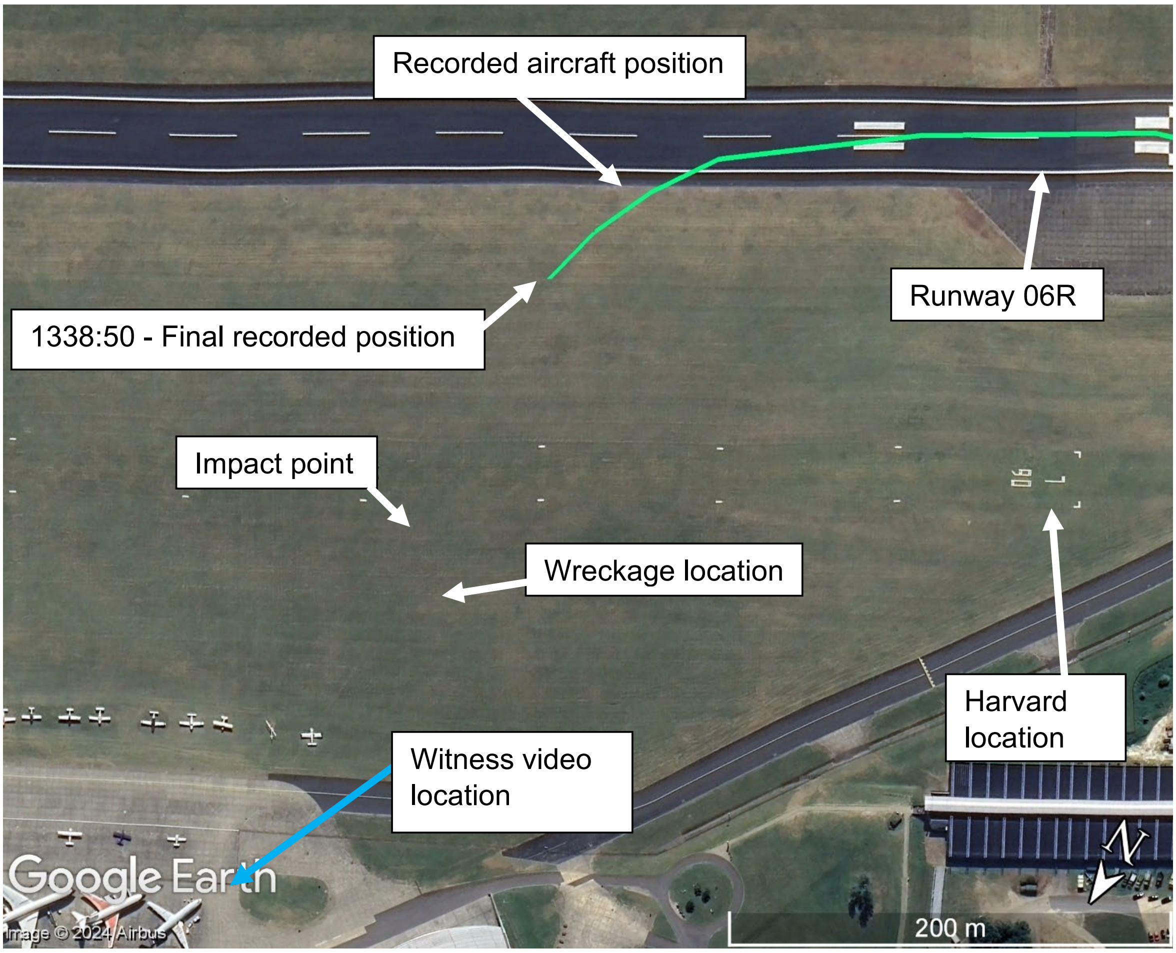

Figure 1

G-RGSK approximate accident track

A witness standing towards the south-western end of the public western apron captured on video the aircraft shortly after it had gone around, its subsequent flight path and the impact sequence. The witness video matched the aircraft attitude in the recorded data. The video did not show the aircraft touchdown or bounce on the runway, but started after the aircraft began deviating to the left. Figure 2 shows snapshots from the video in half second intervals but excludes the impact.

Figure 2

Witness video frames at half second intervals just prior to impact

Airfield information

Duxford Airfield (Figure 3) has two parallel runways: a grass Runway 06L/24R from which aircraft fly circuits to the north, and an asphalt Runway 06R/24L from which aircraft fly circuits to the south. While they are not available for simultaneous use and are to be treated as one runway, often both circuits are active at the same time.

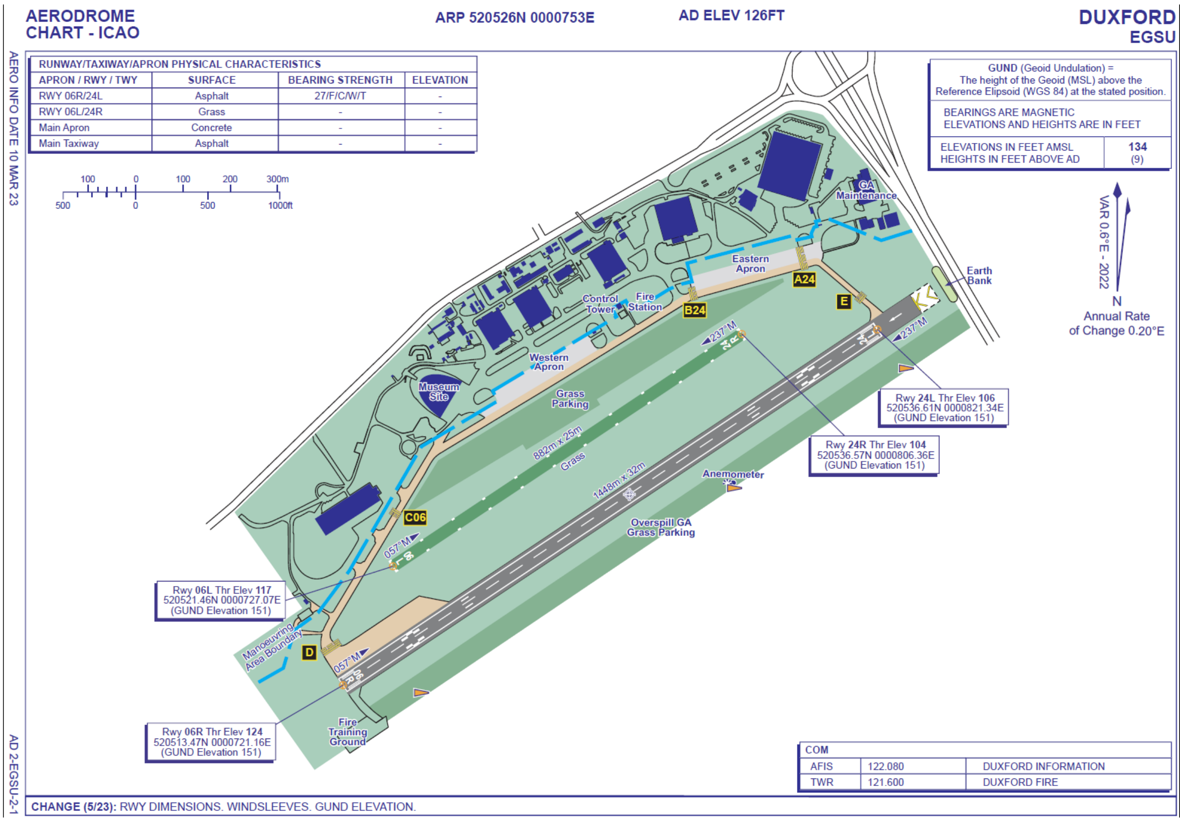

Figure 3

Duxford Airfield AIP AD2 EGSU2 .1

Accident site

The aircraft came to rest on a grassed area near to the threshold of Runway 06L at Duxford Airfield. The initial ground impact mark was clearly discernible from which a fan shaped discolouration of the grass had occurred. This had been caused by the spray of fuel ejected from the ruptured aircraft fuel tanks during the impact. Despite this there was no fire. The aircraft was in a highly disrupted state and had come to rest approximately 40 m from the initial impact point. Examination of the wreckage trail suggests a heading on impact of 308°T. All the propeller blades had detached from the hub and were embedded in the ground about 6 m from the initial impact. The engine cowlings, cockpit doors and part of the cockpit roof had detached and were lying nearby.

The Cirrus Airframe Parachute System (CAPS)[2] parachute had deployed to full extension and was laying out flat along the ground. It was attached to the aircraft by its suspension lines. These were cut by AAIB staff on initial examination of the site to prevent inflation of the chute and dragging of the wreckage. The rocket motor had fired and was found lying on the ground at the top end of the canopy. Both wings were severely damaged, the left wing had detached, and the right wing was twisted around its root with its aileron and flap control surfaces partially detached (Figure 4). The rear fuselage had broken in the vicinity of the tailplane leading edge and was twisted around.

Footnote

[2] Similar systems are fitted to a variety of other light aircraft and are usually referred to as Ballistic Parachute Recovery Systems (BPRS).

Figure 4
Aircraft structural damage

The pilot's four-point harness had been undone by the first responders and was hanging loose, and both the left and right seat shoulder strap air bags had deployed. The seat attachment rails and safety harness attachment points were intact.

The cockpit control panels, instrument screens and side stick control handles were severely disrupted. The power lever was broken and in an indeterminate position. The Emergency Locator Transmitter (ELT) had initiated with its audio and visual warnings activated. The undamaged ELT was deactivated on site.

Despite the damage to the aircraft, both the air conditioning[3] and oxygen systems were intact. To ensure a safe recovery of the aircraft for further examination, the pressurised refrigerant gas within the air conditioning system was extracted. The oxygen storage bottle, pressurised to 1,500 psi, was also discharged on site.

Footnote

[3] The aircraft system contained pressurised 1,1,1,2 Tetraflourethane gas known as R134a. There are hazards associated with R134a so it requires careful handling, and the gas should not be discharged directly to atmosphere. The air conditioning system design is similar to that used on road vehicles. Therefore, a qualified motor vehicle contractor was called in to extract and dispose of the R134a gas within the regulations.

Recorded information

A number of recorded data sources were available to the investigation, including CCTV and radio transmissions from Duxford. The aircraft was fitted with digital displays which recorded information to an SD card and a Recoverable Data Module (RDM), which is a dedicated crash-hardened memory storage device. This device recorded over 600 parameters at a rate of up to 5 Hz. Flap position was recorded but other control surface positions, flight control inputs and throttle positions were not. A 'Percent Power' parameter was recorded which was a record of that displayed to the pilot on the Multi-Function Display (MFD). The Pilot's Operating Handbook (POH) defines this as:

> *'the percentage of maximum engine power produced by the engine based on an algorithm employing manifold pressure, indicated air speed, outside air temperature, pressure altitude, engine speed, and fuel flow.'*

In addition, a 'Normalized' AOA parameter was recorded ranging from zero to one with a value of 'one' representing stall. This parameter is dynamically calculated depending on parameters such as bank angle and flap position.

