Accident

Aircraft Type and Registration:	Vans RV-6A, G-RVSH	
No & Type of Engines:	1 Lycoming IO-360-A1AD (Modified) piston engine	
Year of Manufacture:	2004 (Serial no: PFA 181A-13026)	
Date & Time (UTC):	3 September 2023 at 1406 hrs	
Location:	Truro Airfield, Cornwall	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Fatal)	Passengers - N/A
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	261 hours (of which 115 hours were on type) Last 90 days - 6 hours Last 28 days - 3 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The pilot of G-RVSH came into land on Runway 14 at Truro airfield but touched down off the side of the runway. The nose wheel was not held off, the nose wheel dug in, and the landing gear strut deformed resulting in the aircraft coming to rest inverted. The guidance from the aircraft manufacturer was that the nosewheel should be held '*off as long as possible*'. The Light Aircraft Association (LAA) provided similar guidance. A combination of the aircraft energy and dynamics of the roll over may have contributed to the pilot sustaining a fatal neck injury.

Safety action has been taken by the airfield owner to provide more information on the Pooley's plate. A helicopter training mound has been removed from the airfield.

History of the flight

The pilot of G-RVSH had decided to fly from White Waltham Airfield to Truro Airfield (Truro), a grass airstrip in an actively farmed field (Figure 1). He called the airfield owner at approximately 1145 hrs, asked for permission to land, and informed him that the flight time would be about 1 hour 15 minutes.

At about 1355 hrs the airfield owner heard the aircraft in the vicinity and, shortly afterwards, saw it on the downwind leg for Runway 14 while he noted the windsock indicated that the wind had shifted in favour of Runway 32.

Figure 1
View of Truro in the direction of Runway 14, taken later on the same day as the accident

Witnesses saw the aircraft approaching to land on Runway 14. As the aircraft touched down it appeared to bounce twice before tipping over its nose and then onto its back adjacent to a mound. The owner went to assist the pilot while the other witness called the emergency services.

Accident site

The aircraft came to rest approximately 20 m to the right side of Runway 14 after a ground roll of approximately 100 m. The first ground marks consisted of three tyre tracks in the grass, which started to the side of and about halfway down the runway length (Figure 2).

Figure 2

Accident site, viewed from the Runway 14 direction

The three tracks were consistent with the three wheels touching down at the same time and were parallel to the runway until adjacent to the north side of the mound (Figure 3). The right landing gear wheel track ended near the periphery of the mound. Approximately 6 m after the right track ended, the partial remains of the nose wheel spat were found. Leading up to the spat was a deep furrow created by the nose landing gear, which started before the point where the right tyre track ended. At the same approximate position there was evidence that the left wing tip was in contact with the grass, and this was further confirmed by light scratches on the left wingtip structure. The nose landing gear furrow extended a further 10 m beyond the remains of the spat with the left tyre track ending approximately halfway along. After a gap of approximately 2 m beyond the nose landing gear furrow, an indentation had been made by the propeller spinner. The aircraft came to rest inverted just beyond this indentation.

