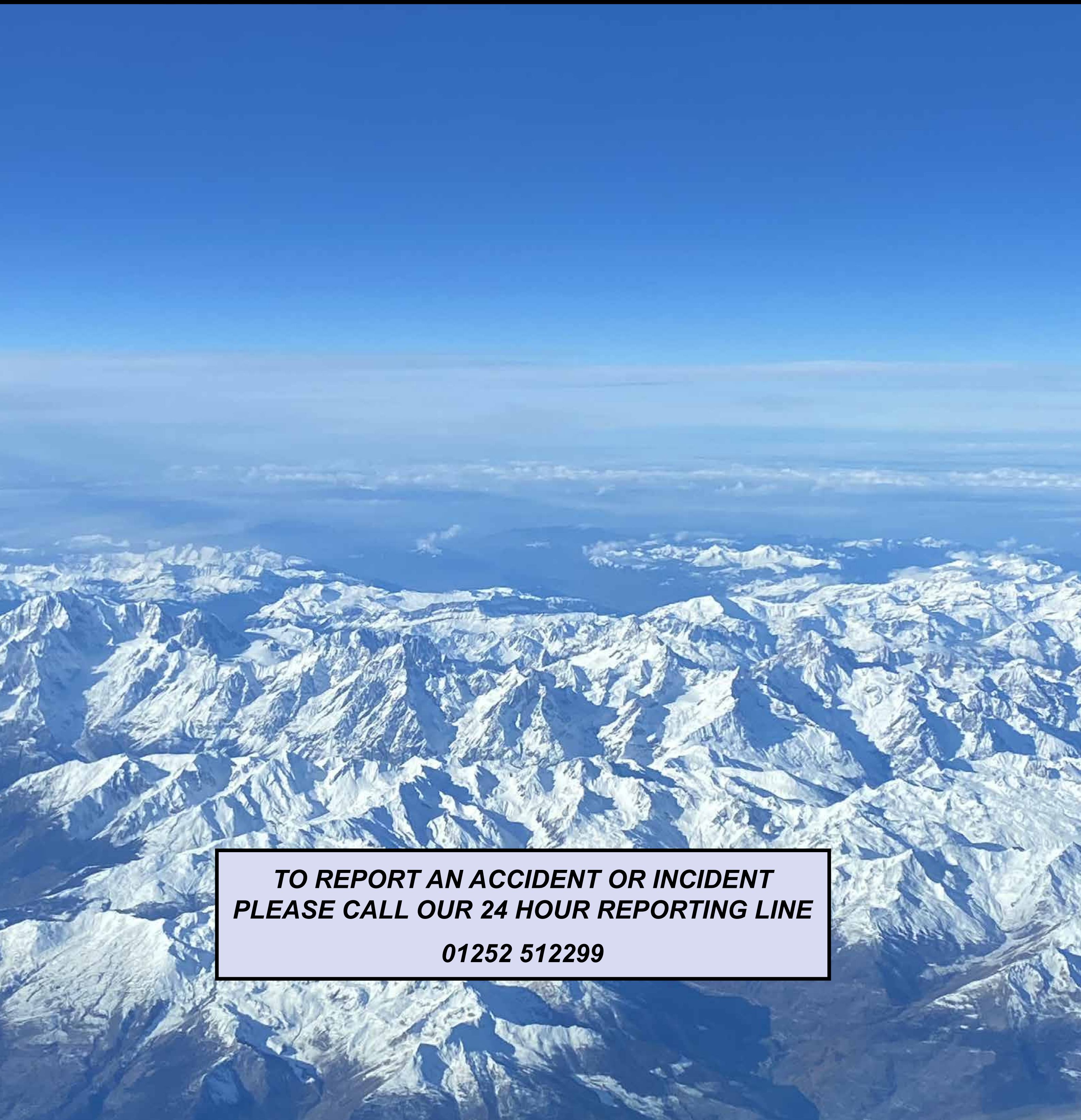
AAIB
Air Accidents Investigation Branch

AAIB Bulletin 12/2023



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01252 512299

Air Accidents Investigation Branch
Farnborough House
Berkshire Copse Road
Aldershot
Hants GU11 2HH

Tel: 01252 510300
Fax: 01252 376999
Press enquiries: 0207 944 3118/4292
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This bulletin contains facts which have been determined up to the time of compilation.

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AAIB Special Bulletins and Interim Reports

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

Farnborough House
Berkshire Copse Road
Aldershot, Hants GU11 2HH

Tel:01252 510300
www.aaib.gov.uk

AAIB Air Accidents Investigation Branch

AAIB Bulletin S2/2023
SPECIAL

Accident

Aircraft Type and Registration:	Airbus A321-253NX, G-OATW
No & Type of Engines:	2 CFM International SA LEAP-1A33 turbofan engines
Year of Manufacture:	2020 (Serial no: 10238)
Date & Time (UTC):	4 October 2023 at 1151 hrs
Location:	London Stansted Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 11 Passengers - 9
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to several cabin windows and impact damage to the left horizontal stabiliser
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	4,905 hours (of which 2,300 were on type) Last 90 days - 128 hours Last 28 days - 27 hours
Information Source:	AAIB Field Investigation

Introduction

This Special Bulletin is published to raise awareness of a recent occurrence in which several cabin windows on an Airbus A321 were damaged by high power lights used during a filming event. The damage was discovered after takeoff on the aircraft's next flight. Work is ongoing with the aircraft manufacturer and operator to fully understand the properties of the lights used and how this risk can be managed in future.

Aircraft owners and operators should consider the hazard posed by such activities to minimise the risk of aircraft damage.

History of the flight

The aircraft was scheduled to embark on a multi-day charter away from base with a flight crew consisting of three pilots, an engineer, a load master and six cabin crew. The first sector was a positioning flight from London Stansted Airport to Orlando International Airport, Florida. In addition to the 11 crew there were nine passengers on board who were all employees of the tour operator or aircraft operating company. The passengers sat together in the middle of the aircraft just ahead of the overwing exits.

The aircraft departed a few minutes ahead of schedule and took off from Runway 22. Several passengers recalled that after takeoff the aircraft cabin seemed noisier and colder than they were used to. As the aircraft climbed through FL100 and the seatbelt signs were switched off, the loadmaster, who had been seated just in front of the other passengers, walked towards the back of the aircraft. He noticed the increased cabin noise as he approached the overwing exits and his attention was drawn to a cabin window on the left side of the aircraft. He observed that the window seal was flapping in the airflow and the windowpane appeared to have slipped down[1]. He described the cabin noise as 'loud enough to damage your hearing'. Figure 1 shows the window in flight.

The loadmaster told the cabin crew and then went to the flight deck to inform the commander. At this stage the aircraft was climbing past FL130, there were no abnormal indications on the flight deck and the aircraft pressurisation system was operating normally. The flight crew stopped the climb at FL140 and reduced airspeed whilst the engineer and then the third pilot went to look at the window. Having inspected the window, it was agreed the aircraft should return to Stansted. The cabin crew told the passengers to remain seated and keep their seatbelts fastened, and reminded them about the use of oxygen masks if that became necessary.

The cabin was quickly secured and the flight crew initiated a descent, first to FL100 and then to FL90. They established the aircraft in a hold whilst they completed the overweight landing checklist, confirmed landing performance and briefed for the return to Stansted. The approach and landing on Runway 22 were uneventful. Landing at 1151 hrs, the total flight time was 36 minutes. With the airport RFFS in attendance the aircraft taxied to the apron, where the passengers disembarked normally.

Having parked and shut down, the crew inspected the aircraft from the outside and saw that two cabin windowpanes were missing and a third was dislodged. During the flight the crew had only been aware of an issue with a single windowpane. The cabin had remained pressurised normally throughout the flight.

Footnote

[1] The crew were not aware if this was only the outer pane or both panes.

Figure 1
View of the left side cabin window aft of the overwing exit

Previous activity

The day before the occurrence flight the aircraft had been used for filming on the ground, during which external lights had been shone through the cabin windows to give the illusion of a sunrise. The lights were first shone on the right side of the aircraft for approximately five and a half hours, with the light focused on the cabin windows just aft of the overwing exits. The lights were then moved to the left side of the aircraft where they illuminated a similar area on the left side for approximately four hours. Photographs taken during filming showed six sets of flood lights on both sides of the aircraft. Figure 2 shows the lights positioned on the left of the aircraft.

Figure 2
Flood lighting on the left side of the aircraft

Recorded information

The aircraft was fitted with an FDR and CVR which were removed and successfully downloaded at the AAIB. The flight was captured on both recorders and the CVR confirmed reports from the flight crew interviews.

The aircraft took off from Stansted at 1115 hrs, climbing progressively to a maximum of 14,504 ft[2] at 1123 hrs (Figure 3). The cabin altitude increased during this time, reaching a

Footnote

[2] Pressure altitude is recorded to a reference pressure of 1013 mb.

recorded maximum of 1,536 ft. The aircraft then descended to 10,000 ft initially, followed by a further descent to 9,000 ft while circling to the north-west of the airport. No pressurisation warnings were recorded during the flight, which landed back at Stansted Airport at 1151 hrs.

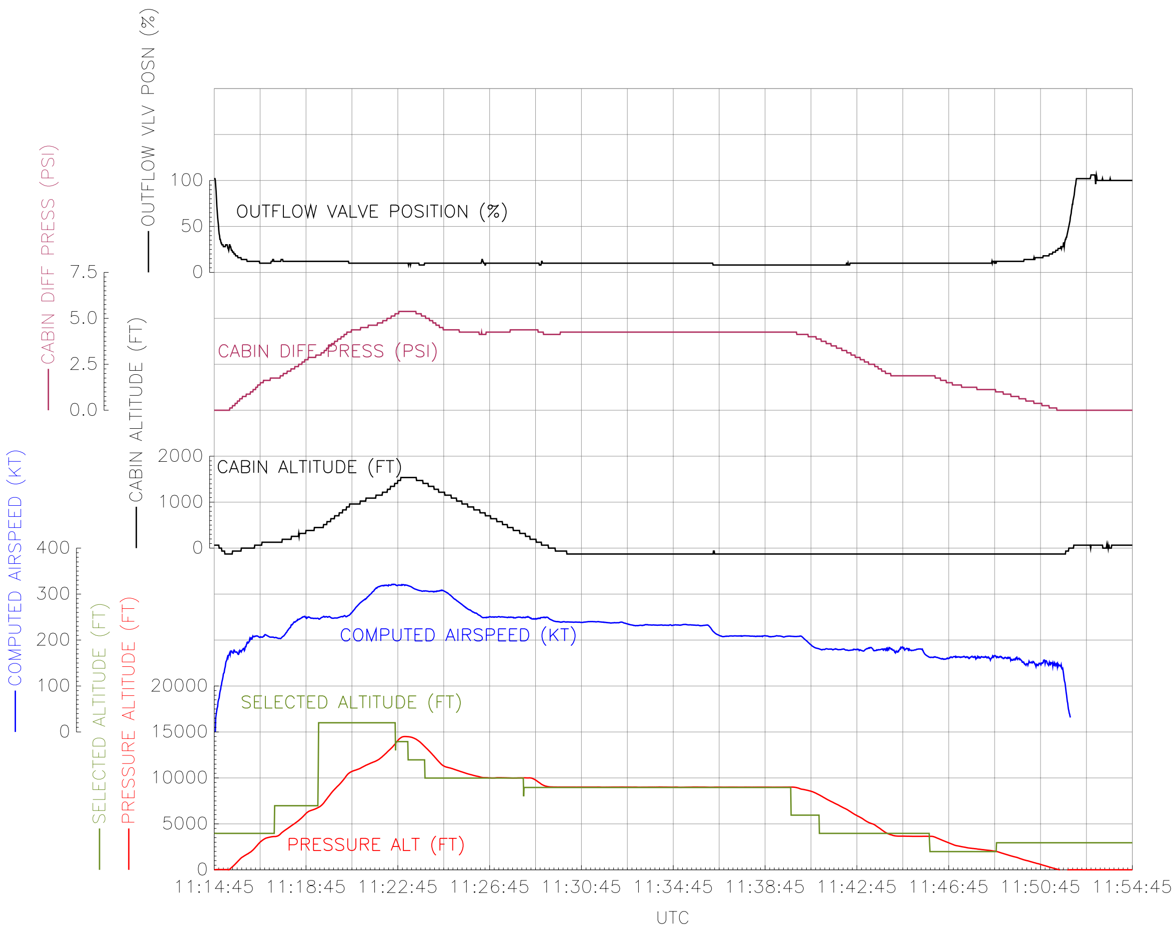

Figure 3

G-OATW FDR data

Aircraft examination

Cabin windows

Two window assemblies[3] were missing, and the inner pane and seal from a third window were displaced but partially retained in the airframe (Figure 4). A shattered outer pane was recovered from the entrance to a rapid-exit taxiway during a routine runway inspection after the aircraft landed.