Due to aircraft damage, the RDM data could not be recovered in situ and was examined and downloaded in the AAIB laboratories. The manufacturer decoded the data, and the accident flight plus previous flights were successfully recovered.

Accident flight

The accident flight recording commenced at 1303 hrs and the engine started just over four minutes later (Figure 5). The aircraft taxied to Runway 06R and took off at 1320:40 hrs and throughout the entire flight, the recorded data confirmed that the autopilot was not engaged. The aircraft entered a right-hand circuit, climbing initially to a recorded pressure altitude of 1,344 ft amsl[4]. Altitude varied between 1,344 ft and 1,033 ft[5] until the end of the downwind leg with recorded airspeed varying between 159 KIAS and 89 KIAS.

Footnote

[4] Pressure altitude was recorded using a QNH of 1013 hPa. This has been corrected to the Duxford QNH at the time of 987 hPa.

[5] Circuit height is 1,000 ft aal. Airfield elevation is 126 ft which equates to a circuit altitude of 1,126 ft amsl.

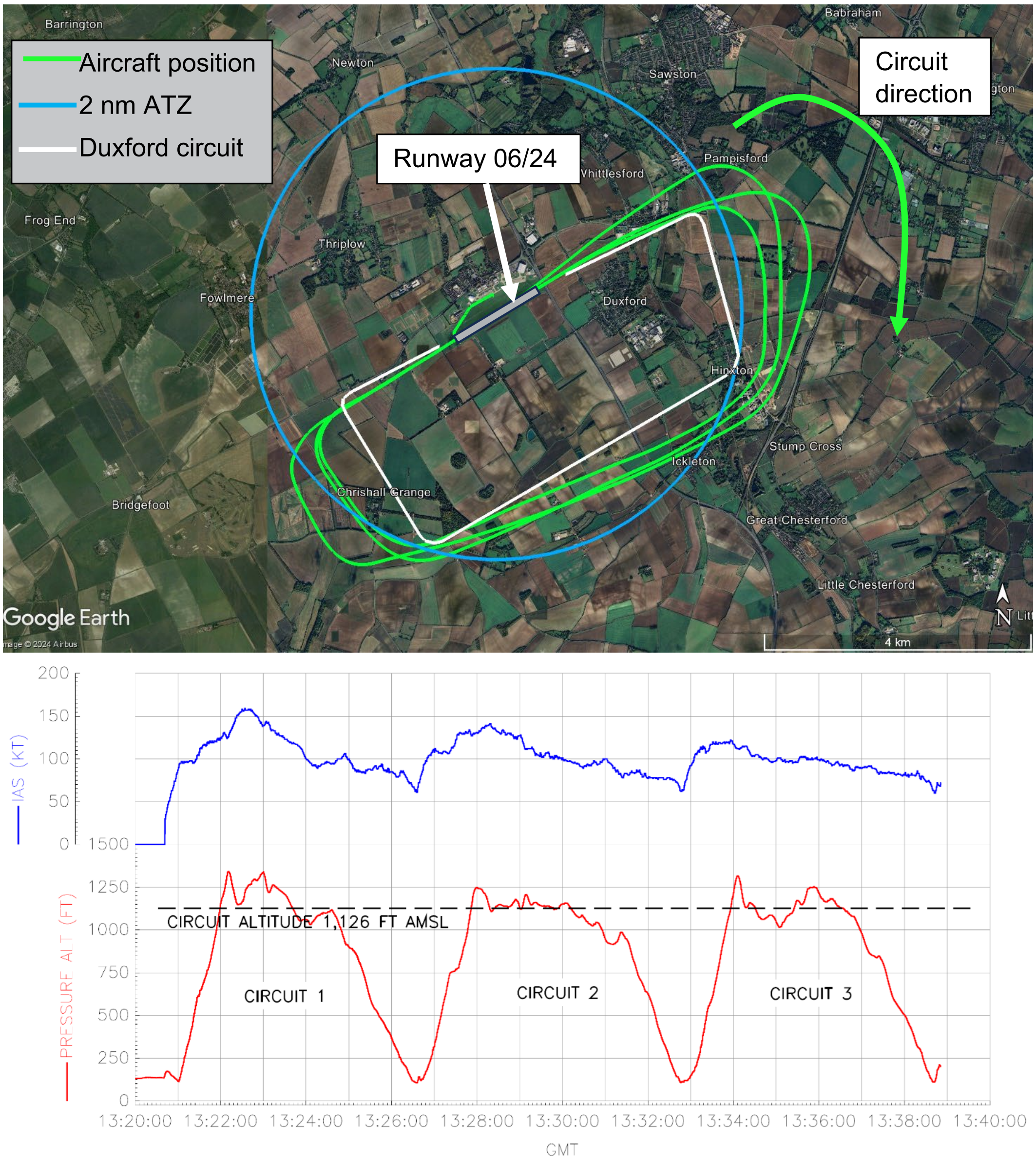

Figure 5

G-RGSK recorded position, indicated airspeed and altitude during the accident flight (circuit shape (in white) sourced from Duxford Airfield website[6])

The vertical speed and airspeed stabilised during the final approach of the first circuit. The approach was made with 100% flap with touchdown at 67 KIAS. The recorded flap position then reduced from 100% to 50%, full power was applied with takeoff at approximately 87 KIAS.

During the second circuit, fluctuations in airspeed and altitude were noted but to a lesser extent than the first circuit. The aircraft touched down at 63 KIAS after which power was applied three seconds prior to the recorded flap setting reducing from 100% to 50%. The aircraft accelerated, taking off at approximately 87 KIAS.

Footnote

6 https://www.iwm.org.uk/visits/iwm-duxford/pilots [accessed on 21 March 2025].

Accident approach

The aircraft then entered the right-hand circuit and, at 1338 hrs, turned on to the final approach at approximately 500 ft aal. The pilot made a radio call that he was on final for a touch-and-go and, at 50 ft aal, the aircraft was descending at 500 ft/min with 100% flap, 75 KIAS and 14% power. Pitch attitude then started to increase and power reduced to 11% (Figure 6).

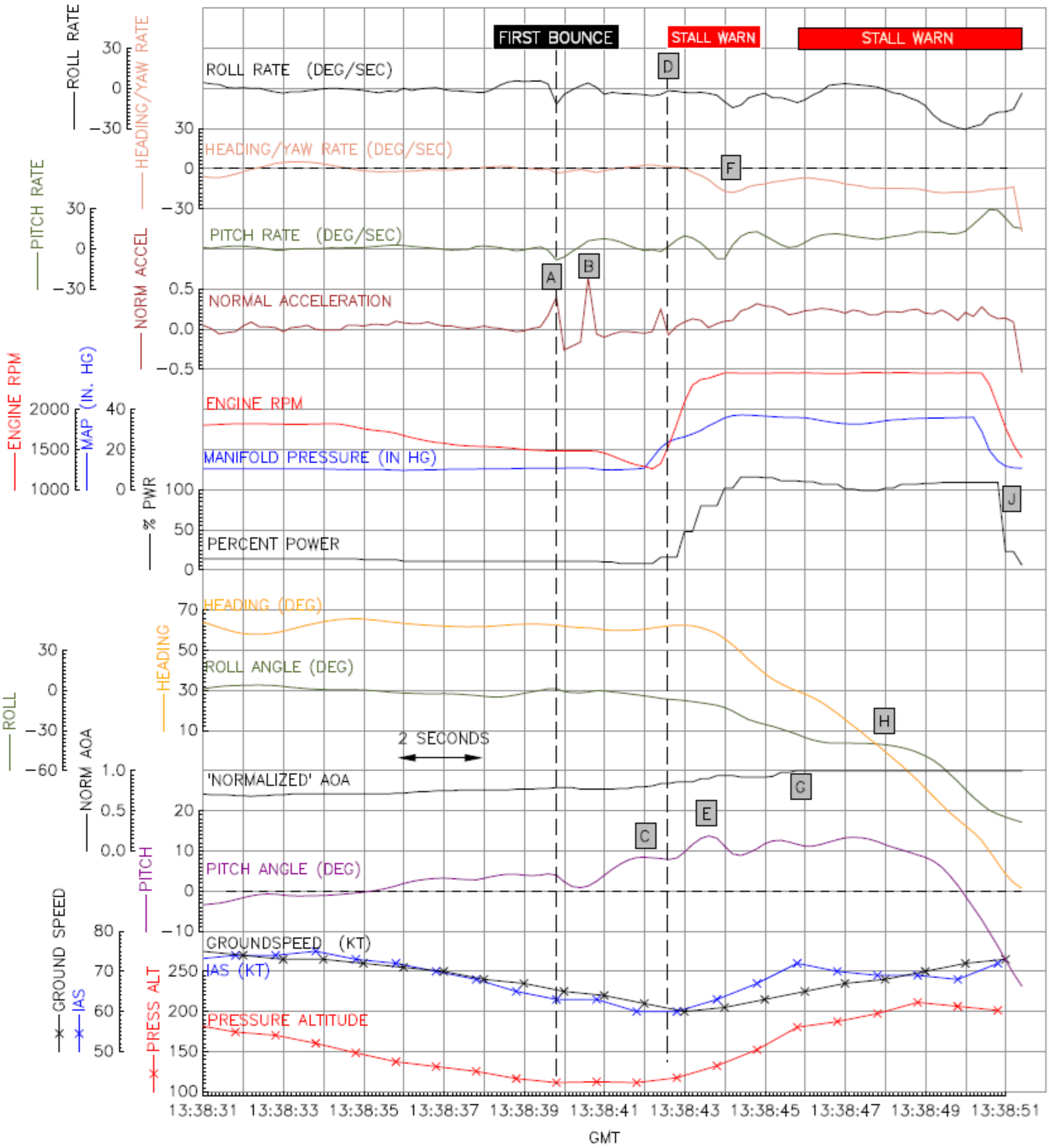

Figure 6

G-RGSK RDM data

Touchdown occurred at 1338:40 hrs at 63 kt IAS, identified by a spike in the recorded normal acceleration of 1.4g[7] (Figure 6, point A). A second spike in the normal acceleration was recorded 0.8 seconds later of 1.67g, suggesting that the aircraft had bounced (Figure 6, point B). A second later, the aircraft had pitched up to 8.4° and started to roll to the left (Figure 6, point C). A further second later, the recorded percent power started to increase, coincident with a recording of the stall warning activating (Figure 6, point D). Percent power increased from 8% to 116%[8] over 2.1 seconds (engine speed increased from 1,261 rpm to 2,500 rpm with a corresponding manifold pressure increase).