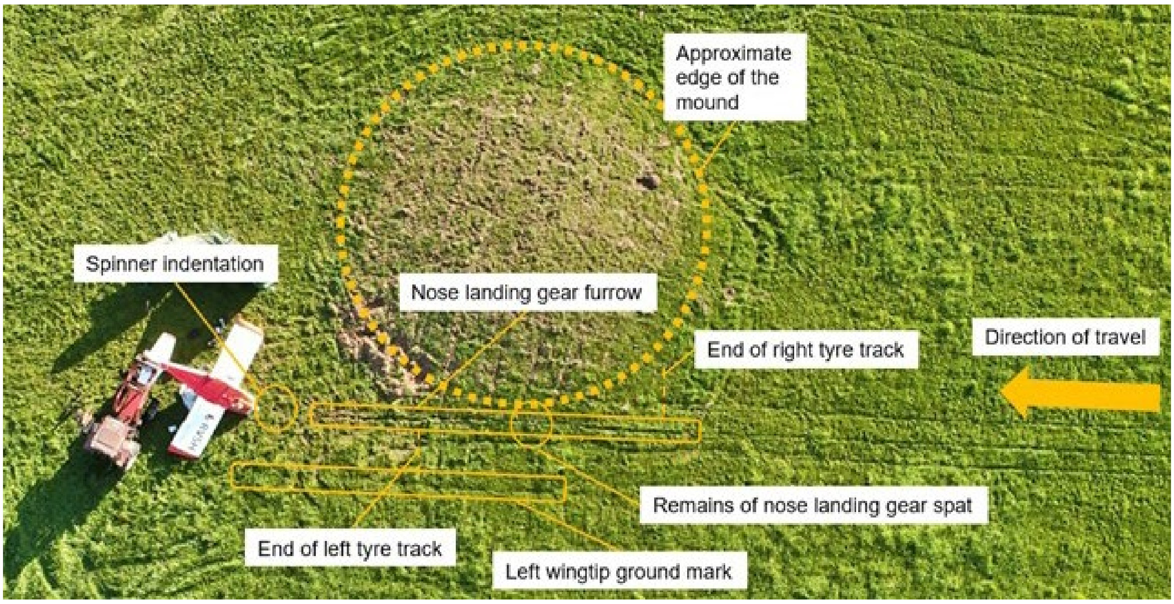

Figure 3
Accident site ground marks

Witness Evidence

Airfield Owner

The airfield owner reported to the AAIB that the pilot called him on the telephone prior to the flight. The owner stated that he confirmed to the pilot that the airfield had two runways, Runway 14 and Runway 32 (which matched entries made by the pilot into a notebook), and that the windsock indicated the wind was about 5 kt, favouring a landing on Runway 14. However, the owner stated that he advised the pilot to check the windsock for indications of the wind direction on arrival and, owing to the downward slope on Runway 14 and since the wind was light, recommended that the pilot should consider landing on Runway 32. He further told the pilot that the circuits were at 800 ft agl to the north, and that there was no dead side.

When the owner heard the aircraft overhead, he moved to a balcony which gave a view of the field in the direction of Runway 32. However, the increasing slope of the field would have obscured his view of the far end of the field, including the first half of Runway 14. The owner stated to the AAIB that at the time he noticed the wind now favoured Runway 32. He reported that the approach seemed normal from his perspective and that the aircraft appeared over the runway. However, he thought it seemed faster than he would have expected for a tailwind and the aircraft appeared to land long.

The owner and another witness, stood beside the airfield owner, stated to the AAIB that the aircraft seemed to bounce twice and seemed out of control before it appeared that the right main wheel contacted the side of a mound as it bounced into the air before landing and rolling over its nose onto its back. The other witness commented to the owner that the aircraft seemed to have landed off the runway.

Farmer

A farmer who was clearing bales on the north-eastern side of the runway saw the aircraft make an approach to Runway 14. He perceived the aircraft was over the runway but faster and deeper than he would have expected.

Recorded information

ATC & flight tracking data

G-RVSH was equipped with a Mode-S transponder. It was first detected by SSR and online flight tracking services as it flew abeam Poole, Dorset. The tracks corroborated GPS tracks downloaded from onboard avionics until G-RVSH descended as it approached Truro. Radar detections of the aircraft's lateral position are usually less accurate than GPS measurements, particularly at low altitudes. The investigation did not find any evidence that the pilot was in contact with ATC at Exeter, Culdrose or Newquay before arriving at Truro.

Onboard data sources

Two digital avionic devices, an EKP-V and an iEFIS, recorded flight parameters to their respective internal memory. The recordings were downloaded with assistance from their manufacturers. Both independently measured heading, acceleration and air data, with the latter being measured from the same air sensors.

The sample rate of iEFIS recordings varied, increasing in dynamic phases of flight and decreasing in steady flight. The EKP-V recorded at a constant 1 Hz sample rate, which recorded air and inertial data as "PFD" parameters, and GPS calculated parameters recorded as "NAV" recordings. In addition to the accident flight, several years of flight recordings were saved in the EKP-V memory.

A comparison of acceleration data from both devices indicated that the iEFIS was less sensitive to g-force changes than the EKP-V, particularly in the vertical axis. The EKP-V also recorded at a more constant rate than the iEFIS, and its acceleration data was more consistent with changes to other parameters, such as attitude and airspeed. Therefore, the investigation did not rely on iEFIS acceleration parameters for its analysis.

A mobile phone and a tablet belonging to the pilot were also recovered from the aircraft. They were undamaged, but the AAIB was unable to download their contents.

Wind speed and direction calculations

The last wind data calculation made by the onboard avionics was recorded as G-RVSH crossed the threshold of Runway 14, and indicated a wind as being from 010 at 6 kt. This is consistent with forecasted wind conditions at the time of the accident and indicates that there was a tailwind component of about 3 kt as G-RVSH landed.