Footnote

[3] A window assembly consists of the inner and outer panes, and a rubber seal.

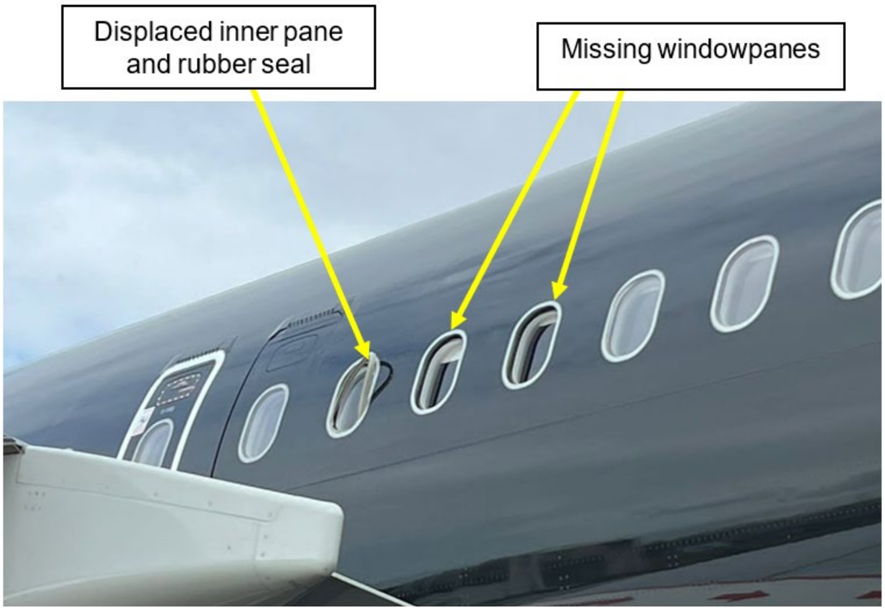

Figure 4
Displaced and missing windowpanes on the left side of the aircraft

A fourth window protruded from the left side of the fuselage (Figure 5). The four affected windows were adjacent to each other, just aft of the left overwing exit.

Figure 5
Protruding window on the left side of the aircraft

Removal of the cabin lining inside the passenger cabin revealed that the window retainers were in good condition and correctly installed. The foam ring material on the back of the cabin liners was found to be melted in the areas adjacent to the windows that were damaged or missing (Figure 6).

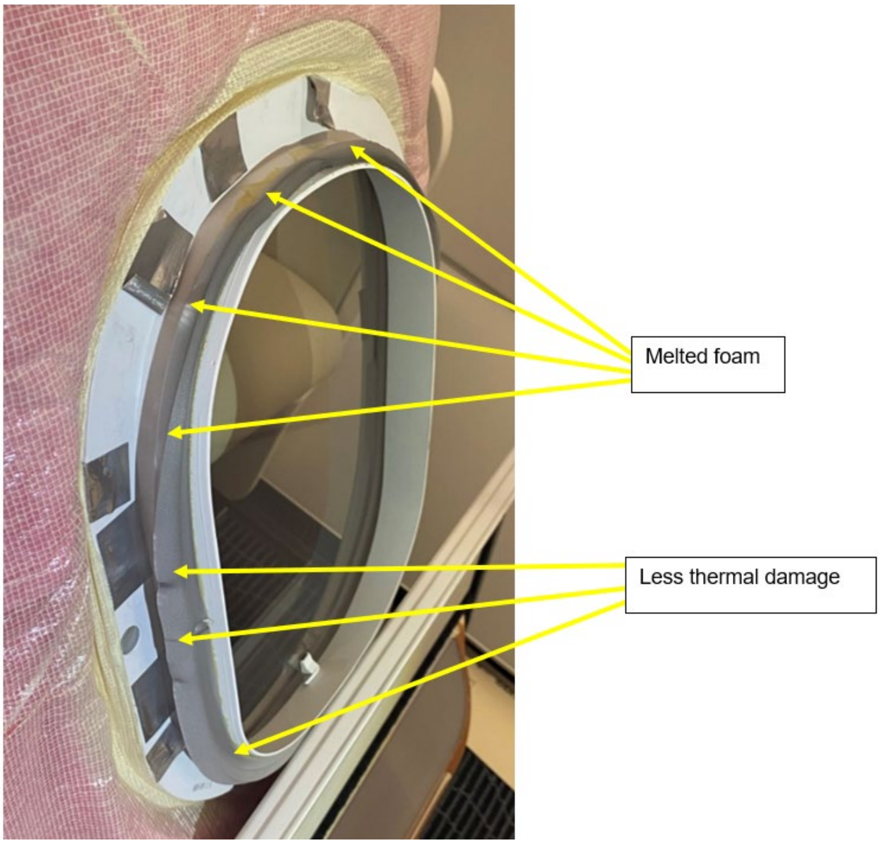

Figure 6

Foam ring material affected by elevated temperatures

Visual examination of the damaged windowpanes revealed that they were deformed and shrunk (Figure 7). The deformed panes no longer formed an effective interface with the rubber seals.

Figure 7

Inner pane showing plastic deformation around the entire perimeter

With the AAIB in attendance, the operator removed several cabin liners from the right side of the passenger cabin. This revealed additional thermal damage and window deformation in the area around the overwing emergency exit, but to a lesser extent than the left side of the aircraft.

Horizontal stabiliser

The underside of the left horizontal stabiliser leading edge panel was punctured. Small pieces of acrylic were found in the stabiliser when the panel was removed.

Cabin windows description

The outer surface of the cabin windows is flush with the outer surface of the fuselage. The windows consist of an inner pane, an outer pane and a seal. The panes are made from stretched acrylic. A vent hole through the inner pane lets cabin pressure into the space between the inner and outer panes.

The cabin windows are attached to the window frames using retainers, eyebolts and nuts (Figure 8).

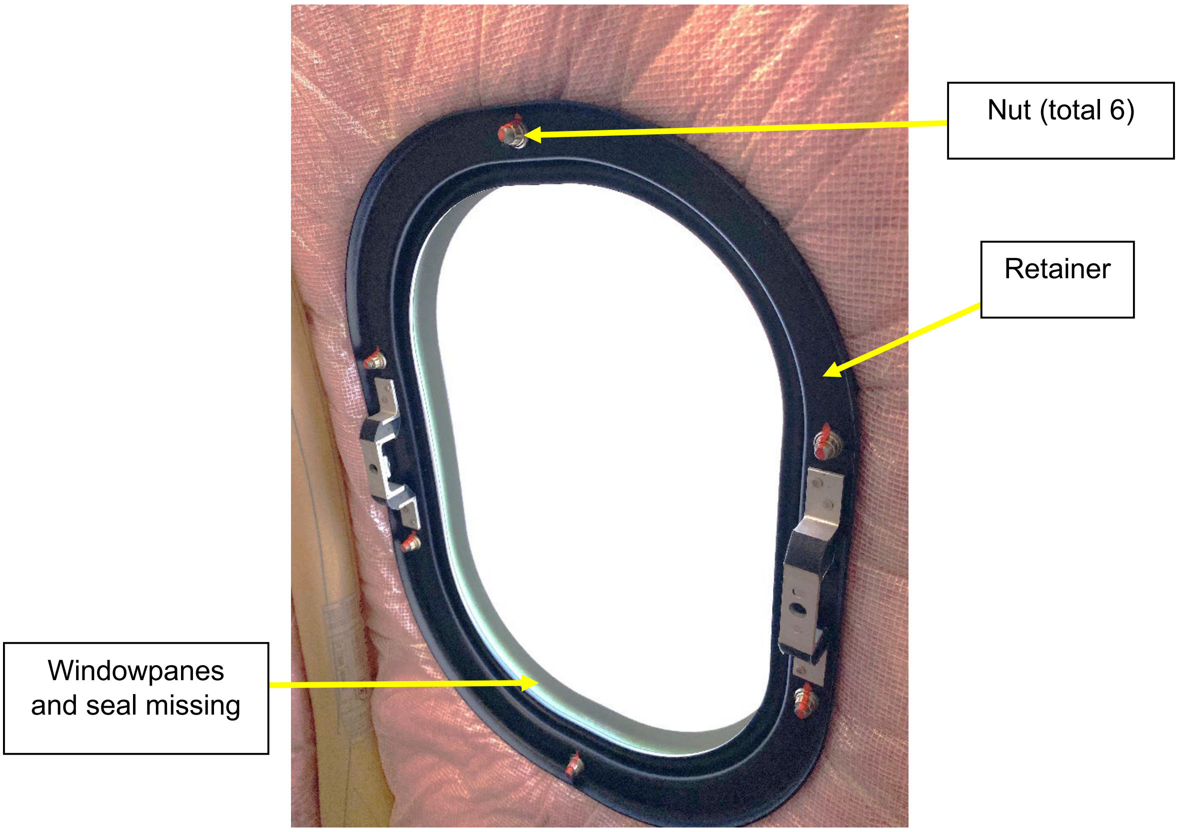

Figure 8

Correct installation of the retainer but the window assembly is missing

External lighting

Photographs of the filming showed that the lights were between approximately 6 and 9 m from the window areas where damage was apparent (Figure 9).