As the engine power increased, the aircraft pitched up further, continued to roll to the left and began yawing to the left (Figure 6, point E). Pitch increased to 13.7° nose-up and then fluctuated over the next five seconds while the recorded 'Normalized' AOA increased, eventually reaching and staying at 1 (indicating a stalled condition) for the remainder of the flight (Figure 6, point G). The recorded negative roll rate signified an increase in left roll from wings level to 40° left wing low over five seconds. Roll attitude held at 40° left wing low (Figure 6, point H) for a second before continuing to increase to the left until the end of the flight.

As soon as the engine power increased, the heading/yaw rate to the left increased and then remained at between 7-18 deg/sec to the left for the remainder of the recording (Figure 6, point F). This meant the aircraft was consistently yawing to the left after engine power was applied.

In the time between power being applied and the end of the recording (8.5 seconds), the aircraft heading decreased and the altitude increased by 100 ft with airspeed initially increasing from 63 KIAS to 72 KIAS. The RDM recording terminated prior to the end of the flight as the final recorded altitude was 206 ft amsl (approximately 80 ft aal). Just prior to the end of the recording, engine power was reduced (Figure 6, point J) but, at this time, the aircraft pitch had reduced, roll attitude was 92° left, and the aircraft had turned through 120° to the left to a heading of 304°. It should be noted that position recording ceased 1.5 seconds prior to the end of the recording.

Approach comparison

Figure 7 shows a comparison of the three approaches and landings during the accident flight. The altitude and airspeed profiles were all similar with 100% flap selected for landing.

Footnote

7 The RDM recorded normal acceleration when stationary on ground was 0 g. References to normal acceleration in the report have added 1 g to this value.

8 Percent power is defined as between 0-100%. The increase to over 100% could not be explained by the aircraft manufacturer but was likely due to this being a dynamically calculated parameter. Engine parameters (rpm and manifold pressure) were within expected limits.

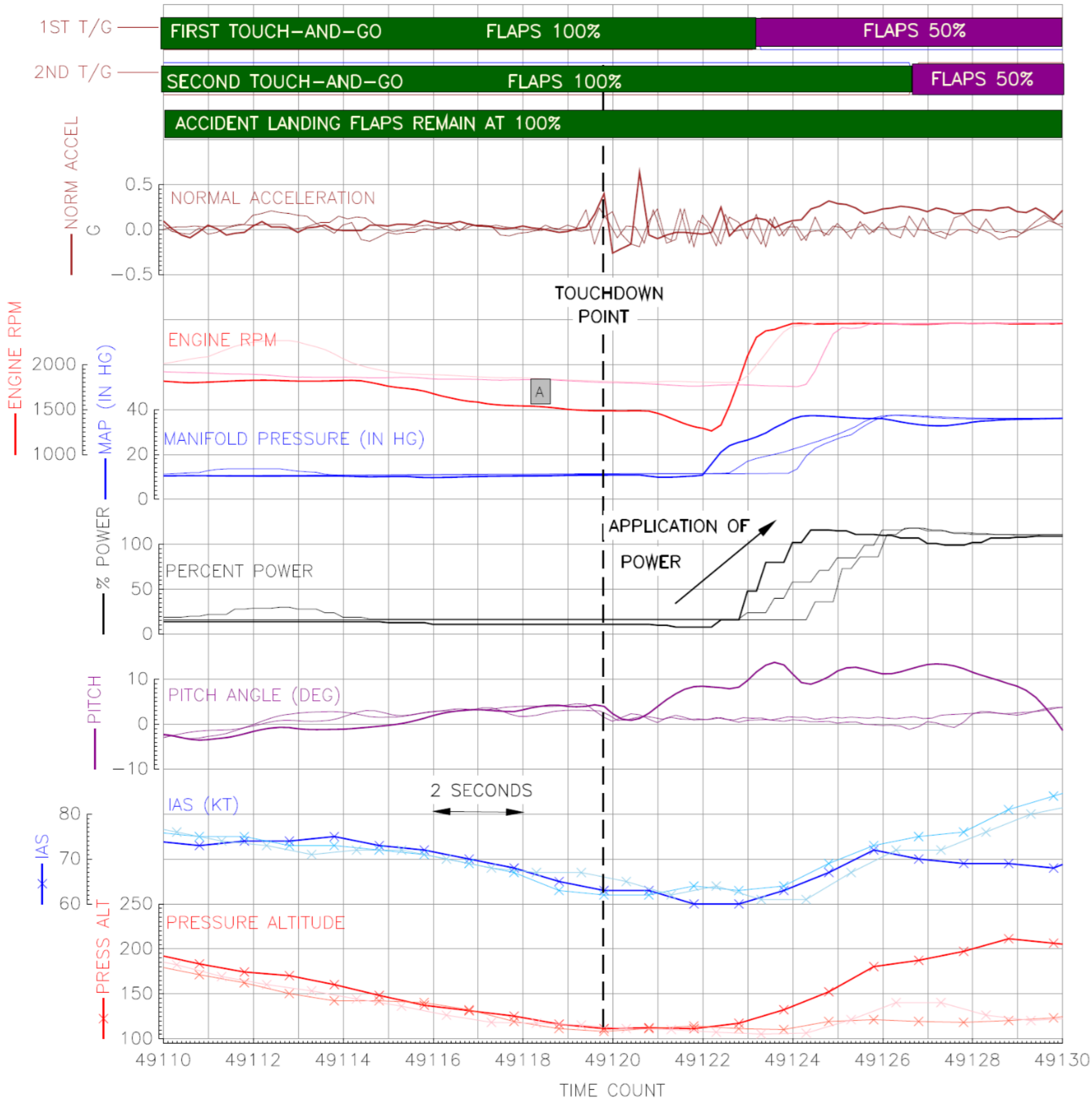

Figure 7

Comparison of approaches during accident flight
(Accident data is shown in bold colour)

Percent power on touchdown was slightly less for the accident landing than the previous two (11% vs 16% and 17% respectively) which can also be seen in a reduced engine rpm (Figure 7, point A). The rate of percent power increase was higher for the accident go-around which reached full power in 1.6 seconds (2.2 seconds and 3.2 seconds for the first and second landings respectively).

Manufacturer's assessment

The RDM was downloaded at the AAIB and the data was sent to the aircraft manufacturer for decoding. The aircraft manufacturer was asked to comment on the accident landing, given their operational experience and capability in analysing RDM data.

They stated that *'The pilot completed two normal touch and go landings'* but the final touch-and-go differed, as described in detail in the recorded information section of this report. They confirmed that when power was applied to abort the landing, 100% flap was still selected but advised that there is sufficient engine power to accelerate the aircraft in this configuration. The manufacturer's view was that excessive pitch up at low speed was the most significant factor in this accident, followed by the fact that the yaw was not controlled as power was applied.

Aircraft information

G-RGSK was a Cirrus SR22T five-seat low-wing monoplane aircraft of composite construction. It was powered by a Teledyne Continental flat six twin turbocharged piston engine producing 315 hp driving a three-blade constant speed governor-regulated propeller. The aircraft was fitted with an advanced avionic display and navigation system.

The flying controls were a conventional mechanical design. To enhance flight control, the aircraft was fitted with a Garmin GFC700 Automatic Flight Control System (AFCS). Sensors within this system were used to provide Electronic Stability and Protection (ESP) which used servos to provide the pilot with a degree of control force feedback to give a tactile indication when the aircraft neared the limits of its defined operating envelope. The ESP only operates within the autopilot operating limitations when the autopilot is disengaged.

The POH states the following limitations for the autopilot:

- Minimum autopilot speed – 80 KIAS
- Maximum autopilot speed – 185 KIAS
- Autopilot Minimum-Use-Height:
    - Takeoff and climb – 400 ft agl
    - Enroute and descent – 1,000 ft agl

In addition, there was a takeoff and go-around (TO/GA) feature which could assist the pilot by engaging the flight director TO or GA command bars on the primary flight display. The pilot could then hand fly the aircraft to follow the path indicated by the command bars.

The aircraft was fitted with electrical screw jack driven trailing edge flaps. These had three positions: fully up (0°), 50% (16.0°) and 100% (35.5°).

The aircraft was equipped with an audio and visual stall warning system. The stall warning was set to trigger at approximately 5 kt above stall with full flaps and power off in wings-level flight[9]. The POH, as part of the normal procedures for a pre-flight inspection, calls for the stall warning system to be tested and to note that the warning horn sounds. Activation of the stall warning system is recorded in the RDM.

Footnote

[9] Cirrus Pilot's Operating Handbook (POH) stall warning system description.

Aircraft history

The aircraft was built in 2023, and test flown in the United States of America by the manufacturer under registration N277SK. It was then ferry flown to a UK based Continued Airworthiness Maintenance Organisation, where it was inspected and issued with a Certificate of Airworthiness (C of A) and a Release to Service. The C of A was issued on 12 October 2023 with an Airworthiness Review Certificate (ARC) valid until 9 October 2024. During this process the CAA allocated and issued its UK registration. It was then delivered to its owner to be based at Duxford. At the time of the accident the aircraft had accrued a total 40 flight hours of which 24 hours were flown during testing and the ferry flight, and 16 hours flown by the owner. There were no aircraft system faults or malfunctions recorded in that time.

Aircraft examination

There was severe disruption of the aircraft systems and structure, however all the components examined showed little wear and tear, which was expected given the age of the aircraft. Continuity of the flying controls in all axes could be demonstrated with all apparent damage attributable to the impact disruption. The flap switch was set to 100% (fully down) and this was corroborated by recorded data in the RDM and by the position of the flap actuator. Both flaps were severely damaged along with the damage to the wings but marks on the hinges also show they were down at impact.

All the propeller blades' roots were broken with the spinner in place. Various pipes, ducts and hoses had detached from the engine systems but apart from distortion and soil embedded in the No 1 cylinder cooling fins and displacement of both magnetos, the engine was undamaged. The exact power output of the engine during the accident sequence could not be determined by any physical evidence on or around the engine. However, recorded data showed the engine was operating normally.

Personnel

The pilot initially commenced his PPL training in late 2021 in a Piper Cherokee Warrior II PA28-161, but his logbook indicates he stopped mid-2022. In May 2023, at a different airfield and with a Cirrus ATO, he recommenced his PPL training on a Cirrus SR20[10] with a Cirrus Standardised Instructor Pilot (CSIP). He gained his PPL (A) with SEP (Land) rating in November 2023, and had completed 87.4 hours, including 12 hours solo, and over 82 flights on the Cirrus SR20 by that time. The Head of the ATO stated this was in the normal range for the completion of a PPL with Cirrus.

The pilot's instructors observed that the pilot displayed signs of inconsistency during his PPL training, especially after a period away from flying, but stated that this was not unusual for pilots at this stage of flying. They did not highlight any specific concerns about his ability to perform go-arounds.