Flight path

The iEFIS and EKP-V received GPS data from their own GPS antennas, which were collocated on top of the cockpit glareshield. The lateral difference between their recorded GPS positions during the final approach and landing was smaller than the typical error in GPS position measurement[1], and indicated that G-RVSH was offset to the right of the Runway 14 edge by about 20 m. This is illustrated in Figure 4, which shows the flight path taken by G-RVSH before landing in the direction of Runway 14. The GPS tracks corroborated the positions of the wheel track marks found on the accident site (Figure 2).

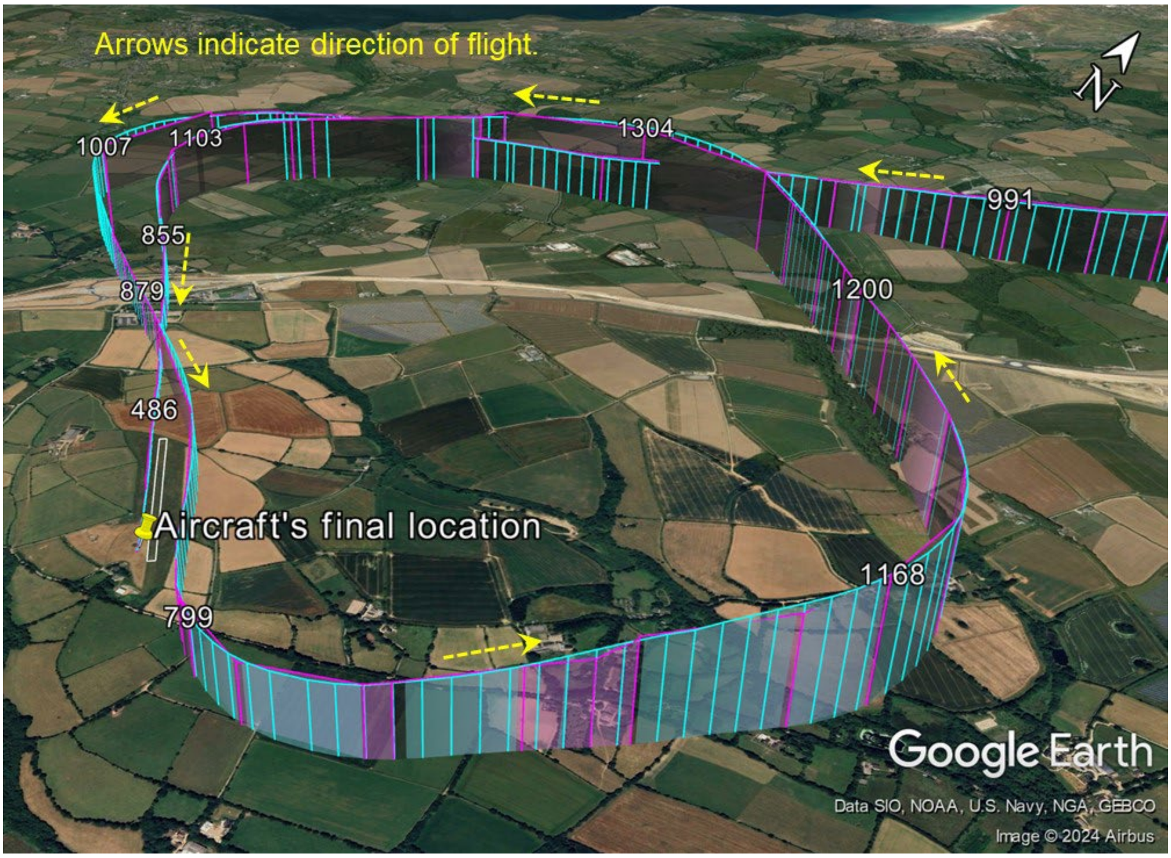

Figure 4

GPS tracks from EKP-V (blue) and iEFIS (purple) recordings, with altitude amsl overlayed
© 2024 Google, Image © Airbus

Figure 5 shows pertinent recorded parameters for the last 60 seconds of the flight. The Flight Path Angle (FPA) was calculated from the recorded data and indicates that the approach was flown at a FPA of between -5° and -7° until the flare. The accuracy of these calculations was limited by sensor measurement and calibration uncertainties, which are not known to the investigation.