Image for illustration only – not to scale

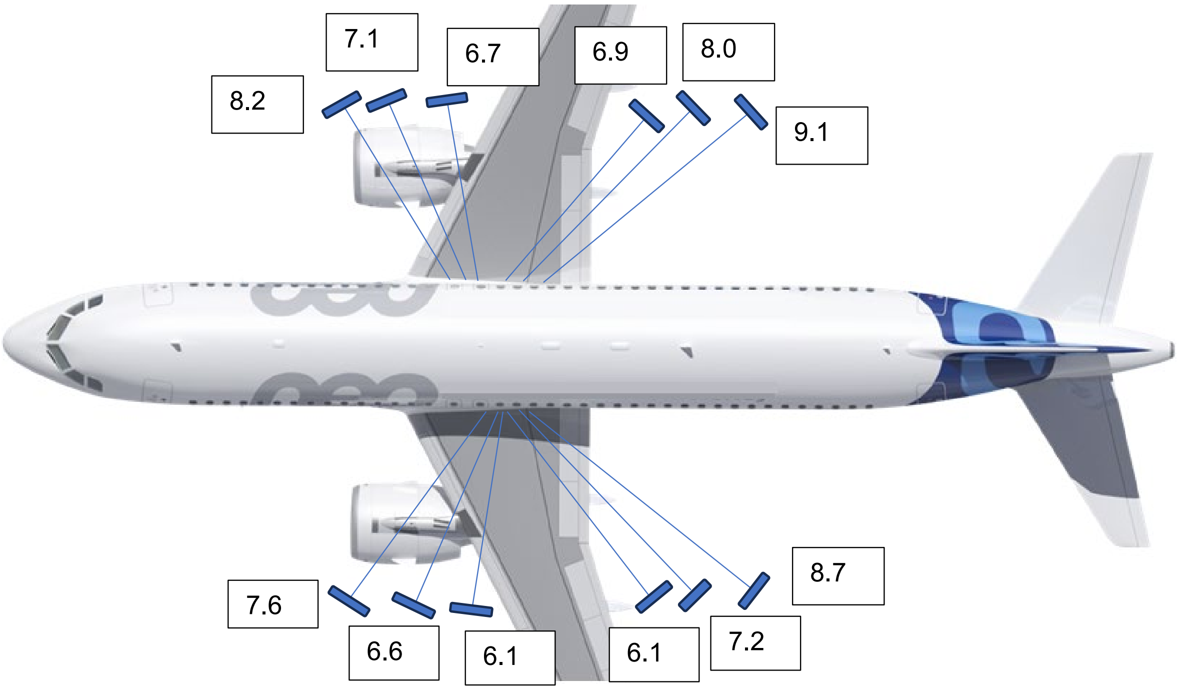

Figure 9

Approximate distance of the flood lights from the fuselage during the filming activity

The aircraft operator identified the flood lights as Maxibrute 12. An online datasheet[4] for these lights included the data at Table 1. The investigation has not yet established the reason for the specified minimum distance from the object to be illuminated.

Parameter	Value
Lighting capacity	12,000 Watts
Minimum distance from object to be illuminated	10 m
Minimum distance from a flammable object	1.5 m
Maximum surface temperature	200°C

Table 1

Data extracted from the flood light datasheet

Footnote

4 Maxibrute_12 (filmgear.net) [Last accessed 13 October 2023]

Observations

The windows appear to have sustained thermal damage and distortion because of elevated temperatures while illuminated for approximately four to five and a half hours during filming activity the day before the flight. It is likely that the flood lights were positioned closer than 10 m. Whereas in this case the damage became apparent at around FL100 and the flight was concluded uneventfully, a different level of damage by the same means might have resulted in more serious consequences, especially if window integrity was lost at higher differential pressure.

Further investigation

The AAIB investigation continues with the support of the BEA[5], the aircraft manufacturer, and the aircraft operator to understand how a similar occurrence can be prevented from occurring again.

Published: 3 November 2023.

Footnote

5 Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile, the French aviation safety investigation authority.

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.

ACCIDENT

Aircraft Type and Registration:	Bombardier Challenger 350, LN-JHH
No & Type of Engines:	2 Honeywell HTF7350 turbofan engines
Year of Manufacture:	2017 (Serial no: 20702)
Date & Time (UTC):	30 May 2023 at 0850 hrs
Location:	Dundee Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to left winglet
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	8,100 hours (of which 700 were on type) Last 90 days - 51 hours Last 28 days - 39 hours
Information Source:	Aircraft Accident Report Form submitted by the commander and further enquiries by the AAIB

Synopsis

Whilst being marshalled on the main apron the left wingtip of the aircraft collided with a lamppost. Neither the flight crew nor the marshaller were aware how close the wingtip was to the lamppost. Wing spotters positioned to mitigate this risk saw the impending collision and attempted to signal the aircraft to stop but neither the flight crew nor the marshaller saw the signals.

The airport operator intends to enhance its guidance to ground crew. The aircraft operator issued a notice to its pilots reminding them about standard marshalling signals.

History of the flight

The aircraft landed on Runway 27 at Dundee Airport at 0847 hrs and was instructed to vacate via Taxiway B and park nose to the south on Stand 1B with the marshaller. It was daytime and CAVOK.

A marshaller was positioned at the head of the stand and two 'wing spotters' were positioned on the end of the apron (Figure 1). Another aircraft was already parked on the adjacent stand (Stand 1A).

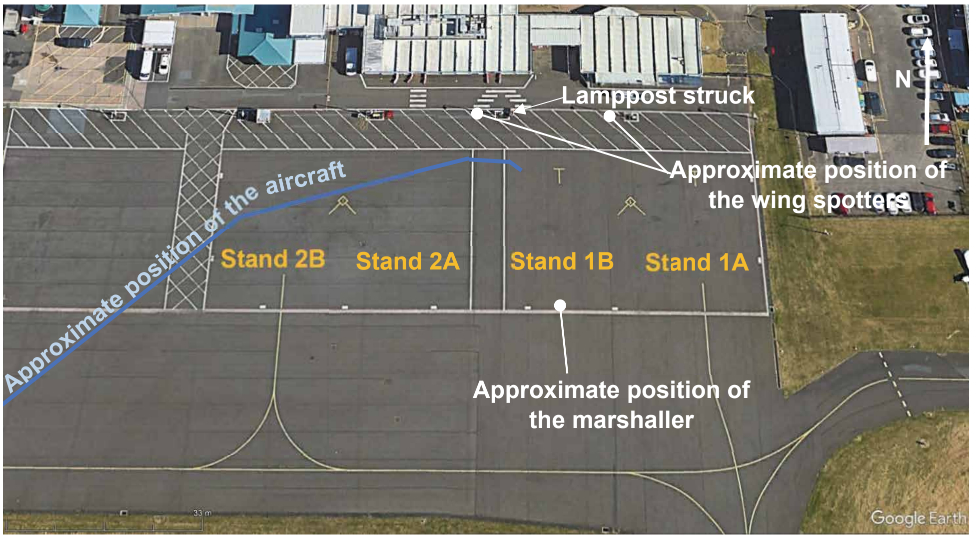

Figure 1

Apron at Dundee Airport showing approximate path of the aircraft and position of the marshaller and wing spotters

The marshaller started marshalling the aircraft as it approached the apron, and the flight crew followed the instructions. As the aircraft approached the edge of the apron both wing spotters could see that a collision was imminent and attempted to signal to the marshaller and the flight crew to stop the aircraft. However, the marshaller was looking at the aircraft and the flight crew were looking at the marshaller so neither saw the signals from the wing spotters. The winglet on the left wingtip collided with a lamppost on the edge of the apron and the aircraft came to an abrupt halt.

Figures 2 and 3 show the aircraft after the collision.

CCTV evidence showed the wing spotters started to signal the aircraft to stop 4 seconds before the collision.

Figure 2

Aircraft after the collision

Figure 3
Damage to the left winglet and lamppost

Recorded information

The occurrence was captured on CCTV. Figure 4 shows the sequence of events. The marshaller is out of shot on the left of the images.

Organisational information

Following the airport operator's investigation into this occurrence it commented that the white hatched area at the top of the apron is intended as a safety buffer zone. No part of the aircraft should enter this area whilst manoeuvring. It intends to instruct wing spotters to stand on the outer edge of the buffer zone rather than inline with the lampposts, to ensure the buffer is maintained. It also intends to:

- Conduct a review of its marshalling training package.
- Consider the introduction of direct headset communications between marshaller and wing spotters.
- Consider a two-stage marshalling process with two marshallers for circumstances similar to the accident.

The aircraft operator issued an Operational Order to all its pilots reminding them about standard marshalling signals.

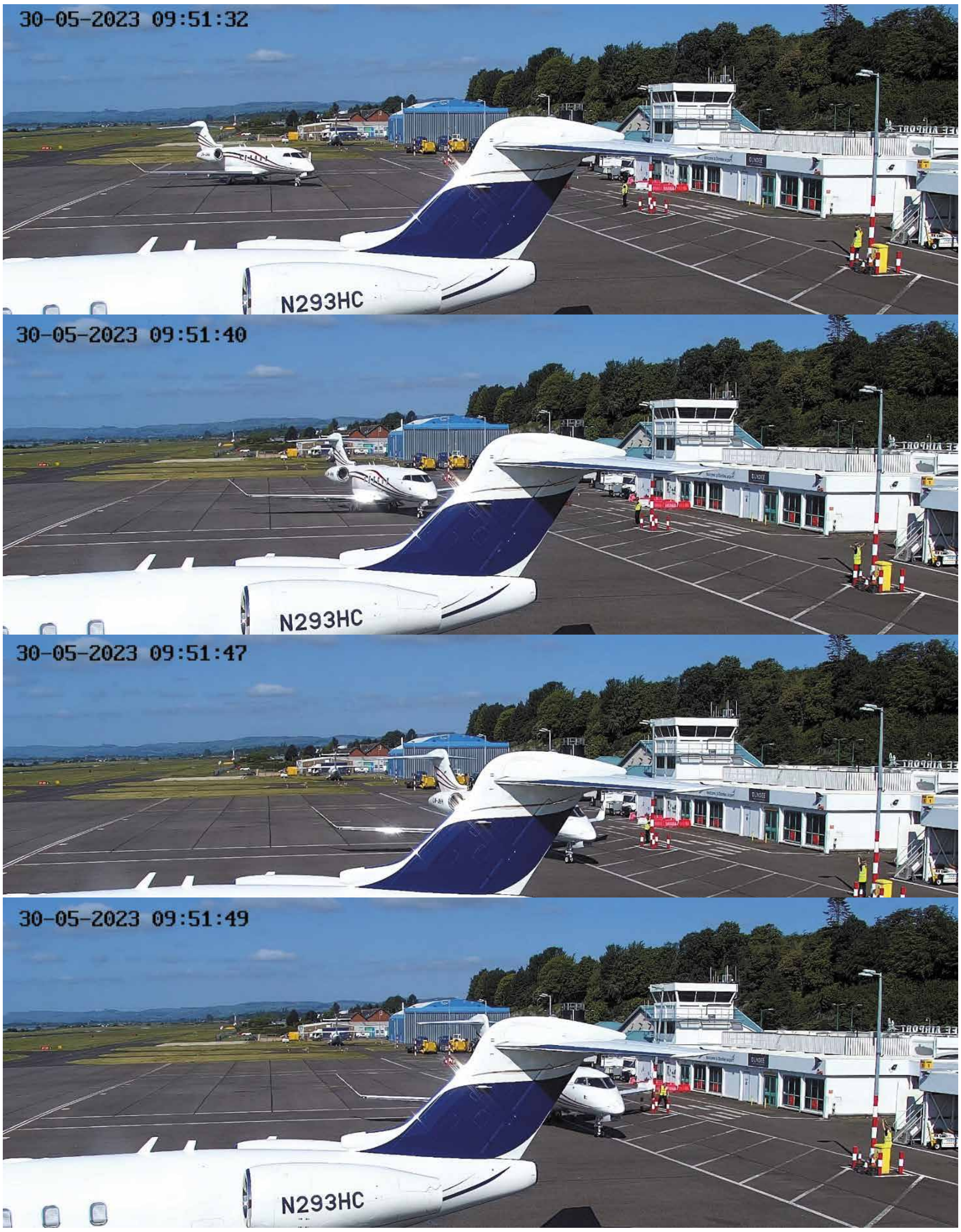

Figure 4

CCTV footage of the occurrence (time stamps are local time)

Analysis

Whilst marshalling the aircraft onto the apron the marshaller directed the aircraft too close to the edge of the apron. From his position at the head of the stand it would be difficult to judge how close the wingtip on the far side of the aircraft was from the lampposts. They did not notice the wing spotters signalling for the aircraft to stop as they were looking at the aircraft. The wing spotter nearest the struck lamppost would have been obscured by the aircraft so could not be seen by the marshaller.