Footnote

[10] The Cirrus SR20 G6 is powered by a Lycoming IO-390 engine of 215 hp (160 kW).

SR22T transition training

In the UK, pilots are required to:

> *'… complete differences training or familiarisation in order to extend their privileges to another variant of aircraft within one class or type rating[11]'.*

This requirement extends to the SR22T because it has a turbocharged engine, and the requirement can be met through the manufacturer's transition training course.

In November 2023, the pilot began the manufacturer's SR22T transition training course and flew three flights with a CSIP totalling 4.2 hours. He covered the handling elements of this training and the CSIP made an entry in his logbook that read '*High Performance Signoff*'.

Subsequent flights

During December 2023 and January 2024, the pilot conducted 11 flights on the SR22T as pilot-in-command, totalling 12 hours of flight time. His last flight was on 1 February 2024, 54 days before the accident, and was from Exeter to Duxford.

Handling considerations during a go-around / rejected landing

Engine power affects the rotational balance of the aircraft about its primary axes ie yaw about the normal axis, pitch about the lateral axis and roll about the longitudinal axis.

Effects of engine power on roll and yaw

For an aircraft such as the SR22T, with a clockwise rotating propeller (viewed from the cockpit), the application of power during a go-around leads to various aerodynamic effects the net outcome of which is a tendency to roll and yaw left:

1. Corkscrew effect of the slipstream. The slipstream from the propeller over the fin, rudder and side of the fuselage aft of the CG, acts in a yaw-left sense, with the effect increasing with power. The slipstream also produces a roll-right moment, but this effect is exceeded by the torque reaction in the opposite direction (see below).
2. Torque reaction. The revolution of the engine and propeller induces an opposing moment in roll, which results in a tendency to roll to the left when the aircraft is in flight.
3. Gyroscopic effects of the propeller. The spinning propeller acts as a gyroscope, and gyroscopic precession means that yawing about the vertical axis leads to a pitching moment, and pitching around the lateral axis leads to a yawing moment.

Footnote

[11] Regulation (EU) 1178/2011, Part FCL, GM1 FCL.700.

4. Asymmetric blade effect[12]. When an aircraft is flying with a high angle of attack (AOA), typically during slow flight, the effectiveness of the downward moving blade is greater than that of the upward moving blade. This moves the centre of thrust from the centre of the propeller outwards towards the tip of the down-going blade, resulting in asymmetric loading of the propeller and a consequent yawing moment to the left.

The manufacturer's advice when applying power during a go-around from a stabilised approach or from a rejected landing is:

> *'… be aware of the left turning tendencies and compensate with right rudder'.*

The effectiveness of an aircraft's control surfaces reduces as airspeed is reduced and, consequently, relatively large control inputs are required at slow speed for a given effect.

Effects of engine power on pitch attitude

An increase of power in aircraft such as the SR22T will disrupt the longitudinal balance of the aircraft, and the effects, which can be magnified when flaps have been selected, are more pronounced at high power and high angles of attack:

1. The position of the thrust line above or below the CG will produce a pitching moment about the lateral axis.
2. Propellers produce a relatively small upward lift component due to the change of momentum of the air passing through them. This tends to pitch the aircraft nose-up.
3. An increase in the downwash angle of the wing changes the angle at which the airflow strikes the horizontal stabiliser.
4. The increased velocity of the airflow at the horizontal stabiliser increases its effectiveness.

The most common overall outcome of these phenomena is a nose-up pitching moment, and this is the case for the SR22T.

Use of ailerons at low airspeeds

The use of ailerons leads to adverse yaw, which is where an aircraft yaws in the opposite direction to the applied roll input. This effect can be more marked at low airspeeds, where larger control inputs will be required for a given effect. Separately, the use of ailerons increases the AOA on the down-going wing, which can cause the wing to stall in circumstances where the aircraft was close to the stall speed. These effects help explain why the manufacturer recommends using right rudder and not right aileron to compensate for the *'left turning tendencies'* during a go-around.

Footnote

[12] This is also known as the 'P' factor or Asymmetric Loading.

Technique for go-around / rejected landing

SR22T POH

In the case of a balked landing[13] / go-around, the SR22T POH states:

> ***'Balked Landing/Go-Around***
>
> 1. Autopilot .... DISENGAGE
> 2. Power Lever...FULL FORWARD
> 3. Flaps 50%
> 4. Airspeed... 80-85 KIAS
>
> After clear of obstacles:
>
> 5. Flaps ....UP
>
> ***Amplification***
>
> *In a balked landing (go around) climb, disengage autopilot, apply full power, then reduce the flap setting to 50%. If obstacles must be cleared during the go around, climb at 80-85 KIAS with 50% flaps. After clearing any obstacles, retract the flaps and accelerate to the normal flaps up climb speed.'*

Manufacturer's training material

The manufacturer's training material amplifies the actions in the POH and advocates a *'4-step flow'* when performing a go-around / rejected landing:

1. Power up. '*Immediately smoothly apply full power using the same 4-5 second motion used during takeoff, be aware of left turning tendencies and compensate with right rudder'*.
2. Pitch up. '*Pitch up to an attitude that is just above the horizon [to begin accelerating] then pitch up to normal go-around climb attitude. Be careful not to over rotate due to a strong desire to pitch up; this may require a little forward pressure to maintain the appropriate attitude*.'
3. Clean up. '*If flaps were 100%, retract to 50% and maintain constant pitch attitude to avoid any sinking from the retraction of the flaps*.'
4. Call up. '*Call ATC … and complete the balked landing checklist.'*

CSIPs' instruction

The instructor who conducted the transition training on the SR22T reported teaching the pilot that power should be applied smoothly during a go-around over two to three seconds with coordinated input of rudder.

Footnote

[13] A balked landing is the same as a rejected landing.

Previous go-around events with loss of control in SR22 variant aircraft

Seven similar accidents involving loss of control of SR22 variants during the execution of a go-around were identified (Appendix 1). Five of these events involved the execution of a go-around following a bounced landing.

In particular, an accident involving VH-XGR in 2023 shared similarities with this accident. After a bounced landing, the Cirrus SR22 entered a steep climbing turn to the left. Having reached a maximum height of about 40 ft, the bank angle exceeded 90° and the aircraft dropped onto the left wing and nose. The Australian Transport Safety Bureau (ATSB) found that:

> '*in the early stages of a go-around from an unstable landing, the pilot was unable to counter the substantial torque effect associated with high engine power, low airspeed, and high pitch angle, resulting in loss of control and collision with terrain*.'

The ATSB noted that the material provided by Cirrus did not highlight the risk of loss of control associated with a go-around during the landing phase, where there was high engine power, low airspeed, and high pitch attitude.

Analysis – aircraft accident

Introduction

The accident resulted from a loss of control in flight at very low level. This occurred during the execution of a rejected landing with a low energy state after the aircraft had bounced on touchdown. The data indicated that the aircraft adopted a sustained high nose attitude with low airspeed, and the aerodynamic effects from the application of power were not contained, resulting in significant yaw and roll to the left. This rolling and yawing persisted until the aircraft struck the ground, and the data indicated that the wing was stalled for the last five seconds of the recording.

Engineering

The aircraft had a valid Certificate of Airworthiness, low airframe hours and was in good condition commensurate with its age. Examination of the aircraft found no pre-existent fault or system malfunction that could have contributed to this accident.

The CAPS was not initiated by the pilot. It activated because of disruption and breakup of the cockpit roof section on which the activation 'T' handle was mounted. This disruption displaced and tensioned the cable which caused the igniter to fire and set off the rocket deploying the parachute in the latter part of the accident sequence.

Aircraft handling during the rejected landing

The technique for going around from a rejected landing in the SR22T involves moving the power lever fully forward, setting flaps to 50% and pitching up initially to an attitude just above the horizon to allow the aircraft to accelerate. During the accident go-around, the aircraft pitched up to 8.4° before the power was applied. This increase in pitch followed, and was possibly a reaction to, the bounce on the runway. When power was applied, it was coincident with the stall warning and was followed by a further increase in pitch attitude to 13.4°. The nose attitude remained predominantly above 10° for the following four seconds before decreasing as the aircraft descended towards the ground. The data indicated that the stall warning was active for all but one of the final nine seconds of flight, indicating that the wing was at or near the critical (stalling) AOA. The stall warning system included both audio and visual indications.

The 'Normalized' AOA parameter began to increase from the point the nose attitude was increased after the first bounce. The AOA continued to increase during the turn until it reached 1, approximately three seconds after the application of power. The AOA parameter indicated that the wing then remained stalled for the final five seconds of flight, even after the nose attitude began to decrease as the aircraft descended. It appeared likely that the sustained high nose attitude during the go-around and first part of the turn caused the wing to stall.

The pilot had flown over 82 flights on the SR20 by the time he completed his PPL but the SR22T is significantly more powerful and the effects of applying power during a go-around are more pronounced. The pilot applied full power in approximately two seconds, which was at the lower end of the two to three seconds taught by CSIPs during transition training to fly the SR22T, but significantly quicker than the four to five seconds in the manufacturer's training material. During the go-around, the aircraft was at slow speed with a high nose attitude and with 100% flaps set, all of which would have tended to increase the '*left turning tendencies*' that the manufacturer's training material states must be countered with right rudder. The relatively quick application of power would have quickened the onset of these tendencies such that a prompt application of rudder would have been required. It was evident from the fact that the aircraft began yawing and rolling left that insufficient right rudder was applied with the increase in power.

At this point, the aircraft was yawing and rolling left. When an aircraft yaws to the left it will begin to roll left, and when it rolls left it will begin to yaw left, leading to a self-sustaining motion in the absence of corrective action from the pilot. In this case, the motion persisted until the aircraft struck the ground indicating that effective corrective action was not taken.

Corrective action in these circumstances would have been to reduce the aircraft's pitch attitude sufficiently to reduce the AOA below the critical angle and to apply sufficient right rudder to stop the yaw. This might have been effective during the early part of the go-around, when reducing the AOA might have left the aircraft with a positive rate of climb and sufficient power to accelerate. Reducing the AOA when the aircraft was established in the turn, however, is likely to have resulted in a loss of height with the risk that there would be insufficient time to recover to safe flight before impact with the ground. This is why a loss of control is so hazardous when close to the ground and controlling the pitch attitude during a go-around is so important.

Experience

In general, greater experience brings advantages in terms of increased consistency of performance and familiarity with a greater range of situations. More experienced pilots can also perform manual flying skills with less conscious attention, therefore freeing more capacity to deal with concurrent tasks and respond appropriately to unexpected and adverse situations in the air.

The pilot was inexperienced in terms of flying hours overall and time on type. At this stage in his flying, the pilot was still consolidating his skills and likely vulnerable to being overwhelmed by unexpected events. However, previous similar accidents have occurred with pilots with higher levels of experience and even with instructors on board. This suggests that general flying experience on type or on other types does not assure that the appropriate handling technique will always be followed.