Footnote

1 For further information see: https://www.gps.gov/systems/gps/performance/accuracy/ [accessed January 2024].

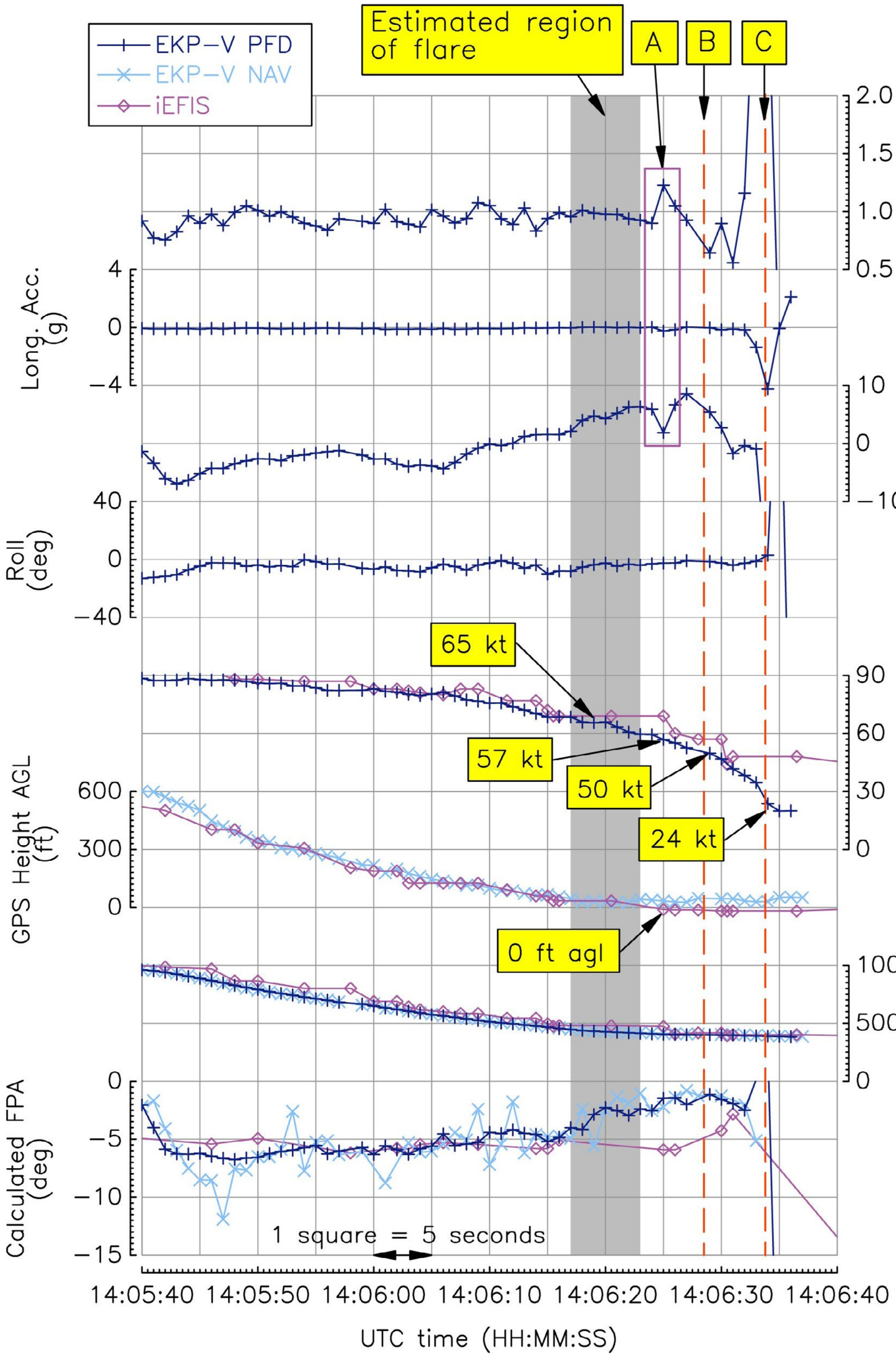

Figure 5

Pertinent recorded parameters for the final 60 seconds of the flight

Interpretation of approach and landing data

The airspeed was about 90 kt at the start of the approach, gradually reducing to about 65 kt where the data indicates G-RVSH began to flare (shown as the shaded region in Figure 5). The recorded GPS position at 1406:20 hrs indicates that G-RVSH was abeam Runway 14 and about a fifth of the length along it when the flare was performed.