The flight crew did not notice that the left wingtip was too close to the lamppost. The commander commented that it is difficult to judge the wingtip clearance due to the wing sweep. They also did not see the wing spotter signalling for the aircraft to stop as their attention was on the marshaller.

Conclusion

A collision occurred because neither the flight crew nor the marshaller noticed the aircraft was too close to the lamppost. The wing spotters positioned to mitigate this risk were unable to prevent the collision.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-180, G-AVSC
No & Type of Engines:	1 Lycoming O-360-A4A piston engine
Year of Manufacture:	1967 (Serial no: 28-4193)
Date & Time (UTC):	1 August 2023 at 1254 hrs
Location:	Near Seaton, Devon
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to propeller and nose gear leg
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	73 years
Commander's Flying Experience:	7,600 hours (of which 250 were on type) Last 90 days - 35 hours Last 28 days - 22 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The flight departed from Dunkeswell Aerodrome with the purpose of revalidating the aircraft owner's PPL. The instructor was demonstrating the procedure for an engine failure at 2,200 ft and a target airspeed of 80 kt. He reported that as he applied nose-up pitch, there was a loud bang and the aircraft immediately pitched down with severe buffeting.

After recovering control, the instructor elected to make a forced landing and, considering it to be the only safe option, he chose to land in a nearby field. On landing he was unable to stop the aircraft before entering a river at around 30 kt, with the aircraft finally coming to rest after striking the opposite bank. Neither of the occupants were injured. The instructor subsequently found that the baggage compartment door was open, and the canvas aircraft cover was missing. He attributed the accident to the compartment door opening in flight releasing the aircraft's cover, which temporarily affected the airflow over the elevator, resulting in the uncommanded pitch change.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152, G-BLJO
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979 (Serial no: 1627)
Date & Time (UTC):	2 January 2023 at 1230 hrs
Location:	Field about 1.5 nm north-east of Shoreham Airport, West Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear leg collapsed and damage to bulkhead
Commander's Licence:	Private Pilot's Licence
Commander's Age:	28 years
Commander's Flying Experience:	89 hours (of which 17 were on type) Last 90 days - 13 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

While on late downwind the engine started coughing and losing power. The pilot carried out some checks, but the engine subsequently lost all power. He picked a field and glided to it but touched down nosewheel first causing the nose landing gear leg to collapse. The pilot had recently practised forced landings with an instructor and this likely contributed to the safe outcome. An aircraft examination did not reveal any faults, and the conditions were conducive to serious carburettor icing at any power, but the cause of the loss of power could not be determined.

History of the flight

The pilot was carrying out circuit practice at Shoreham Airport using Runway 20. He had carried out four uneventful circuits with 'touch-and-go' landings, and then while late downwind on his fifth circuit, at about 1,100 ft aal, he reported that the engine started coughing and losing power. He pumped the throttle, checked the magnetos were on and that the mixture was rich. He could not recall if the carburettor heat was on or if he selected it on.

The engine subsequently lost all power. He made a MAYDAY call and looked for potential landing sites as he did not think he could make it back to the runway. He found a field to the north-east and headed towards it. He set two stages of flap, and once closer he set full flap, but he did not recall doing any shutdown checks. The aircraft touched down "fairly flat" but nosewheel first, causing the aircraft to bounce and the nose landing gear leg to collapse. The aircraft came to rest on its nose (Figure 1). The pilot exited the aircraft and was not injured.

The pilot stated that he did not know what had caused the power loss and that he had done the same thing on each of the previous four circuits, such as his downwind checks which included checking that the mixture was rich and selecting the carburettor heat on for 10 seconds. He said he had practised forced landings with an instructor the week before, and this enabled him to go into "autopilot mode" with picking a field and setting up an approach. He thinks he flared a bit too early with the downhill slope which contributed to the nosewheel-first touchdown.

The pilot stated that since the accident he has practised more forced landings.

Figure 1
Accident site

Aircraft examination

The maintenance organisation carried out an initial examination at the accident site the day after the accident. They stated that there was nearly full fuel onboard. The spark plugs looked normal, and the crankshaft could be rotated with the plugs removed. There was no evidence of oil leaks. The fuel hose was disconnected from the carburettor and fuel flowed freely. Fuel tank drain checks revealed a few droplets of water from the left tank and no water from the right tank. Both magnetos were secure with no evidence of slippage.

After the aircraft was recovered from the field the maintenance organisation removed the air intake assembly and carburettor. The carburettor heat valve operated normally and actuating the throttle mechanism caused fuel to be ejected from the fuel jet. The carburettor was then installed on another engine and the engine ran normally.

At the time of writing the engine core has been removed from service and will be sent for overhaul at some stage.

During the aircraft's last annual maintenance check in September 2022, about 100 flying hours before the accident, the engine had a top overhaul. The engine had accumulated over 2,500 hours since its last complete overhaul when the engine manufacturer's recommended time between overhaul (TBO) is 2,400 hours. The operator was operating the engine beyond the TBO by using an engine extension programme as defined in their risk assessment RA47 which involved more detailed checks and inspections; this had been approved by the CAA as part of their approved maintenance programme.

Meteorology

Ten minutes before the accident, the METAR at Shoreham Airport stated that the wind was from 250° at 9 kt, the visibility was more than 10 km, the clouds were few at 1,500 feet and scattered at 1,900 feet, with a temperature of 9°C and a dewpoint of 6°C; this meant the relative humidity at the airport was 81%. At the circuit height of 1,100 ft aal the temperature would have been about 2°C colder[1], so the relative humidity would have been closer to about 93%.

According to the CAA's risk of carburettor icing chart, in the Safety Sense Leaflet on Piston Engine Icing[2], the temperature and dewpoint spread at the airport elevation indicated that there was a serious risk of carburettor icing at any power setting (Figure 2).

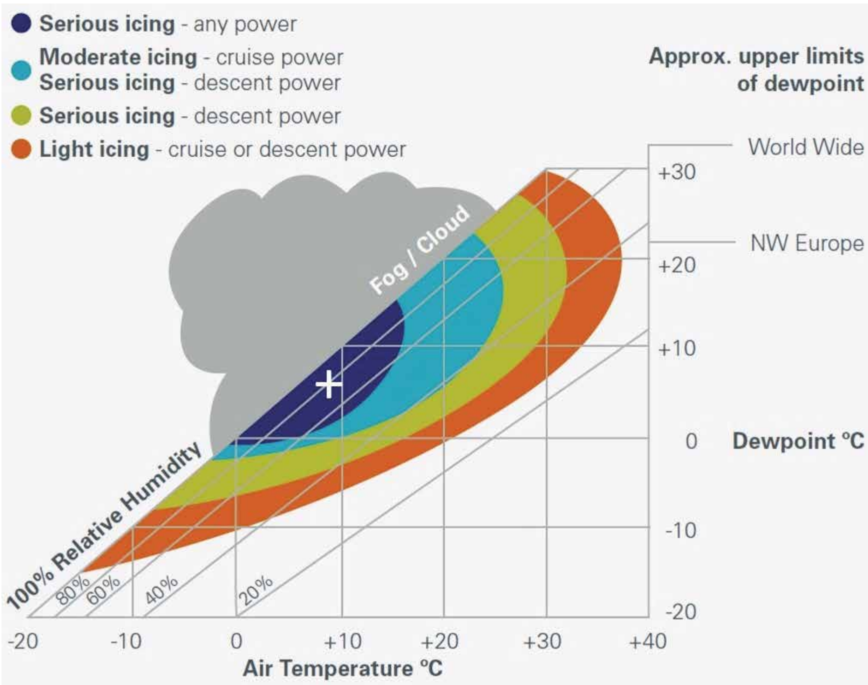

Figure 2

Temperature and dewpoint, at Shoreham Airport near the time of the accident, marked with a white cross on the CAA's risk of carburettor icing chart

Footnote

1 The standard lapse rate in the International Standard Atmosphere (ISA) is 2°C/1,000 ft. The actual lapse rate on the day could have been different.

2 CAA Safety Sense Leaflet on Piston Engine Icing, June 2023, [accessed October 2023].

Pilot's training history

The pilot had learnt to fly in California and after 54 hours of training in a Piper PA-28, during July and August 2018, he passed his skills test and obtained his Private Pilot's Licence with an SEP rating that was valid for two years until 31 August 2020.

After flying once in the UK in 2019, he flew on 15 occasions in 2020 and 2021 from Redhill Aerodrome in both a Piper PA-28 and a Cessna 152. He then did not fly for over a year before starting to fly at Shoreham on 18 November 2022. He needed five flights with an instructor, one in the Cessna 152 and four in a PA-28, before he was cleared to fly solo. The instructor reported that he flew well but had issues with his checks and would sometimes forget to turn the carburettor heat on when on downwind. He reported that after the training flights his checks were good, so he signed him off.

The instructor's understanding was that he had cleared the pilot to fly the PA-28, but the pilot understood that he was cleared to fly the PA-28 and the Cessna 152. The paperwork the instructor had signed stated '*ready to fly solo'* without specifying a type.

Neither the flying school nor the instructor had checked the pilot's licence which showed that his SEP rating had expired on 31 August 2020. The pilot reported that he was unaware that his rating had expired. There is no CAA system for reminding pilots when their ratings are due to expire[3]. In the year leading up to 31 August 2020 the pilot had flown more than 12 hours and had flown more than one hour with an instructor, so he had met the requirements for rating revalidation but had not obtained the required signature in his licence. The pilot subsequently obtained a new SEP rating on 18 January 2023.

The pilot flew a PA-28 solo from Shoreham on 16 and 20 December 2022, and then a PA-28 with an instructor at Redhill. On the day of the accident the pilot had booked to fly the Cessna 152 solo from Shoreham. The flying school's booking system allowed the pilot to book this aircraft despite the flying school being of the view that he was not cleared to fly the Cessna 152 solo.

The flying school has updated its electronic booking system to show in red any pilot who is out of currency or not checked out when they try to book an aircraft. Pilots' licence and rating validities are now checked by admin staff and daily checks are carried out by a flight instructor.

Aircraft flight manual

The flight manual[4] for the aircraft states the following procedure for an engine failure during flight:

'1. Glide Speed – 111 km/h – 60 kts – 69 MPH IAS.

2. Carburetor Heat – "ON".

Footnote

[3] Unlike with driving where the UK's Driver and Vehicle Licensing Agency (DVLA) reminds drivers when their driving licence is about to expire.

[4] Aircraft Flight Manual Reims/Cessna F152, D1170-13GB, serial number F15201429 and up.

3. Primer – IN and LOCKED.

4. Fuel Shutoff Valve – "ON".

5. Mixture – RICH.

6. Ignition Switch – "BOTH" (or "START" if propeller stopped).'

It also contains a procedure for 'Rough Engine Operation or Loss of Power'; this states that a gradual loss of engine rpm and engine roughness may result from carburettor ice and that to clear the ice full throttle should be applied and the carburettor heat knob pulled fully out. It states that engine roughness can also be caused by spark plug fouling or a magneto issue, and the magneto switch should be momentarily moved to the left and right position to help diagnosis.

Use of carburettor heat in the circuit

The flight manual's 'Before Landing' checklist states '*Carburetor Heat – "ON" (apply full heat before reducing power)*.' The 'Balked Landing' checklist starts with: '*1. Throttle – FULL OPEN, 2. Carburetor Heat – COLD.*'

When flying a circuit, the 'Before Landing' checklist is carried out on the downwind leg; therefore, following the flight manual's checklist would involve selecting the carburettor heat ON when on downwind and then leaving it on until landing, unless a 'balked landing' (goaround) is performed.