Recency

In general, pilots with more recent practice show better performance[14]. The pilot last flew 54 days before the accident flight and his instructors commented that during his training, like most novices, his performance would reduce after a period of non-flying. The variability of speed and altitude during the first two circuits of the accident flight suggests there may have been some reduction in performance compared to when the pilot had been flying regularly and this may have contributed to the loss of control.

In a flying club environment, there is commonly a recency requirement where if a pilot has not flown for a defined period of time (often around a month), they are required to fly with an instructor before flying in command of a club aircraft. Outside of a club environment, pilots are not subject to such requirements but have the option to employ an instructor to fly with them if skill fade is a concern.

Workload

The traffic conditions in the circuit did not appear challenging, so high workload due to other traffic was probably not contributory to the accident. However, circuit flying is a relatively demanding task, and the pilot may still have experienced high workload throughout the flight because of lack of recent practice. This might have left him with less capacity to correctly execute the rejected landing.

Startle

The pilot appears not to have taken sufficient action to correct the high pitch following the bounce, nor the aerodynamic effects from the application of power. The bounce was of a greater magnitude than in the landings on the previous two circuits and it is possible that the pilot was startled. Startle is a "*brief, fast and highly physiological reaction to a*

Footnote

[14] Civil Aviation Authority (2023). *Civil Aviation Publication 737 Flight Crew Human Factors Handbook*, p154. https://www.caa.co.uk/publication/download/14984 [accessed 25 March 2025].

sudden, intense or threatening stimulus"[15] which occurs involuntarily and can interrupt task performance for up to 1.5 seconds[16]. This may have impaired him causing the faster than usual application of power (an example of a 'flight' response) and subsequent lack of response to correct the aircraft's unusual attitude (an example of a 'freeze' response).

The data indicates that the stall warning activated around the time when the power was applied. This had the potential to prompt the pilot to make a pitch-down control movement, but the pitch attitude increased further. The pilot may not have heard the warning due to inattentional deafness[17] or he may have heard it and found it confusing or further startling because it was heard in a situation where he would probably not expect it.

Conclusion

The accident occurred during the go-around from a bounced landing when the aircraft adopted an excessively high nose attitude during the initial part of the go-around. The aircraft's tendency to yaw and roll left following the application of power was not controlled, causing the aircraft to turn left, and a relatively high nose attitude was sustained during the turn, causing the wing to stall. The rolling and yawing motion continued until the aircraft struck the ground.

The pilot was relatively inexperienced and had not flown for 54 days before the accident flight and it is possible this led to a reduction in his performance. No corrective action was apparent after the initial loss of control, and it is possible that a startle effect degraded the pilot's ability to respond appropriately.

Similar accidents have occurred in SR22 and SR22T aircraft even with pilots with higher levels of experience or with instructors on board. These occurrences indicate that, irrespective of experience, using the manufacturer's technique to go around is paramount for the safe operation of the aircraft.

Section two – Ballistic Parachute Recovery System

Cirrus Airframe Parachute System (CAPS)

G-RGSK was fitted with the CAPS. This feature is a parachute recovery system installed for use in flight to '*bring the aircraft to the ground in the event of a life threatening emergency*'. It consists of a large parachute that can be deployed in an emergency by the pilot or aircraft occupants and is designed to hold the aircraft in a stable and controlled vertical descent to the ground. It is activated by pulling a red 'T' handle positioned in the cockpit on the roof panel.

Footnote

[15] Landman, A., Groen, E.L., van Passen, M.M. Bronkhorst, A. & Mulder, M. (2017) 'Dealing with unexpected events on the flight deck: A conceptual model of startle and surprise' in Human Factors, Vol 59 pp 1161-1172 [accessed 14 January 2025].

[16] Martin, W., Murray, P. & Bates, P. (2012) 'The effects of startle of pilots during critical events: a case study analysis' Proceedings of 30th EAAP Conference: Aviation Psychology & Applied Human Factors – working towards zero accidents [accessed 14 January 2025].

[17] A phenomenon where '*unexpected salient sounds can remain unnoticed under attention demanding conditions*' (Dehais, F., Causse, M., Vachon, F., Regis, N., Menant, E. and Tremblay, S. (2014). Failure to Detect Critical Auditory Alerts in the Cockpit: Evidence for Inattentional Deafness. *Human Factors: The Journal of the Human Factors and Ergonomics Society, vol. 56 (4)*. p 631-644 [accessed 14 January 2025].

This activates an electro-mechanical igniter system to fire a rocket from a compartment in the crown of the fuselage, behind the cockpit, that deploys the main parachute. To make the system safe on the ground, a safety pin with a 'Remove Before Flight' flag is inserted into the 'T' handle to prevent inadvertent operation.

The only indication to an external observer that the CAPS system was fitted to this aircraft were two small placards. These were fixed to the upper rear fuselage surface on the left and right edges of the CAPS frangible panel. Each state in plain black text the following:

'WARNING!
ROCKET FOR PARACHUTE DEPLOYMENT INSIDE
STAY CLEAR WHEN AIRPLANE IS OCCUPIED'

From a distance and in low light conditions these placards are barely discernible and do not draw particular attention to the potential danger within. Figure 8 shows the placard on the left side of G-RGSK.

Figure 8

CAPS placard left side
(Note in this case the CAPS had activated, and the frangible panel was repositioned for illustrative purposes)

Information on the CAPS for first responders is included in an information manual produced by the manufacturer. However, this requires prior knowledge of the aircraft type and may not be immediately available to emergency first responder and/or local authority fire and rescue services.

A report into a Cirrus SR22 accident involving VH-XGR in 2023 published[18] by the ATSB detailed how the first responders conducted an accident victim extraction from an inverted aircraft. They needed to cut into the aircraft in proximity to the CAPS and its armed initiation devices. The unobtrusive nature of the placard and the fact the aircraft was inverted meant the placard went unnoticed. They were unaware of the risk CAPS presented until they were later informed by an individual with a knowledge of the aircraft and its systems. Steps were then taken to make it safe.

In its final report, the ATSB noted that the aircraft manufacturer '*advised that they have enhanced the external CAPS placarding on 2 new models of aircraft (the SF50, and another in development) to align with current American Society for Testing and Materials[19] (ASTM) standards. The SR2X series of aircraft (the SR20, SR22, and SR22T) were certified prior to the implementation of ASTM standards. At the time of writing, Cirrus was reviewing the possibility to enhance the placard that was certified with SR2X.*'

During the course of the G-RGSK investigation, the aircraft manufacturer advised that, for CAPS placards, it has initiated a project 'to address SR20, SR22 and SR22T aircraft'.

Separately, although the Federal Aviation Administration (FAA) and the European Union Aviation Safety Authority (EASA) requirements (14 CFR 23 and CS-23 respectively) have been updated to require appropriate placards for new Type Certificate applications for designs of aircraft which incorporate a BPRS, these requirements are not retrospectively applicable to existing designs.

Previous Safety Recommendations made by the AAIB

An investigation carried out by the AAIB into an accident in 2008 to a Dyn'Aero MCR-01, F-JQHZ[20] found that the warnings and placarding of BPRS was unsatisfactory. As a consequence, Safety Recommendation 2009-008 was made to the CAA, the FAA and to the EASA to require placards of a commonly agreed standard to be fitted, and Safety Recommendation 2009-007 was made to ICAO to publish an international Standard on warning placards. ICAO responded that it would be inappropriate to develop such a Standard until the FAA, CAA and EASA had addressed Safety Recommendation 2009-008. While the CAA acted on Safety Recommendation 2009-008 and amended BCAR Section S to include a description and visual depiction of the required placards, the EASA felt that the publication of an ICAO State Letter on the risks to third parties from BPRS was sufficient and, therefore, no further action was taken. The FAA evaluated the mandatory application of placards and determined the proposal did not meet the criteria for issuing a retroactive airworthiness directive for existing Part 23 certificated aircraft, but did mandate compliant placards on new type certificated aircraft and those subsequently modified to fit a BPRS.

Footnote

18 https://www.atsb.gov.au/publications/investigation_reports/2024/report/ao-2023-011 [accessed 14 January 2025].

19 The standards detailed in ASTM F3408-21 - *Standard Specification for Aircraft Emergency Parachute Recovery Systems* are identified as being acceptable to both the FAA and EASA.

20 https://assets.publishing.service.gov.uk/media/5422f02940f0b61346000311/Dyn_Aero_MCR-01__21-YV_callsign_F-JQHZ_06-09.pdf [accessed 14 January 2025].

A subsequent AAIB investigation into an accident in 2014 to CZAW SportCruiser, G-EWZZ[21], made similar Safety Recommendations to the EASA and the CAA regarding the visibility and positioning of warning placards. The EASA response was considered partially adequate as retrospective action to ensure compliance for in-service aircraft was not proposed. The CAA published BCAR Section S, Issue 7 in December 2018 with amendments to Sub-Section K paragraphs S 2003(g) and S 2014(c), but this did not apply to larger private light aircraft such as the Cirrus SR20 and SR22. However, the CAA did, through Mandatory Permit Directive MPD2019-005, apply the requirements retrospectively for those aircraft falling under BCAR Section S.

Analysis – Ballistic recovery system

In addition to Cirrus SR20 and SR22 aircraft, there are other types of aircraft operating in the UK with BPRS. The majority of these are microlight aircraft under BCAR Section S operated within the regulations set out in CAP 482, Sub-Section K. This Sub-Section details the requirements for those aircraft fitted with BPRS and specifically mandates the placards and markings that are to be clearly visible close to and from a distance, on aircraft external surfaces. The placarding requirements reflect those stipulated in ASTM F3408-21. Figure 9 shows the placard that must be fitted near the aircraft access door.