A change in vertical and longitudinal acceleration, and temporary reduction in pitch, were recorded shown as point A in Figure 5, and the airspeed was about 57 kt. The sample rate and precision of the altitude and vertical acceleration recordings were not sufficient to determine whether this data indicates a bounce, float or ballooning. Furthermore, similar fluctuations in the recorded vertical acceleration were observed in the data throughout the flight to Truro.

Point B shows the timestamp at which a GPS position was recorded which corresponded with the point where wheel tracks were first visible in the grass. The recorded airspeed at this time was about 50 kt, giving an estimated groundspeed of about 53 kt.

At point C, the variation in acceleration and roll angle parameters indicate the point at which G-RVSH rolled over. When this occurred, the NAV recordings indicated a GPS calculated groundspeed of 35 kt but this parameter varied more than the airspeed, since it is a parameter calculated from differences in GPS positions. The PFD recorded airspeed was 24 kt, giving an estimated groundspeed of 27 kt, which is likely to more accurately reflect the aircraft's speed when it rolled over.

Aerodrome information

Truro Airfield (Figure 6) is located approximately 4 miles north-west of central Truro and has an elevation of 400 ft amsl. It has a single grass runway, 20 m wide, oriented approximately 140°/320°. Runway 14 has a 1.8% slope downhill. It is an unlicenced airstrip and, consequently, there is no requirement for any regulatory oversight.

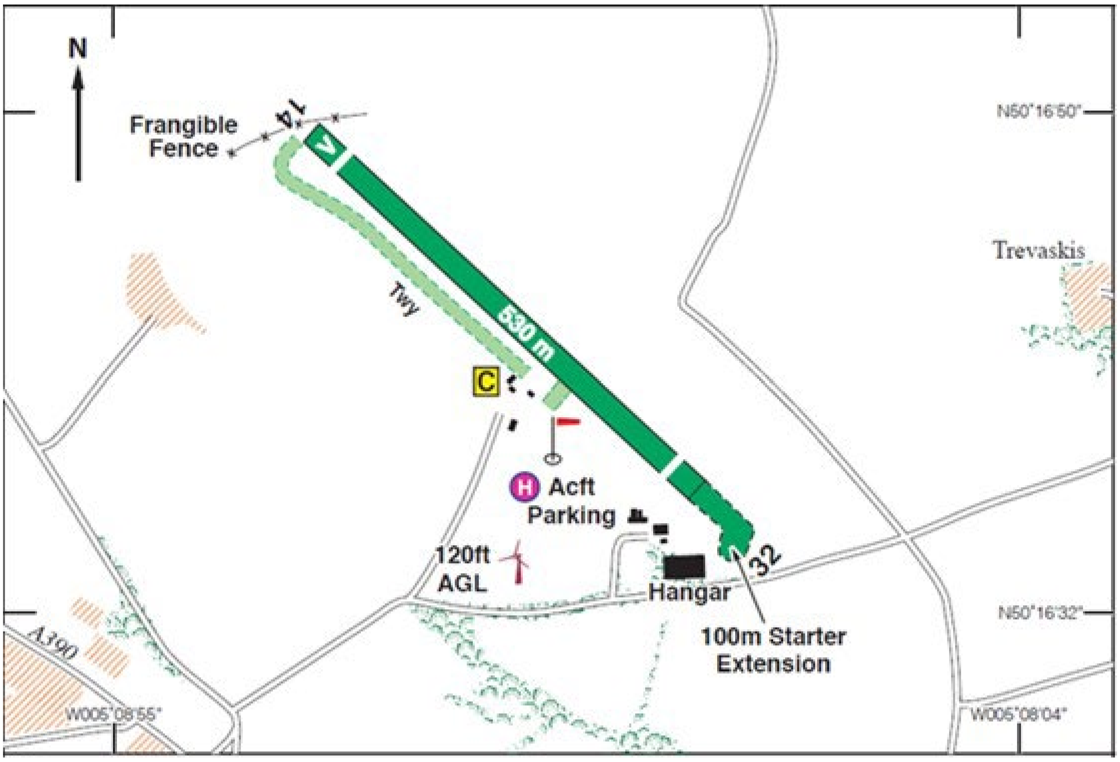

Figure 6

Pooley's Plate of Truro Airfield
2023, Robert Pooley

Truro used to be a licenced airfield, and concrete runway number identifications remain at the threshold of each runway. The numbers used to be painted white but had faded over time. There is a narrow grass taxiway, which runs between a hedgerow defining the airfield boundary and the runway.