The pilot's instructor at Shoreham had taught the pilot to use the same carburettor heat technique on both the PA-28 and the Cessna 152. The flight manual for the Piper PA-28-161[5] states in the 'Descent' checklist '*Carburetor heat…ON if required*'. It does not have a checklist for a balked landing or go-around.

The instructor had taught the pilot to select carburettor heat on for 10 seconds on downwind, to check for the presence of carburettor ice, and then to turn it off if no ice is present. The presence of ice is established by noting any increase in engine rpm which can result after the ice has melted although some rough running can also occur when heat is first applied and ice is present. The instructor taught the pilot to turn carburettor heat on again prior to reducing power on the base leg, and then to turn it off when cleared to land on final - that is four actuations of the carburettor heat knob during each circuit. He said that some of their instructors teach to land the Cessna 152 with the carburettor heat on and then to turn it off during a touch-and-go, because their belief is that the power loss from the carburettor heat in the Cessna 152 is less than on the PA-28.

Other instructors are known to teach students to turn the carburettor heat on while on downwind and then to leave it on until final or until doing a go-around or touch-and-go.

Footnote

5 Pilot's Operating Handbook, Piper Cherokee Warrior II, PA-28-161. VB-880. Revision 25 April 2005.

The CAA's Safety Sense Leaflet on *Piston Engine Icing* states the following:

> *'Landing*
>
> *When conducting 'downwind' or 'joining' checks prior to landing, select the carburettor heat on to remove any ice that may be present. It should be selected to hot before power is reduced on base leg or final approach. In many aircraft it is recommended to select the carburettor heat to cold again at around 300 ft, to give improved power in the event of a go-around or touch and go. The carburettor heat should be selected cold after landing if this was not already done on final.*
>
> *Go-around or touch and go*
>
> *If the carburettor heat is still in the hot position, ideally it should be moved to cold, prior to the application of take-off or go-around power. Check after applying power that you have remembered to do so. This is to ensure the engine is developing full power for the manoeuvre.'*

The safety sense leaflet includes the following caveat: '*The Aircraft Flight Manual (AFM) or Pilot's Operating Handbook is the primary source of information for individual aircraft. In the case of a conflict between the guidance in this SSL and the applicable AFM, the latter shall take precedence'.*

The PA-28 types the pilot had been flying and the Cessna 152 use a carburetted Lycoming engine. The engine manufacturer has published a Service Instruction concerning 'Use of Carburettor Heat Control'[6]. It states that 'Full Heat' should be applied during landing approach if icing conditions are suspected. It also states that: '*In the case that full power needs to be applied under these conditions, as for an aborted landing, return the carburetor to "Full Cold" after full power application*.' This is different to what is recommended in the CAA's safety sense leaflet which states to move it to 'cold' before power application.

Analysis

The relatively low-hours pilot experienced a complete loss of engine power at about 1,100 ft aal in the circuit but was able to select a field, maintain control and land. The aircraft suffered some damage, but the pilot was uninjured. The pilot had recently practised forced landings with an instructor and this likely contributed to the safe outcome.

The maintenance organisation's examinations did not reveal any faults with the engine or fuel systems and there was sufficient fuel onboard. A few droplets of water were recovered from the left fuel tank, but this was a day after the accident so could have been the result of condensation. Water in the fuel tanks usually affects engine performance shortly after takeoff, but in this event the pilot had completed four circuits, so it is unlikely that water was a factor.

Footnote

6 Lycoming Service Instruction No. 1148C, published 12 October 2007.

According to the CAA's chart on the risk of carburettor icing, the conditions on the ground were conducive to carburettor icing at any power setting. There was a cloud layer 400 feet above circuit height so the relative humidity would have been higher at circuit height than at ground level. It is possible that the pilot forgot to select carburettor heat on downwind or did not set it for long enough. This could have led to carburettor ice formation and the coughing symptoms reported. The flight manual's 'rough engine operation' checklist calls for full carburettor heat to be selected. The pilot could not recall if it was still set or if he set it. He recalled pumping the throttle which is not a procedure in the flight manual for 'rough engine operation' or for an engine failure. Pulling the throttle back to idle, during pumping, could exacerbate a carburettor icing condition. The flight manual calls for full power to be set. It also states to check each magneto, which the pilot did not attempt, but he was at a very low height where the priority is to select a safe place to land and maintain control of the aircraft.

The pilot had been taught to select carburettor heat on while on downwind, then off after 10 seconds, then on again on base, and then off again on final once cleared to land. That is four selections of the carburettor heat knob which could increase the opportunity for one of these selections to be missed. The flight manual does not include a pre-landing check that involves selecting carburettor heat on for 10 seconds; it states to select carburettor heat on, and then leave it on until landing or a 'balked landing'. Flying a downwind leg with the carburettor heat off could contribute to carburettor ice formation.

Carburettor icing is a possible cause of the loss of power experienced, but it is also possible that the pilot made an incorrect fuel system or engine control selection because this was only his second flight in a Cessna 152 in over a year. The flying school stated that the pilot had not been approved to fly the Cessna 152 solo, but this was not clear to the pilot and the booking system did not prevent him booking that aircraft type. The booking system has been modified to prevent this in future.

The engine core has not yet been examined so an engine fault cannot be entirely ruled out.

Conclusion

The engine lost power late downwind in the circuit. The maintenance organisation's engine and fuel system examinations did not reveal any faults, although the engine core had yet to be examined. The conditions were conducive to carburettor icing at any power, so this was a possible cause, but no conclusive cause could be determined. The pilot had recently practised forced landings with an instructor and this likely contributed to the safe outcome.

Safety actions

The flying school has updated its electronic booking system to show in red any pilot who is out of currency or not checked out when they try to book an aircraft. Pilots' licence and rating validities are now checked by admin staff and daily checks are carried out by a flight instructor.

ACCIDENT

Aircraft Type and Registration:	Scintex CP301-C1, G-CKCF
No & Type of Engines:	1 Continental Motors Corp C90-14F piston engine
Year of Manufacture:	1960 (Serial no: 557)
Date & Time (UTC):	31 October 2022 at 1058 hrs
Location:	Blue Bell Hill, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	5,425 hours (of which 16 were on type) Last 90 days - 88 hours Last 28 days - 25 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft settled into trees shortly after takeoff. The pilot reported that he took action to remain in control of the aircraft until impact and the occupants were rescued uninjured. The pilot suspected that the engine had suffered from carburettor icing and reported that the aircraft encountered turbulence sufficient to cause a loss of control. The aircraft probably exceeded its maximum takeoff weight.

History of the flight

The occupants intended to fly from Rochester to Goodwood. The pilot reported that there was no pressure to undertake the flight.

After the pre-flight ground inspection and start-up, the aircraft remained on the apron for the engine oil to warm up, then taxied on the Eastern Taxiway to the threshold of Runway 20R. An engine check was conducted at the threshold, during which the magnetos performed normally, and the application of carburettor heat was accompanied by a 100 rpm drop. Carburettor heat remained ON until the aircraft was lined up and ready for takeoff, with one stage of flap set, and during this interval the engine ran smoothly and without any signs of carburettor icing.

The pilot reported that the takeoff and initial climb were normal, and flap was raised as usual.

Approaching a wooded ridge south of the aerodrome, the pilot perceived that the aircraft was lower than usual and the passenger, who was also a pilot, noticed that engine speed had reduced. The pilot recalled that the indicated airspeed was 55 kt and that the aircraft then encountered turbulence which resulted in an incipient spin. He immediately applied opposite rudder and nose-down elevator, and regained wings level flight shortly before the aircraft settled into trees, impacting with sufficient force for both occupants' headphones and glasses to come off, but not to cause injury. Their four-point harnesses and the cabin remained intact, and there was no apparent fuel leak.

The pilot switched off the fuel and magnetos, and used the radio to call for assistance. Rescue from the tree canopy was complex and took several hours, involving machinery for working at height.

Aircraft information

The Scintex CP301-C1 is a light two seat taildragger of mostly wood and fabric construction with a maximum takeoff weight of 650 kg. G-CKCF was fitted with two fuel tanks in the fuselage with a total capacity of 120 litres. The propeller, a Hoffman 7H-14-RZ of 178 cm diameter and 120 cm pitch, was refurbished in April 2022.

A witness familiar with the aircraft reported that the engine was equipped with a carburettor heat system that, when selected ON, directed warm air into the carburettor air intake. Such a system can reduce or prevent ice build-up in the intake and throttle body and may reduce ice that has already accumulated.

No pre-existing mechanical defects were reported.

Weight and balance

The aircraft had a basic weight of 427 kg when checked in June 2019. Its maximum takeoff weight was 650 kg. Both fuel tanks were full before the flight.

The pilot calculated that the aircraft's weight on this takeoff was 648.5 kg, stating that he assumed a fuel weight of 73.5 kg. He had understood that the capacity of the tanks was approximately 100 litres, and he used a specific gravity of 0.7 kg per litre to calculate the weight of the fuel.

At standard pressure and temperature, the specific gravity of 100LL (Avgas) fuel is 0.72 kg per litre, and full fuel (120 litres) in both tanks would weigh approximately 86 kg. There was no evidence of activity before takeoff that would have significantly reduced the weight of fuel.

At the time of the accident the pilot estimated that he and his passenger together weighed 148 kg, making the aircraft approximately 11 kg overweight without any additional load.

The pilot stated that the aircraft also carried two headsets, a quart of oil, a fuel strainer and dipstick, some cloths and a bag. He estimated that together these weighed no more than 10 kg. Therefore, the aircraft probably weighed approximately 671 kg, 3.2% above the stated maximum.

Meteorology

An unofficial report of conditions at Rochester at 1058 hrs indicated wind from 140° at 12 kt, visibility more than 10 km, cloud scattered with a base at 2,000 ft and surface temperature 12°C. At 1050 hrs weather information obtained from Biggin Hill, 18 nm west of Rochester, indicated similar conditions, with wind from 150° at 9 kt, temperature 14°C, dewpoint 12°C and QNH 1014. At Southend, 15 nm to the north-east, the wind was from 160° at 12 kt, temperature 16°, dewpoint 13° and QNH 1014.

Wind speed and direction remained largely constant in the hour before and after the occurrence, and there were no reports of significant gusts. There had been light rain at Rochester approximately 24 hours before the takeoff.

Aerodrome information

Rochester Airport has an elevation of 426 ft and two parallel grass runways. Runway 02L/20R has a TODA of 830 m and Runway 02R/20L a TODA of 684 m. The average slope from north to south is approximately 1% up.

The pilot recalled that the surface was dry and firm during the takeoff. Other reports indicated that it was wet or very wet, with soft ground in places. Photographs taken shortly after the accident showed wet grass and some standing water in the vicinity.

The area of wood into which the aircraft descended rises to the same elevation as the aerodrome approximately 400 m to the south of the upwind runway threshold, then rises steadily to 130 ft above the aerodrome elevation at the accident site, a further 1,000 m to the south-south-west. The relative locations are shown in Figure 1. The average gradient from the runway end to the accident site is therefore approximately 3%.

A note on the aerodrome's website stated, *'The proximity of large buildings and topography may cause turbulence and windsheer* [sic] *in some wind conditions.'*[1]

Aircraft performance

Demonstrated performance

The aircraft manual shown to the AAIB did not contain takeoff performance information. Other sources indicate that at the maximum takeoff weight of 650 kg, a typical takeoff ground roll from a hard runway would be approximately 280 m, and the takeoff distance to clear a 15 m obstacle approximately 500 m.[2]

During an assessment reported to the LAA in 2021 the aircraft achieved a climb rate of approximately 600 fpm at full throttle and 58 KIAS, between 1,500 and 4,460 ft. The aircraft was found to exhibit a pre-stall buffet at 40 KIAS with flaps up. Insufficient information was recorded to determine the density altitudes at which the assessment was conducted.