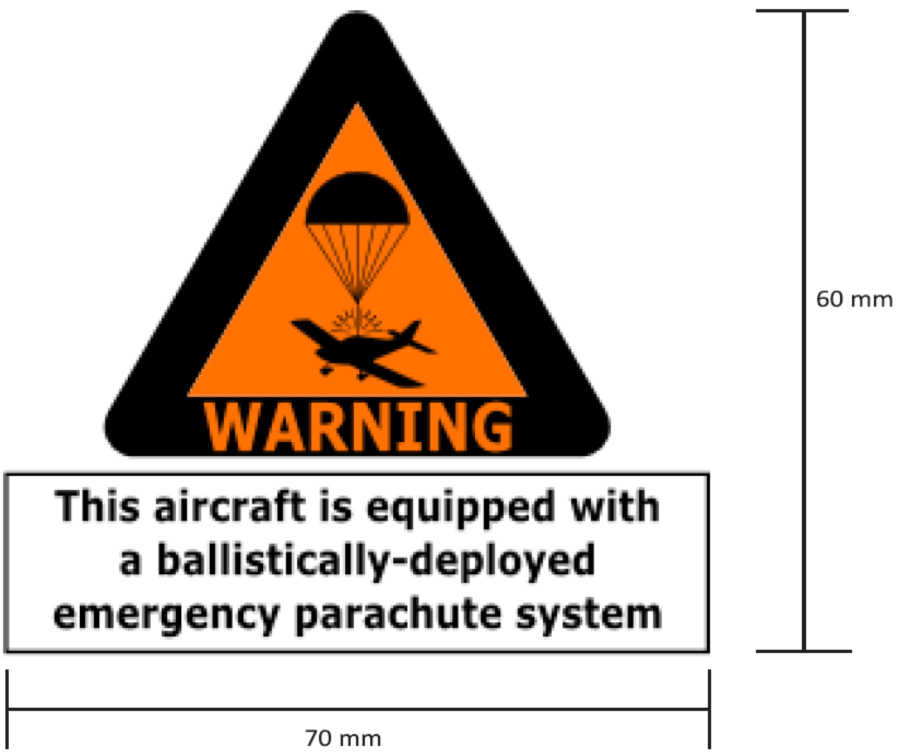

Figure 9

CAP 482 example BPRS warning placard

Footnote

21 https://assets.publishing.service.gov.uk/media/55532790ed915d15db00005e/CZAW_SportCruiser_G-EWZZ_05-15.pdf [accessed 14 January 2025].

Similar placards are applied to the area where the BPRS is located in the aircraft along with a yellow and black chequered line showing the device exit point from the airframe.

The placards have been designed to be visually clear pictograms and to follow the conventions found on military aircraft fitted with ejection seats and explosive release devices, which are recognisable and familiar to UK emergency services.

However, the UK is not the state of design, state of manufacturer nor certification authority of either the Cirrus SR20 or SR22 aircraft variants and therefore the CAA cannot directly influence or mandate the requirements set out in CAP 482 on these aircraft.

The CAA has published Safety Notice[22] SN-2025/003 – *Part 21 Aircraft with Ballistic Parachute Recovery Systems (BPRS) Fitted* which is intended for owners of Cirrus aircraft, and other aircraft not already covered by CAP 482, to encourage and promote the application of appropriate warning placards. The placard design is the same as that already mandated in CAP 482.

The FAA is the certifying authority for the Cirrus SR20 and SR22 and so can mandate that conspicuous and unambiguous markings are provided on these aircraft. To warn and protect people who may be unfamiliar with these systems, such as the emergency rescue services and others, from the potential danger, the following Safety Recommendation is made:

Safety Recommendation 2025-001

It is recommended that the Federal Aviation Administration mandate the application of conspicuous, unambiguous markings to the external surfaces of all in-service and future Cirrus SR20 and SR22 aircraft to warn of the presence, location and hazards of the Cirrus Airframe Parachute System (CAPS) and for all other Part 23 aircraft fitted with a Ballistic Parachute Recovery System (BPRS).

EASA is the validating authority for the Cirrus SR20 and SR22 aircraft and so can only take action in cases where it deems that an 'unsafe condition' exists. EASA has advised that the absence of appropriate placards does not constitute such an 'unsafe condition' and therefore cannot mandate changes on aircraft for which it is not the certifying authority.

Footnote

22 https://www.caa.co.uk/publication/download/24189 [accessed 20 February 2025].

However, the AAIB notes that other aircraft types, falling under CS-23, may be similarly affected. To warn and protect people who may be unfamiliar with these systems, such as the emergency rescue services and others, from the potential danger, the following Safety Recommendation is made:

Safety Recommendation 2025-002

It is recommended that the European Union Aviation Safety Authority mandate, for all CS-23 certified aircraft for which it is the certifying authority, the application of conspicuous, unambiguous markings to the external surfaces to warn of the presence, location and hazards of an installed Ballistic Parachute Recovery System (BPRS).

Safety action taken

The CAA has published Safety Notice SN-2025/003 – *Part 21 Aircraft with Ballistic Parachute Recovery Systems (BPRS) Fitted* which is intended for owners of Cirrus aircraft, and other aircraft not already covered by CAP 482, to encourage and promote the application of appropriate warning placards.

Appendix 1

The following Cirrus SR22 and SR22T accidents were identified by the AAIB. A summary of pilot experience, together with other factors identified during these investigations, is shown in Table 1.

N246MT, Lumberton, New Jersey, on 19 October 2006[23]

The pilot initiated a go-around during the flare due to low airspeed. The aircraft veered to the left before striking a tree and coming to rest upright.

N221DV, Falmouth, Massachusetts, on 1 September 2012[24]

After an unstable approach flown by a student pilot under instruction, a go-around was initiated close to the ground. The aircraft pitched up significantly and veered to the left. It struck the ground left wing down and came to rest inverted. The NTSB highlighted the control of the aircraft during the approach and the instructor's '*inadequate remedial action*.'

VH-OPX, near Moree, New South Wales, on 17 September 2015[25]

After a bounced landing, the pilot initiated a go-around. However, the left wing dropped, and the aircraft yawed to the left and collided with a dam wall to left of the runway. Shortly after the accident there was a significant wind gust that equated to a downwind component of 17 kt and a crosswind of 15 kt. If similar conditions were encountered at the time of the accident if may have contributed to the pilot's ability to control the aircraft during the go-around.

N702N, Raton, New Mexico, on 10/08/2024[26]

After a bounced landing, the pilot initiated a go-around. At about 15-20 ft agl the aircraft stalled, and the right wing dropped. The aircraft struck an embankment to the right side of the runway. The pilot believed that windshear contributed to the event and the NTSB concluded that the pilot did not attain proper airspeed during the go-around.

Footnote

[23] National Transportation Safety Board (2006), NYC07CA010 Aviation Investigation Final Report, https://data.ntsb.gov/carol-repgen/api/Aviation/ReportMain/GenerateNewestReport/64869/pdf [accessed on 14 January 2025].

[24] National Transportation Safety Board (2012), ERA12FA540 Aviation Investigation Final Report, https://data.ntsb.gov/carol-repgen/api/Aviation/ReportMain/GenerateNewestReport/84876/pdf [accessed on 14 January 2025].

[25] Australian Transport Safety Board (2015), Collision with terrain involving a Cirrus SR22, VH-OPX, near Moree, New South Wales, on 17 September 2015, https://www.atsb.gov.au/publications/investigation_reports/2015/aair/ao-2015-110 [accessed on 14 January 2025].

[26] National Transportation Safety Board (2019), CEN17LA359 Aviation Investigation Final Report, https://data.ntsb.gov/carol-repgen/api/Aviation/ReportMain/GenerateNewestReport/96045/pdf [accessed 14 January 2025].

VH-PDC, Orange Airport, New South Wales, on 15 May 2018[27]

After a bounced landing during training for a night rating, the pilot initiated a go-around. The aircraft pitched up and entered a left roll that the pilot was unable to correct. The instructor did not physically intervene, and the aircraft struck the ground and came to rest inverted. The ATSB concluded that the pilot may have become spatially disorientated.

N123RE, at Lamoni Airport, Iowa, on 1 July 2021[28]

After a bounced landing, there was an increase in engine power consistent with an attempt to initiate a go-around. The aircraft banked left, the left wingtip struck the ground, and the aircraft cartwheeled and impacted the ground to the left of the runway. The NTSB's analysis stated that the behaviour of the aircraft was consistent with '*insufficient right rudder control to counter the airplane's left-turning tendency associated with the increased engine power.*'

The pilot had completed 23 hours of transition training in the SR22.

VH-XGR, at Bankstown Airport, New South Wales, on 17 March 2023[29]

After a bounced landing, the aircraft entered a steep climbing turn to the left. Having reached a maximum height of about 40 ft, the bank angle exceeded 90° and the aircraft dropped onto the left wing and nose. The ATSB found that in the early stages of a go-around, '*the pilot was unable to counter the substantial torque effect associated with high engine power, low airspeed, and high pitch angle, resulting in loss of control and collision with terrain.*' The ATSB noted that the material provided by the manufacturer '*did not highlight the risk of loss of control associated with a go-around during the landing phase, where there was high engine power, low airspeed, and high pitch attitude.*'

Footnote

[27] Australian Transport Safety Bureau (2019), Loss of control and collision with terrain involving Cirrus SR22, VH-PDC, Orange Airport, New South Wales, on 15 May 2018, https://www.atsb.gov.au/publications/investigation_reports/2018/aair/ao-2018-038 [accessed 14 January 2025].

[28] National Transportation Safety Board (2022), CEN21FA299 Aviation Investigation Final Report, https://data.ntsb.gov/carol-repgen/api/Aviation/ReportMain/GenerateNewestReport/103396/pdf [accessed 5 March 2025].

[29] Australian Transport Safety Bureau (2024), Loss of control and collision with terrain involving Cirrus SR22, VH-XGR, at Bankstown Airport, New South Wales, on 17 March 2023, https://www.atsb.gov.au/publications/investigation_reports/2024/report/ao-2023-011 [accessed 14 January 2025].

Aircraft registration and type	Date	Total hours	Hours on type	Other factors identified
N246MT SR22	19/10/2006	805	405	
N221DV SR22	01/09/2012	117	100	Student pilot Instructional quality
VH-OPX SR22	17/09/2015	1,400	80	Crosswind and tailwind
N702N SR22T	10/08/2017	153	83	Windshear
VH-PDC SR22	15/05/2018	500 on Cirrus aircraft		Spatial disorientation Instructor intervention Pilot had a private instrument flight rules rating and about 50 hours of instrument flight time.
N123RE SR22	01/07/2021	166	45	
VH-XGR SR22TN	17/03/2023	860	47 in 6 months	Crosswind but considered within the capabilities of the aircraft and the pilot.

Table 1

Summary of pilot experience in previous go-around loss of control events involving SR22 aircraft

Published: 3 April 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:	Boeing 777-236, G-VIIT
No & Type of Engines:	2 General Electric Co GE90-85B turbofan engines
Year of Manufacture:	1999 (Serial no: 29962)
Date & Time (UTC):	28 June 2024 at 1120 hrs
Location:	London Gatwick Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 13 Passengers - 334
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fire on the right-side main wheel brakes which was extinguished by fire crew
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	22,374 hours (of which 18,616 were on type) Last 90 days - 210 hours Last 28 days - 54 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and other enquiries by the AAIB

Synopsis

During takeoff, the co-pilot began retarding the thrust levers at airspeed V_1, instead of removing his hand from them. After momentarily advancing them again, he initiated the rejected takeoff (RTO) procedure around 2 KIAS later. The RTO was performed effectively and the aircraft stopped some distance before the end of the runway surface.

The report considers the complex nature of the takeoff roll and why mental rehearsal of motor actions may benefit pilots, particularly after time off from flying. It discusses the industry-wide challenge of preventing action slips. This operator had already published a methodical approach to control selections, which it has promoted in pre-flight briefing material. It has included the wider issue of 'focus' in its recurrent simulator training.

History of the flight

The aircraft was taking off from London Gatwick Airport (Gatwick), Runway 26L. On hearing the aircraft's automatic callout of airspeed "V_1"[1], the co-pilot (who was PF) inadvertently began retarding the thrust levers, instead of removing his hand from them to continue the takeoff. Simultaneously, the commander called "ROTATE" as the airspeed continued increasing through V_r[2]. The co-pilot vocalised the error and momentarily advanced the thrust levers again, before performing the RTO procedure[3].

The aircraft stopped before intersection GR (Figure 1). The airport rescue and firefighting service attended the aircraft and extinguished a fire from hot brakes on the right main landing gear.

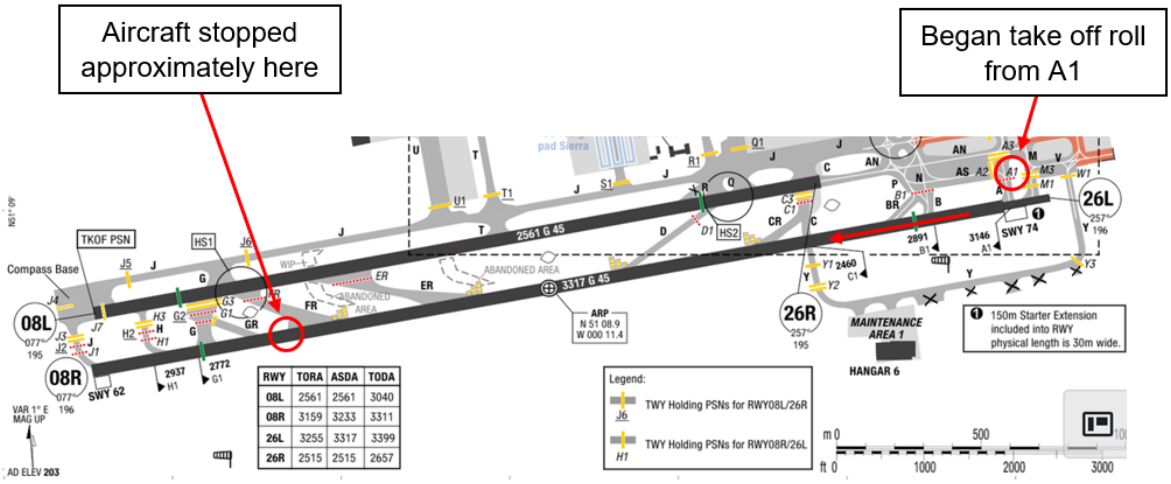

Figure 1
Excerpt from Gatwick ground chart

Information from the operator's operating manuals

The operator's *'Flight crew training manual'* (FCTM) described V_1 as *'the maximum speed in the takeoff at which the pilot must take the first action… to stop the airplane within the accelerate-stop distance*[4]*'* and *'the minimum speed… following a failure of an engine at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance'.* It stated *'The PF should keep one hand on the thrust levers until V1 in order to respond quickly to a rejected takeoff condition. After V1, the PF's hand should be removed from the thrust levers'.*

Footnote

1 V_1 is defined in the next section of this report.
2 V_r – The speed at which rotation of the aircraft into the air should be initiated.
3 The second thrust reduction began around two seconds after the first.
4 Acceleration stop distance available (ASDA) consists of the takeoff run available plus any stopway.

Performance

The aircraft's takeoff weight (TOW) was 248 tonnes, around 20 tonnes below its maximum takeoff weight (MTOW). Weather conditions were 11 kt headwind, temperature 18°C, QNH 1016 hPa, and dry runway surface. Departing from intersection A1 required using FLAP 5, assumed temperature[5] 42°C, and speeds V_1 160 kt, V_r 161 kt and V_2 165 kt.

The thrust levers were retarded first at around 160 KIAS[6], then again at around 162 KIAS. G-VIIT reached approximately 167 KIAS before stopping (Figure 2).

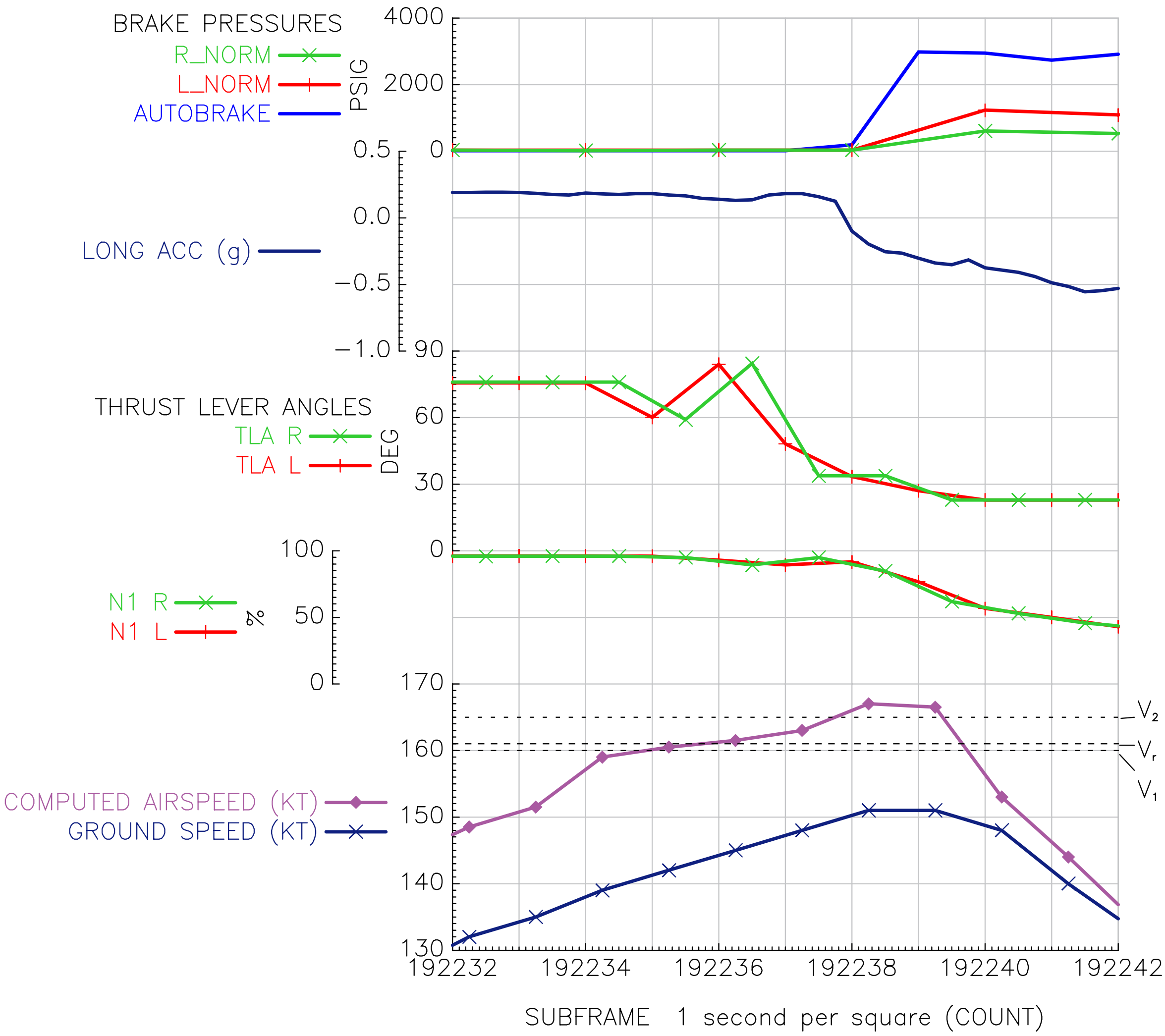

Figure 2

Recorded flight data

Footnote

[5] Using an 'assumed' temperature which is warmer than ambient temperature reduces engine thrust for takeoff.

[6] KIAS figures are based on 'computed airspeed' (Figure 2), which is the value displayed to the pilots.

Information from the operator's report

The operator's *'Cognitive task analysis'* report described the morning as otherwise *'unremarkable'* for the crew, with no obvious distraction or workload issues before the incident. The aircraft queued at A1 before lining up and waiting on the runway behind a landing aircraft.

Additional information from the crew

At the time of the incident, the co-pilot had 6,156 hours total flying time, with 2,700 hours on type, and 44 hours in the last 28 days. He was returning from annual leave having last flown on 14 June 2024. All his commercial flying had been in the right-hand seat. His last recurrent simulator evaluation was in February 2024.

The co-pilot reported being well-rested and feeling fine. He expressed surprise in himself over the inadvertent thrust reduction and could not identify a reason for it. He described instinctively pushing the thrust levers forward again. However, concern over re-adding thrust while further along the runway, and the uncertain takeoff performance decrement, meant he decided to commit to the RTO (which he felt he had effectively already initiated). He commented that in another situation he might have continued the takeoff using TOGA[7] thrust.

There was insufficient time for the commander to fully assess the situation before the aircraft began stopping. CVR evidence showed he responded to the RTO calmly and methodically such that it, and subsequent actions, were handled effectively by the crew.

Action slips

An action slip occurs when an action is not performed as intended, arising in routine or highly learned motor action sequences[8].

The operator had already reviewed its standard operating procedures relating to movement of critical controls and found that absence of cognitive thought and speed of execution commonly featured during action slips, such as flap and landing gear mis-selections. It released an *'Operational safety notice'* (OSN)[9] four days before the incident stating *'Pause before execution, and cognitively consider what the required action is… Methodically execute the action… Confirm correct execution'.* The operator described taking a cautious approach to publicising specific incidents to its crew, given industry experience suggests the act of discussing mis-selections might actually prime crew towards, rather than against, making them[10]. It has included 'mis-selections' in a new *'Safety topic'* section of its pre-flight briefing material for crew, and promoted the human factors topic of 'Focus' in its recurrent simulator training package.

Footnote

7 TOGA - Maximum take off and go-around thrust.
8 For example, AAIB report DHC-8-402, G-JEDU about inadvertent flap retraction after takeoff, which contains references to other events [accessed 17 March 2025].
9 Entitled *'Action slips when moving controls in the flight deck'.*
10 See footnote 8.

Mental rehearsal (perhaps colloquially called 'armchair flying') benefits cognition and motor skills for physical tasks[11].