Footnote

1 Aerodrome website accessed October 2023.
2 At sea level, 15°C and QNH 1013 HPa.

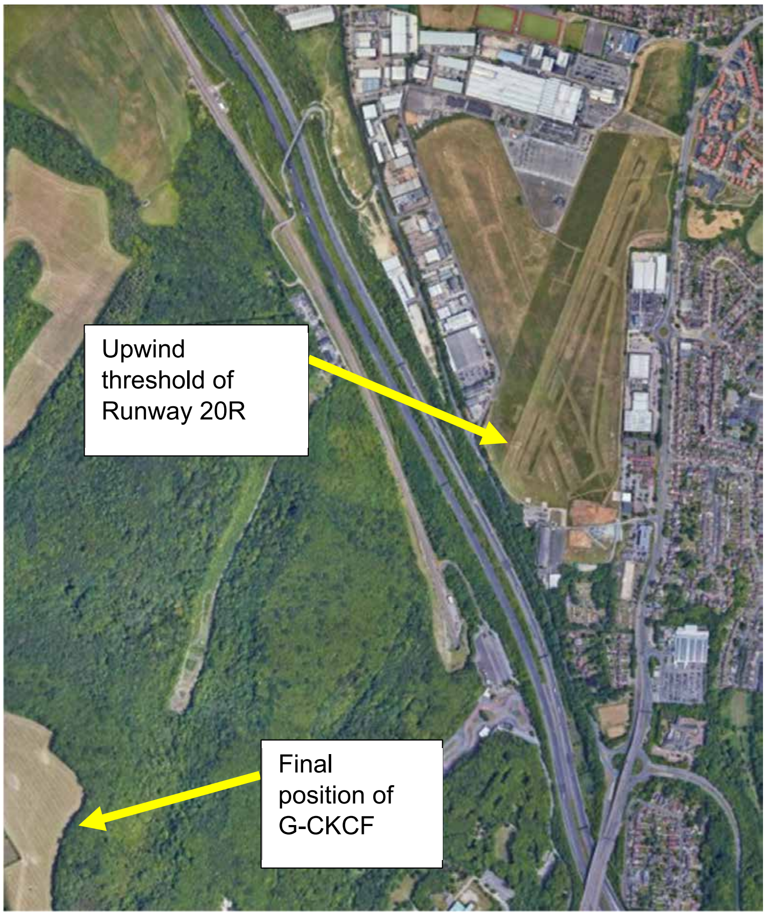

Figure 1

The relative locations of the upwind threshold of Runway 20R and the final position of G-CKCF

During a Permit revalidation check flight in May 2022, the aircraft achieved a climb from 1,000 ft to 2,000 ft in 110 seconds at 61 KIAS, 2,200 rpm. This equates to a climb rate of 545 fpm and a climb gradient of 8.8% in still air. The departure aerodrome for the check flight had an elevation of 565 ft, at which the surface temperature was 14°C and the QNH 1010 HPa.

Factors affecting takeoff performance

Safety Sense Leaflet 7 – *'Aeroplane performance'*, published by the CAA, includes guidance on assessing takeoff performance and summarises information provided in Aeronautical Information Circular (AIC) 127/2006. These documents include factors that may be applied to basic performance data to determine the likely effect of runway and atmospheric conditions. AIC 127/2006 cautions that for surface and slope factors the increases shown are to the takeoff distance to a height of 50 ft, but that since these factors do not influence the airborne part of the takeoff, the effect on ground run is proportionally greater. As surface and slope have no effect once the aircraft is airborne, it is possible to estimate the effect of these factors on the ground run if data is provided for both takeoff run and takeoff distance.

Applying the factors for wet grass, upslope and soft ground yields a ground run of 700 m or more. Applying the recommended safety factor of 1.33 indicates that the takeoff ground run required may have been 930 m or more, exceeding the takeoff run available.

Lifting off before an adequate climb speed has been achieved results in less than optimum climb performance. The best angle of climb is achieved at the airspeed where excess thrust (the amount of thrust available above thrust required) is greatest. Below this speed, the thrust required to overcome total aircraft drag increases and excess thrust reduces.

Other information

A witness reported that as the aircraft passed the upwind end of the runway it was flying slower than expected, in a steep nose-up attitude.

The pilot stated that his normal technique was to apply carburettor heat until setting power for takeoff, and then to take off with full power and one stage of flap set. He reported that he considered the sustained drop in rpm when carburettor heat was selected ON during the power check, and the absence of rough running indicated that icing was not present. He commented that the performance of the aircraft was normally "ok but not sparkling".

The pilot recalled that on the accident takeoff he checked that the rpm at full power was correct at about 2,450-2,500 rpm. An engine speed of 2,350 rpm was achieved during a full power takeoff when assessed in 2021.

The pilot reported that the takeoff and initial climb were normal but that the flight path seemed low over the trees. When the trees could not be avoided he resisted the temptation to raise the nose, keeping the wings level and maintaining flying speed until impact.

Safety Sense Leaflet 14 – *'Piston engine icing',* includes a chart indicating that the prevailing temperature and dewpoint were within the range conducive to the formation of severe icing at any power setting. [3]

The pilot commented that he could have applied carburettor heat if he had suspected carburettor icing sooner, but that the situation developed so quickly he doubted it would have helped. It is possible for ice to defeat a carburettor heating system if it has accumulated before the system is selected ON.

A pilot who had flown G-CKCF from Rochester reported that with one person on board and full fuel the performance was "barely sufficient" to clear obstacles in the takeoff flight path, and that in 30 hours of operating the aircraft he had not encountered carburettor icing on takeoff.

Another pilot reported that he would not fly the aircraft from Rochester with full fuel and a passenger.

Footnote

3 Accessed August 2023.

Analysis

There was no report of pre-existing mechanical defects. The aircraft weight probably exceeded its maximum for takeoff of 650 kg.

It was not possible to determine if carburettor icing had reduced the available engine power. The pilot's statements indicate he had determined no carburettor icing was present before the aircraft was ready for takeoff. However, the temperature and dewpoint were within the range conducive to the formation of severe icing at any power setting.

The investigation did not determine at what point on the runway the aircraft became airborne, nor its initial climb speed. The takeoff ground roll would have been influenced by the aircraft weight, aerodrome elevation, surface condition, and upslope. Applying the factors suggested in relevant CAA guidance indicates that the takeoff run required may have exceeded the available runway length. The low speed and steep attitude observed by one witness, if representative, are consistent with an attempt to continue the takeoff without having achieved sufficient speed for adequate climb performance.

The full-throttle climb performance at maximum takeoff weight demonstrated in 2021 and 2022 exceeded the gradient from the runway end to the point of impact. Not achieving this performance in the prevailing conditions, which were not significantly different, is consistent with additional weight, reduced power, takeoff and climb with insufficient speed, or a combination of these.

Information published by the aerodrome indicated that windshear was possible in some circumstances. There were no indications of meteorological conditions conducive to significant windshear.

The aircraft settled into trees upright and largely wings level. The pilot reported having resisted the temptation to raise the nose, maintaining a speed of approximately 50 kt until impact. Maintaining controlled flight until touchdown or impact increases the probability of a survivable outcome.

Conclusion

The aircraft had insufficient performance to clear obstacles in the takeoff path. Its weight probably exceeded the maximum permitted for takeoff, and its performance may have been diminished by a reduction in power due to carburettor icing.

Safety information

CAA Safety Sense Leaflet 07 – *'Aeroplane performance'*, Safety Sense Leaflet 14 – *Piston engine icing'* provide relevant guidance. The *Skyway Code* also provides advice and guidance relating to aircraft mass, balance and performance.[4]

Footnote

[4] Accessed October 2023.

SERIOUS INCIDENT

Aircraft Type and Registration:	Vans RV-7, G-RVDB
No & Type of Engines:	1 Superior XP-IO-360-B1HC2 piston engine
Year of Manufacture:	2018 (Serial no: PFA 323-14526)
Date & Time (UTC):	29 August 2022 at 0753 hrs
Location:	Ronaldsway Airport, Isle of Man
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	1,874 hours (of which 1,769 were on type) Last 90 days - 23 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and other AAIB enquiries

Synopsis

After attending to an uneasy passenger while orbiting over the sea, the pilot inadvertently approached and landed on Runway 03 instead of the active Runway 08. The ATCO, who was attending to ground activities, did not observe the aircraft during its final approach.

The report considers the importance of recovering situation awareness and adopting sterile cockpit procedures before commencing with an approach. It discusses vigilance in ATC and the importance of teamwork in detecting possible misperceptions.

The air traffic services unit is taking safety action relating to the monitoring of aircraft, and team resource management training.

History of the flight

The aircraft was cleared on Ronaldsway's radar frequency to enter the control zone under VFR, and advised to expect joining right hand downwind for landing on Runway 08, which was in use. When around 3.5 nm south-east of the airport at 2,800 ft amsl, the aircraft was transferred to the tower frequency. The ATCO reported a surface wind from 080° at 9 kt, offering the pilot a choice of Runways 08 or 03.

The pilot requested Runway 08 before being instructed to 'REPORT READY FOR RIGHT BASE RUNWAY ZERO EIGHT.' The aircraft appeared to turn downwind for Runway 08 although its position was also consistent with right base for Runway 03 (Figure 1)[1],[2].

Figure 1

G-RVDB's position after pilot requested Runway 08

From there, the pilot reported ready for right base (Figure 2). He was instructed to orbit left to accommodate an ATR 76 on a commercial air transport flight that was joining final for Runway 08 at 8 nm.

Figure 2

G-RVDB's position when the pilot reported ready for right base Runway 08

The pilot was unable to see the ATR during its approach so the ATCO advised him when it landed, and the pilot reported ready to leave the orbit (Figure 3).

Footnote

1 Figures 1-4 are screenshots of the Air Traffic Monitor from the ATS unit's investigation report on the incident.

2 The ATM screen is orientated south up, because of the control tower's orientation.

Figure 3

G-RVDB leaving orbit

The pilot reported that he aligned the aircraft with a "large runway slightly off to [his] right", calling 'FINAL ZERO EIGHT' on the radio frequency, and was cleared to land on Runway 08 (Figure 4). However, he inadvertently performed an approach and landing on Runway 03 instead.

Figure 4

G-RVDB reports turning final Runway 08

The aircraft stopped its landing roll around the intersection of the two runways (Figure 5). Confusion over taxi instructions, which the ATCO issued as though the aircraft had landed on Runway 08, led the pilot to re-orientate the airfield against the chart he was using.

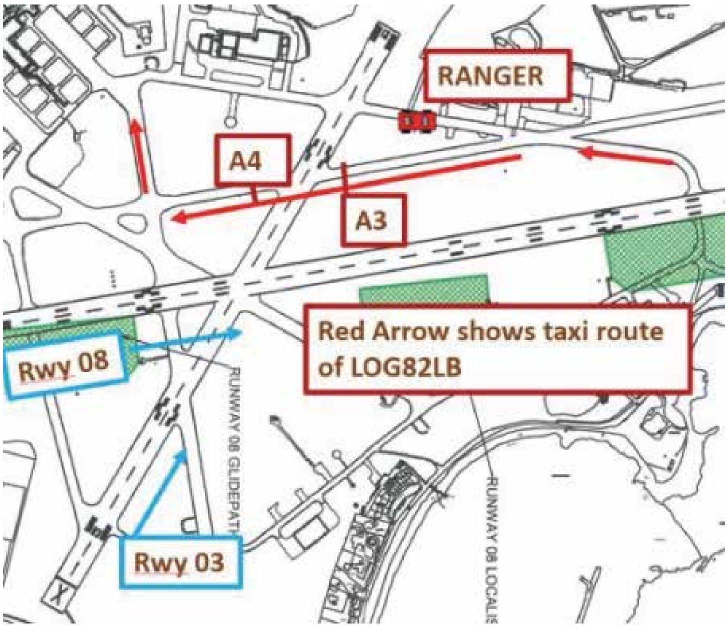

Figure 5
Ground situation after the ATR had landed

Meteorological information

Ronaldsway's visibility was reported at 0750 hrs as 10 km or more, with few clouds at 1,500 ft.

Additional information from the pilot

The pilot reported he had focussed attention on reassuring the passenger who expressed unease while orbiting over the sea. The absence of fixed ground references made orientating himself during the turning manoeuvre more difficult. He noticed a crosswind after joining final approach but did not check the compass. Having been given a choice of runways, he believes he experienced confirmation bias[3] during the approach by mis-reading the runway designation numbers '03' as '08', while he was thinking about his landing technique.

Information from the air traffic services unit (ATSU)

The ATC tower

Both the ATCO and air traffic services assistant (ATSA) said it had been a quiet morning. Glare from the morning sun and sea made it difficult to see aircraft from the south-facing control tower, with the sunblinds themselves presenting a "margin" across the window and additional glare from their "shiny" surface (Figure 6).

Footnote

3 Confirmation bias – tendency to seek out and prefer information that supports an existing belief, even in light of contradictory information.

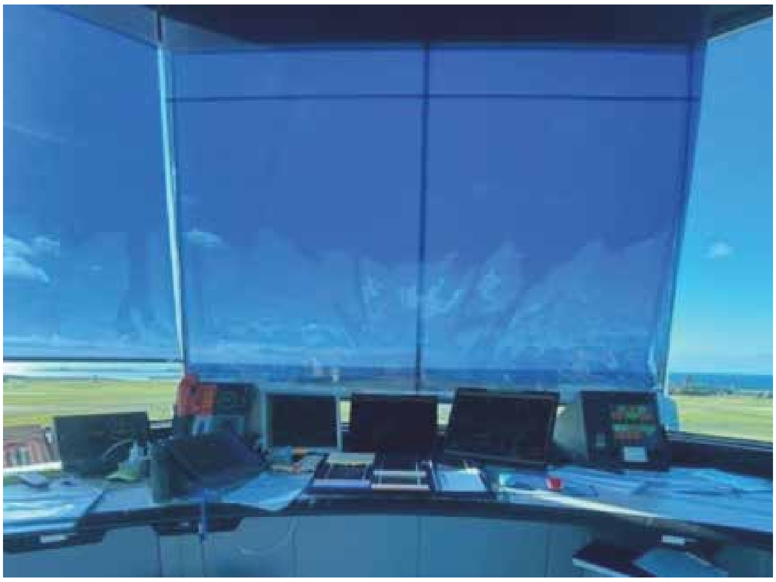

Figure 6

View of Runway 03 approach with similar glare and sunblind position as the incident[4]

The ATSA

The ATSA indicated that around the time G-RVDB reported ready for right base, he told the ATCO that from the air traffic monitor (ATM) he believed the aircraft was not aligning correctly with the runway but that the ATCO did not respond. The ATCO asked the aircraft to orbit, which the ATSA felt corrected the situation to the extent the pilot would need to re-orientate himself. He could see the aircraft while it orbited.

While the ATR was on 'short final' for Runway 08, the ATSA took an operational phone call. He returned looking for G-RVDB on Runway 08's final approach but noticed it had already landed. Sensing it had arrived sooner than he expected, he asked the ATCO if it had landed on Runway 03. The ATCO indicated he believed it had landed on Runway 08.

The ATCO

The ATCO indicated that because of the outside glare he had observed G-RVDB on the ATM while it was orbiting. He recalled wondering why the pilot could not see the ATR during its approach and felt confident from the pilots readbacks that he would align with Runway 08. He did not visually acquire the aircraft during its final approach because he was checking that the ATR's parking stand was clear. Similar to the ATSA, he said he returned to looking for G-RVDB on 'short final' for Runway 08 to find it had landed. He said he discovered it had landed on Runway 03 during the subsequent couple of days.

The ATCO reflected on the importance of monitoring general aviation aircraft, especially those unfamiliar with Ronaldsway, and responding to colleagues' input. He said he

Footnote

4 Photograph from the ATS unit's investigation report on the incident.

previously worked in a control tower with no ATM and as a result of this incident intends to monitor the ATM more often.

The ATSU's investigation report

The ATSU's investigation report on the incident listed *'Preventative actions'*[5], including:

> *'1. A reminder of the obligations to monitor all stages of final approach, in order to recognise when an aircraft might be incorrectly or dangerously positioned on approach should be included in the next safety digest.*
>
> *2. A programme of TRM* [team resource management] *training should be put in place. All members of the ATS section, including managers should undergo TRM training. This should be done as a matter of urgency…*
>
> *3. The sunblinds within the* [visual control room] *VCR are commonly acknowledged within the section to cause significant visibility issues.' An 'action' was opened to research an 'alternative solution… or replacement blinds…'*

The Isle of Man's Head of air traffic services reported the first item had been completed, and confirmed their intent to undertake items two and three as safety actions in an appropriate time frame.

Regulatory information

The CAA's *'Civil Aviation Publication (CAP) 493 Manual of air traffic services – Part 1'*[6] included the following:

> *'Aerodrome controllers shall maintain as far as practicable, a continuous watch by visual observation on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area. Visual observation shall be achieved through direct out-of-the-window observation, or through indirect observation utilising a visual surveillance system*[7] *which is specifically approved for the purpose by the CAA…*
>
> *A landing aircraft, which is considered by a controller to be dangerously positioned on final approach, shall be instructed to carry out a missed approach. An aircraft can be considered as dangerously positioned when it is poorly placed either laterally or vertically for the landing runway.'*

Footnote

5 Listed as *'Preventative actions'* in the report - these have been confirmed as safety actions by the Isle of Man Head of air traffic services.

6 Formally adopted by the Isle of Man CAA (IOMCAA).

7 The IOMCAA stated no such visual surveillance system is approved at Isle of Man.

Human performance guidance

Situation awareness

The Civil aviation authority of New Zealand's *'Situation awareness'* guidance document states[8]:

> *'We have limited ability to divide attention amongst tasks and generally, have to switch attention back and forth between tasks. This leaves us vulnerable to losing track of the status of one task when our attention is drawn away from the task at hand, or while engaged in another task.'*

The UK CAA's *'Civil Aviation Publication 737'* (CAP 737) suggests pilots can update their situation awareness using a systematic process, for example, *'Rotate attention from plane to path to people (aviate, navigate, communicate)…'*; and *'Monitor and evaluate current status relative to your plan… Focus on details and scan the bigger picture…'*[9,10]

Skybrary's *'Situational Awareness Quick Reference & Reminder'*[11] states:

> *'Manage workload… Manage attention… Validate your data… Use multiple sources… Check Your Understanding… Check for contradictory elements… Think ahead…'*

Its advice on recovering situation awareness includes:

> *'Go to the nearest SAFE, SIMPLE and STABLE solution… Communicate – Asking for help is not a weakness… Take time to think… Be willing to delay flight progress.'*

Sterile cockpit procedures

The European Aviation Safety Agency (EASA) describes *'sterile'* cockpit procedures as time when pilots *'shall not be disturbed… except for matters critical to the safe operation of the aircraft and/or the safety of the occupants.'*

The CAA's Safety Sense Leaflet 31 – *'Distraction'*[12] provides guidance on *'Distraction and interruption in general aviation'*. It states, *'Research suggests that the disruptive effects of distractions and interruptions can be reduced by making us aware of our vulnerability to them'*.

Footnote

8 Situational awareness guidance (aviation.govt.nz) [accessed 5 May 2023]
9 Referenced under *'Tips for good SA management (Bovier, 1997)'*.
10 CAP737 Flight-crew human factors handbook (caa.co.uk) [accessed 5 May 2023]
11 PowerPoint Presentation (skybrary.aero) [accessed 5 May 2023]
12 Safety Sense Leaflet - Distraction (caa.co.uk) [accessed 11 October 2023]

Vigilance

SKYbrary describes vigilance[13] as:

> *'…paying close and continuous attention to a field of stimulation for a period of time, watchful for any particular changing circumstances.*
>
> *...changes may be quite small, but their potential effect may be considerable. The speed and accuracy with which we detect these changes (assuming we detect them at all) determines the timeliness of our decisions and actions. Vigilance is greatly affected by our level of alertness, and this is why we can be affected not only by being overloaded but also by being 'under-loaded'.*
>
> *Perception and vigilance are closely related and affect the accuracy and currency of our mental model of the air traffic situation. The vigilant ATCO can detect situations where a misperception is likely and will therefore be more likely to detect whether their perception is correct than a non vigilant ATCO…*
>
> *Vigilance is not a skill… [It] is a result of a number of circumstances over which the individual does not always have sufficient influence. It is also very difficult for the individual to detect changes in their vigilance… Often, reduced vigilance is revealed by unwanted outcomes of decisions and actions. That is why it is very important that colleagues keep an eye on each other. It is usually easier for somebody else to notice when things start to deteriorate then it is for us. We can, however, take a number of measures that will help us to remain vigilant for a longer period of time. By making sure we are physically fit, well rested, well trained and informed, we enhance our capacity to stay vigilant longer.'*

Analysis

The aircraft

It may have been disorientating and distracting to orbit without a fixed ground reference while looking for inbound traffic and reassuring the passenger. Pilots can maximise their situation awareness by managing potential distractions and taking time to focus systematically on the aircraft, its flight path, and necessary communications – sometimes summarised as *'plane, path, people'.* Seeking help from ATC and taking time to observe the aerodrome environment can avoid errors like confirmation bias.

ATC

The radio calls between the ATCO and the pilot were consistent with an aircraft performing an approach to Runway 08, but neither seemed aware G-RVDB was approaching Runway 03 until after it landed. It is apparent the ATSA may have detected that the pilot was making an approach to the wrong runway.

Footnote

[13] Vigilance in ATM | SKYbrary Aviation Safety [accessed 12 July 2023]

The ATSA could see G-RVDB while it orbited. The ATCO referred to the ATM because of sun glare, which was known to impede direct visual observation of aircraft at Ronaldsway. While the ATSU considers sun glare to be inherent to Ronaldsway's south-facing control tower, it intends to explore alternatives to the existing sun blinds.

The ATCO stopped monitoring G-RVDB to check on ground activities, feeling assured the pilot knew which runway to use. The quiet morning may have reduced his vigilance. Being alert to small changes or anomalies, and the possibility for unexpected events, helps ATCOs to maintain their situation awareness and detect possible misperceptions – in themselves or others.

In this case the outcome of G-RVDB landing on the wrong runway was benign. However, Figure 5 illustrates the potential for conflict with other aircraft using the active runway or taxiways.

Conclusion

The runway incursion occurred because the pilot mistook Runway 03 for Runway 08, having been reassuring an uneasy passenger while orbiting over the sea. The ATCO did not monitor the aircraft during its final approach.

Safety actions

> The ATSU has published a reminder to controllers to monitor all stages of an aircraft's final approach to recognise when an aircraft might be incorrectly or dangerously positioned. It intends to provide TRM training for all members of the ATS section and to replace the VCR sun blinds if a better solution can be found.