Analysis

The RTO

The V_1 callout was a normal prompt for the co-pilot to move his left hand during the takeoff roll, while preparing to pull back on the control column with his right hand. However, he unintentionally pulled his left hand back instead. The resulting 'action sequence' resembled the RTO or landing manoeuvres, rather than a normal takeoff. There was no obvious reason for him being primed to do that – for example, he had not recently changed aircraft seat or type, or practiced landings or RTOs in a simulator – and he could not identify a reason for it on the day.

Any decision to stop an aircraft should be made by V_1, such that it is already stopping at V_1. The co-pilot first retarded the thrust levers at V_1. While the subsequent, instinctive, re-application of thrust would impede the aircraft's stopping performance, after a moment's conscious thought, he committed to the RTO procedure, fully retarding the thrust levers at around 2 KIAS above V_1. The aircraft's inertia meant its airspeed rose by another 5 KIAS before, in the somewhat benign performance conditions, it stopped some distance before the end of the runway surface. The crew performed the RTO and subsequent actions calmly and effectively.

The co-pilot identified that an alternative response to the action slip might have been to continue taking off using TOGA thrust. Performance calculations allow for taking off with one engine having failed after V_1. Both engines were operating during this event, but the investigation did not determine alternative outcomes.

Control selections and mental rehearsal

This incident alludes to the ongoing challenge for operators and crew in attending to control selections. This operator had already promulgated a staged method to its crew which, although written for other mis-selections, could encourage more deliberate motor actions. It has promoted the subject in training and briefing material.

The incident emphasises the complex nature of the takeoff roll. Pilots perform a series of motor actions during a normal takeoff, while also mentally preparing themselves to decide upon and enact different action sequences for an RTO. As well as relevant multi-crew and emergency briefings, pilots can improve their individual performance by mentally rehearsing what might seem like routine parts of an operation, especially after time away from flying.

Footnote

[11] For example: The Effects of Mental Practice on Motor Skill Performance: Critical Evaluation and Meta-Analysis - Karin E. Hinshaw, 1991; Retention of Airline Pilots' Knowledge and Skill - Stacey M. L. Hendrickson, Timothy E. Goldsmith, Peder J. Johnson, 2006 [accessed 13 March 2025].

Conclusion

By way of an action slip, the co-pilot began retarding the thrust levers at airspeed V_1. He instinctively advanced them again, then initiated the RTO procedure around 2 KIAS later. The RTO was performed effectively and, in benign performance conditions, the aircraft stopped some distance before the end of the runway surface.

Preventing action slips is an ongoing challenge for operators and crew. This operator had published guidance on methodical control selections, and has promoted the human factors topic of 'focus' in training and briefing material. The report considers why even experienced pilots may benefit from mentally rehearsing the takeoff roll and other routine procedures, especially after returning from time off.

Accident

Aircraft Type and Registration:	Beagle B121 Series 1 Pup, G-AXOZ
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1969 (Serial no: B121-115)
Date & Time (UTC):	30 January 2025 at 1612 hrs
Location:	Bagby Airfield, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Wing structure, landing gear, fuselage skin and side panel damage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	1,287 hours (of which 49 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot was carrying out practise touch and go circuits at Bagby Airfield. After the second circuit, as he approached to carry out a touch-and-go, the aircraft drifted off the centre line. As the pilot flared the aircraft it struck a hedge near the runway to the right of the touchdown area. This caused the aircraft to veer into a muddy field, where it remained upright and came to a stop. The aircraft sustained damage during the impact; the pilot was uninjured. The accident resulted from low sun dazzle during the approach causing the pilot to lose sight of and misidentify his touchdown aiming point.

History of the flight

The pilot was carrying out a local flight as part of a skills refresher and had flown back to Bagby Airfield to carry out touch-and-go circuits. It was late in the afternoon with a low setting sun and the pilot observed some dazzle effect during his first circuit. After his second circuit he made an approach to Runway 24 to carry out another touch-and-go. As he flared the aircraft, at a low power setting, the aircraft struck a hedge near the runway and contacted the ground to the right of the touchdown area. It veered to the right approximately 10° off the runway heading and rapidly came to a stop in a muddy field next to the runway. The pilot was uninjured, but the aircraft sustained wing, landing gear, fuselage skin and side panel damage.

Pilot's comments

The pilot considered there were several factors which led to the accident. The wind conditions at the time were 330° at 10 to 15 kt which, in the pilot's opinion, gave him the option of using Runway 06 but he assumed there would be a slight downwind effect. However, there was a 90° crosswind component on either runway. In choosing to carry out a touch-and-go on Runway 24 rather than Runway 06, which was normal practice at Bagby in these wind conditions, the risk of low sun causing dazzle that he had already observed in the circuit, continued to be a factor. At first, the approach was visually unhindered, and he could clearly see the touchdown point. But as the sun dazzle became more pronounced, he drifted off the runway centre line. He considered the low sun created poor runway definition which meant he had mis-identified his aiming point, but he committed to continuing instead of initiating a go-around. He also thought that there was a determination to achieve the required number of landings for currency under the 90 day[1] rule after a period of non-flying, which might have affected his decision making.

Footnote

[1] The 90-day rule published in the CAA Skyway Code is summarised as follows: In order to carry passengers, a pilot must have completed three take offs and landings in a preceding 90-day period as the sole manipulator of the controls in the same type or class of aircraft to be used on the flight.

Accident

Aircraft Type and Registration:	CZAW Sportcruiser, G-CZAW
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2006 (Serial no: PFA 338-14542)
Date & Time (UTC):	17 July 2024 at 1630 hrs
Location:	Near Sherburn-in-Elmet Airfield, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	67 years
Commander's Flying Experience:	1,335 hours (of which 210 were on type) Last 90 days - 44 hours Last 28 days - 19 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft's locker cover opened in flight. The pilot could not maintain height and the aircraft subsequently struck some trees short of the airfield. A post-accident inspection revealed that the one half of the locker hinge had been secured using only sealant and without rivets, but rivets were present on the other half of the hinge.

History of the flight

The aircraft departed Sherbourne-in-Elmet for Stoney Lane Airfield in Worcestershire. Having flown approximately 5 miles the pilot heard a loud bang, and the left wing dropped, which the pilot countered with full right aileron and full right rudder. The pilot diagnosed the issue as the left-wing locker cover having opened into the airflow along its leading edge. The pilot made a "PAN" call and decided to return to Sherbourne-in-Elmet.

Subsequently the engine started to run roughly, which the pilot considered may have been a fuel issue due to the significant sideways attitude of the aircraft. Switching tanks did not resolve the issue, and the aircraft was unable to maintain height or reach the airfield. The aircraft struck some trees short of Runway 28 and the pilot and passenger sustained minor scratches and cuts.

Aircraft inspection

The left-wing locker cover had opened along its hinge line on the leading edge. Rivet holes were present in the forward half of the hinge, but there were no corresponding holes in the wing and no rivets were present. The forward half of the hinge had been held in place with what appeared to be silicone sealant; the aft half of the hinge had rivets present. It was concluded that the hinge had not been rivetted to the wing prior to delivery. This aircraft was the UK prototype, and it is likely that this was an omission during the original manufacture.

Safety Action taken by the Light Aircraft Association (LAA)

The LAA do not consider that this is a widespread issue, but they are aware of some similar issues with wing locker covers opening inadvertently and have taken the following safety action to update the Type Acceptance Data Sheet (TADS) for this aircraft to:

- Remind owners to check that the wing lockers on their aircraft have been rivetted correctly
- Remind owners about latching the lockers properly and potentially adding a rubber strip under the edge of the locker where the latch is, so the locker can be clearly seen to be sitting proud if it has not been locked.

Accident

Aircraft Type and Registration:	DJI Avata 2
No & Type of Engines:	4 Electric motors
Year of Manufacture:	2024 (Serial no: 1581F6W8B245H00203CZ)
Date & Time (UTC):	30 November 2024 at 1505 hrs
Location:	Prince George's Playing Fields, Surrey
Type of Flight:	Private
Persons on Board:	Crew - None Passengers - None
Injuries:	Crew - N/A Passengers - N/A
Nature of Damage:	Broken propeller arm and propeller blades
Commander's Licence:	Other
Commander's Age:	49 years
Commander's Flying Experience:	27 hours (of which 5 were on type) Last 90 days - 6 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The operator reported that the UA was returning to base because of a low battery indication when it "pitched up steeply, was unable to recover and bounced off the grass at low altitude". The UA reportedly stopped responding to control inputs and accelerated forwards and upwards, clearing a road and fence, before entering the grounds of a football club. It overflew an ongoing football match before entering a spectator stand. Nobody was struck by the UA and there was no damage to property.

The operator reported that the UA was returned to the manufacturer under warranty, and they had agreed to provide a replacement.

Accident

Aircraft Type and Registration:	DJI Ultralight Mini 2
No & Type of Engines:	4 electric motors
Year of Manufacture:	Unknown (Serial no: Unknown)
Date & Time (UTC):	18 August 2024 at 1830 hrs
Location:	Victoria Embankment, Nottinghamshire
Type of Flight:	Private (UAS)
Persons on Board:	Crew - None Passengers - None
Injuries:	Crew - N/A Passengers - N/A Other - 1
Nature of Damage:	Destroyed
Commander's Licence:	Unknown
Commander's Age:	Unknown years
Commander's Flying Experience:	Unknown hours (of which Unknown were on type) Last 90 days – Unknown hours Last 28 days – Unknown hours
Information Source:	Enquiries made by the AAIB

The UA was being flown near the Nottingham carnival and during the flight the UA was commanded to land by a minor who accompanied the remote pilot. At the time the remote pilot was distracted by talking to another person and as the UA approached the ground it struck an uninvolved minor who was sitting atop someone's shoulders. The uninvolved minor suffered a cut to the forehead. The police attended the scene and the UA was confiscated. The UA did not display an Operator ID[1] and was being flown over crowds of uninvolved people.

Despite AAIB enquiries it was not possible to understand what, if any, risk assessment had been carried out by the remote pilot, the purpose of the flight or why the UA was being flown over crowds of uninvolved people.

Footnote

[1] The Drone and Model Aircraft Code | UK Civil Aviation Authority (accessed 14 March 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: February - March 2025

9 Mar 2025 **MA Pilot-RC Laser** Near Basildon, Essex

The remote control model aircraft began a left turn but the left horizontal stabiliser and elevator broke away from the fuselage. The aircraft entered a spin and struck the ground outside of the flying field's perimeter hedgerow, close to a cyclist.

17 Mar 2025 **DJI Mavic 3** Lewisham, London

The remote pilot reported that the UA's obstacle sensors were supposed to be active, but the UA collided with a tree and fell to the ground.

18 Mar 2025 **Chubory X10 Pro** Bournemouth, Dorset

The sub-250g UA experienced a flyaway event while conducting a survey flight over a built-up urban area. At the time of reporting the UA had not been found.

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).

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

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