ACCIDENT

Aircraft Type and Registration:	DJI Mavic 2 Pro
No & Type of Engines:	4 DJI electric engines
Year of Manufacture:	Unknown (Serial no: 163CJ1JR0A780V)
Date & Time (UTC):	27 March 2023 at 1000 hrs
Location:	Liverpool
Type of Flight:	Private
Persons on Board:	Crew - None Passengers - None
Injuries:	Crew - N/A Passengers - N/A
Nature of Damage:	Front left, rear left and rear right arm modules damaged and damage to the camera gimbal module
Commander's Licence:	None
Commander's Age:	28 years
Commander's Flying Experience:	0 hours (of which 0 were on type) Last 90 days - 0 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During a short flight the unmanned aircraft collided with a building. The pilot reported he inadvertently pressed the wrong control lever. He did not hold the necessary qualification to operate the aircraft. The operator has implemented new procedures to prevent recurrence.

History of the flight

The unmanned aircraft (UA) had been purchased by the university to assist with research. The university had registered as an 'operator' with the CAA.

On the day of the accident the aircraft was being flown by a research student. It was his first flight of any UA and he had not undertaken any training. He was intending to evaluate how the aircraft could be used to assist his research. He decided to fly it from the window of his living quarters on the third floor of the building, having confirmed there were no people in the vicinity. After approximately 3 minutes of flight, whilst the aircraft was maintaining 10 meters above the ground, the pilot attempted to increase its height. However, he believes he inadvertently pressed the forward/backward stick instead of the up/down stick. The aircraft moved towards the building, collided with the wall and fell to the ground. No one was injured but the aircraft was extensively damaged.

The pilot did not know what mode the UA was operating in when the accident occurred.

Aircraft examination

The aircraft and the flight logs were sent to the manufacturer for analysis. The manufacturer confirmed the aircraft was behaving normally until the moment of the accident and there was no evidence of any malfunction. It confirmed the aircraft was in 'positioning mode' when the accident occurred[1].

Aircraft information

The DJI Mavic 2 Pro is a quadcopter with a takeoff mass of 907 g. It is fitted with a gimbal mounted camera.

The UA has a vision system to detect obstacles and prevent collisions. However, it can only see obstacles within its detection range and the system requires sufficient lighting and sufficiently marked or textured obstacles. The vision system is not available in all flight modes.

Drone regulation

UK Regulation (EU) 2019/947 and its associated acceptable means of compliance and guidance material provides the regulation and policy in relation to the operation of UAS. CAA CAP 722 'Unmanned Aircraft System Operations in UK Airspace'[2] provides guidance to assist in compliance with the applicable regulatory requirements.

If the accident flight was operated in compliance with the regulation it would have come under the A2 subcategory. To operate in this category the pilot is required to obtain a Flyer ID and hold an A2 Certificate of Competency (A2 CofC). To obtain this certificate a pilot is required to undertake a theory course, pass an exam and certify they can safely fly specified manoeuvres.

Details of the requirements for UA pilots and operators can be found via the CAA's Drone and Model Aircraft Registration and Education Scheme found at https://register-drones.caa.co.uk/

Organisational information

Following the accident the university has reviewed its procedures for operating UAs and introduced the following guidelines:

- All UAs (irrespective of the category they are flown in) must be logged with the Safety Adviser's office. No flying is allowed if the UA is not logged.
- All UAs will have a nominated responsible person assigned to them.

Footnote

1 The UA has three selectable modes (positioning, sport and tripod) plus a fourth mode (ATTI) which it can switch to automatically in certain circumstances. In positioning mode the UA utilises GPS and its vision system to locate itself, stabilise and navigate.

2 CAA CAP 722 'Unmanned Aircraft System Operations in UK Airspace' available at https://publicapps.caa.co.uk/docs/33/CAP722_Edition_9.1%20(1).pdf (accessed 19 July 2023)

- All areas will need to introduce secure arrangements for the storage and access to the UAs.
- All pilots will complete the A2 CofC course.
- All pilots will attend the Safety Adviser's Office drones training session.

Conclusion

During flight the pilot inadvertently pressed the forward/backward lever causing the UA to collide with a building. The investigation did not determine why the UA's vision system did not detect the obstacle. The pilot had not undertaken any training and did not hold the required qualification to operate the aircraft.

The university has implemented procedures to ensure appropriate control of UAs and to ensure all pilots have completed the appropriate training, registration, and qualifications.

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: September - October 2023

4 Mar 2023 **Piper PA-38-112** **G-OFFS** Hawarden Airport, Flintshire

The student pilot reported that while the aircraft was at the refuelling point, its flaps and engine were affected by downdraft from a helicopter hover taxiing on an adjacent taxiway. A subsequent engineering inspection found no damage to the aircraft, which was returned to service.

28 May 2023 **Cessna 175B (modified)** **G-ARMN** Near Aldermaston, Berkshire

Having successfully completed power checks, the aircraft took off and at approximately 250 ft there was a loud bang. The engine lost power and the pilot made a forced landing in a muddy field. After a ground roll of about 30 m the nosewheel dug in and became detached. The engine was 21 years old and maintained on-condition having gone beyond the manufacturer's 12 years service life check. The failure was subsequently attributed to a failure of one of the cylinder head spark plug threads which caused the spark plug and heli-coil to be ejected from the engine, and on further inspection one of the remaining cylinders was found to have low compression.

31 May 2023 **Piper PA-28-181** **G-BPXA** Netherthorpe Airfield, Nottinghamshire

During approach to grass Runway 06 at Netherthorpe, a change in wind resulted in the aircraft's wheels touching a hedge near the threshold. The wheel spats, nose landing gear, flaps, propeller and tailplane were damaged but the pilot was able to taxi the aircraft.

4 July 2023 **Piper PA-23-250** **N15YP** Clayton J Lloyd International Airport, Anguilla

During the normal procedure to lower the landing gear for landing, the nose gear did not extend. After several attempts to extend it and flying by the control tower to obtain confirmation, the pilot observed three green lights and proceeded to land. The nose landing gear collapsed on landing. The cause was not established.

16 July 2023 **Rotorsport UK MT-03** **G-CEYR** Eaglescott Airfield, Devon

The student pilot had just touched the gyroplane down after some solo circuits; the wind was reported as 12 kt on the runway heading but varying slightly from left to right. After touchdown, the pilot moved the stick forward and slightly left (into wind) while the rotors were still turning but the gyroplane "felt out of control" and rolled over onto its side. The pilot stated that the accident would have been avoided if the stick had been held back until the rotors had stopped and then pushed forward.

Record-only investigations reviewed: September - October 2023 cont

19 July 2023 **Team Minimax 91** **G-BYFV** Hughley Airfield, Shropshire

The Single Seat De-Regulated (SSDR) aircraft suffered an engine failure shortly after takeoff. During the forced landing, the wingtip struck a tree and the aircraft landed heavily. The pilot escaped unaided but sustained minor injuries; the aircraft was destroyed by the post-accident fire. Later examination by the owner revealed the engine's rear crankshaft bearing had failed. The pilot suggested that pilots practise rapid evacuation from the cockpit and consider wearing fireproof clothing.

20 July 2023 **Casa 1-131E Series 1000 Jungmann** **G-BHPL** Henstridge Airfield, Somerset

On takeoff from Runway 24 at Henstridge the engine 'coughed' at about 100 ft then stopped, and the pilot considered options for a forced landing. The aircraft hit trees at the edge of the airfield and came to rest inverted with substantial damage. The pilot was not injured. The pilot did not identify a cause of the engine failure.

10 Aug 2023 **Fournier RF6B-100** **G-BKIF** Near Gloucester

The aircraft was approaching Gloucestershire Airport and descending at low power with the carburettor heat set to OFF. The engine began to run roughly and the pilot selected carburettor heat ON, but the engine then stopped. The pilot manoeuvred the aircraft to glide toward the airfield but, on short final and concerned the aircraft would not clear trees short of the runway, the pilot made a right turn and landed on the central reservation of the A40 dual carriageway. The cause of the engine failure was not positively determined. There was significant damage to the aircraft.

3 Sept 2023 **Vans RV-6A** **G-RUSL** Westonzoyland Airfield, Somerset

The aircraft touched down heavily, then bounced which possibly damaged the nosewheel. As the aircraft rolled out, the nosewheel dug into the grass runway causing the aircraft to pitch onto its nose and become inverted.

4 Sept 2023 **Piper PA-28-161** **G-XENA** Alderney Airport, Guernsey

On departure, a pilot from another aircraft reported that one of the red threshold light units had fallen over. It was later established that the previous aircraft, G-XENA, approached very low and hit the light. The pilot of G-XENA commented that the aircraft descended unexpectedly on short final.

Record-only investigations reviewed: September - October 2023 cont

6 Sept 2023 **Piper PA-28-161** **G-BFDK** Compton Abbas Airfield, Dorset

Whilst taxiing to park after landing, the left wing struck a fence causing damage to its tip and leading edge. The pilot was concentrating on manoeuvring past a line of parked aircraft to the right, and insufficient attention was given to avoiding the fence to the left.

6 Sept 2023 **Piper PA-28-181** **G-BGWM** Solent Airport Daedalus, Hampshire

The aircraft was taxiing from a grass parking area for departure and its left wingtip collided with the propeller of a parked aircraft. The plastic wingtip of the taxiing aircraft was destroyed and the parked aircraft required inspection before further flight. The pilot attributed the collision to 'a momentary lapse of concentration'.

9 Sept 2023 **Vans RV-4** **G-INTS** London Ashford Airport, Lydd, Kent

After landing, the right main landing gear collapsed. The aircraft had ground-looped on its previous landing and it was possible that this damaged the landing gear making it more likely that it would collapse.

13 Sept 2023 **Piper PA-28-161** **G-BMKR** Leeds East Airport

The aircraft touched down normally but, as the student pilot applied the brakes, it veered off the runway and onto the grass. As the aircraft came to a halt, the nose landing gear collapsed.

14 Sept 2023 **Cessna A152** **G-BOSO** Redhill Aerodrome, Surrey

The pilot made a normal approach but the sun was in his eyes, impairing his vision, and the aircraft bounced on touchdown. He initially pulled back on the control column but then pitched the aircraft nose down to improve his view, and the aircraft struck the ground and turned over. The pilot vacated the aircraft without assistance and sustained only minor injuries. He subsequently observed that a go-around would have been a better response to the initial bounce.

18 Sept 2023 **Rotorsport UK Calidus** **G-GRYN** Kiltinney Airfield, County Londonderry

During takeoff from a narrow runway with a crosswind the aircraft departed the runway. The pilot aborted the takeoff, the right mainwheel settled in boggy ground and the aircraft toppled over onto its right side.

25 Sept 2023 **Piper PA-28-140** **G-OFTI** St Athan Airfield, Vale of Glamorgan

The aircraft landed heavily, the nose landing leg failed and the propellers struck the runway surface.

Record-only investigations reviewed: September - October 2023 cont

30 Sept 2023 **Piper PA-15 (modified)** **G-ASHU** Popham Airfield, Hampshire

The aircraft's engine lost power after lift-off following a touch-and-go landing. The pilot lowered the nose to land ahead on the remaining runway, but the aircraft suffered a hard touchdown and ran off the side of the runway, and the landing gear collapsed.

9 Oct 2023 **Cessna 170B** **N2366D** Duxford Airfield, Cambridgeshire

During the rollout after landing, the aircraft hit a bump and started to drift to the right. The left gear and spat dug into soft ground and the aircraft ground looped. A subsequent inspection revealed that the airframe structure had slight deformation.

15 Oct 2023 **Aeroprakt A22 Foxbat** **G-CHAD** Park Hall Airfield, Derbyshire

The aircraft landed heavily in gusty conditions which resulted in a bent nose landing gear leg.

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

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