The owner stated he had cut the grass on the runway the day before. The surrounding field had been cut for silage during the previous month. Figures 1 and 7 show the contrast between the runway strip and the adjacent grass in the field at the time of the accident.

On the day of the accident flight there were large hay bales to the north of the runway at various locations, some of which were adjacent to the edge of the runway. At the time of the accident, a farmer was collecting bales on the north-eastern side, towards the Runway 14 threshold. Several bales remaining on the north-eastern side of the runway were within 25 m from the centreline (Figure 7).

The airfield was also used as a training location for helicopters to conduct sloping ground landing training and practice. To facilitate this, a mound, about 30 m from the centre of the runway to the south-west between the windsock and the Runway 32 threshold, had been constructed. The base of the circular mound was 18 m in diameter with a 10° slope to a maximum height of 1.5 m. The Pooley's plate made no reference to the mound.

Runway dimensions and obstacles at unlicensed aerodromes

The Civil Aviation Authority publishes a Civil Aviation Publication (CAP)[2] for operations at unlicensed aerodrome. The publication states:

> *'The contents of this CAP are not mandatory, nor do they purport to be exhaustive. However, they do provide what can be considered as sound practice that has been developed in consultation with industry representative bodies.'*

The CAP recommends a minimum runway width of 18 m at unlicensed airfields where light aircraft under 2,730 kg MTWA are intended to operate. It also states that there should be:

> *'No vertical obstacles within 25 m either side of centreline.'*

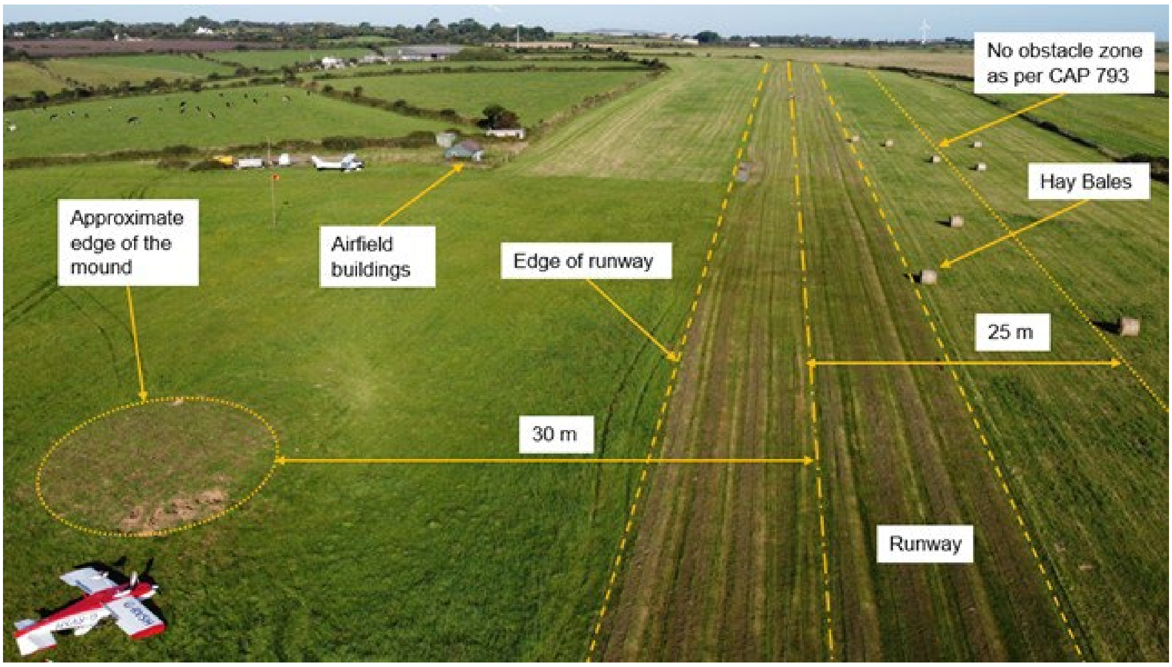

Figure 7

Truro airfield viewed in direction of Runway 32 showing hay bales and the mound

Aircraft information

General

The Vans RV-6A is a two-seat amateur built all metal aircraft powered by a Lycoming IO360A1AD engine and fitted with a constant speed two bladed Hartzell propeller. The two on-board avionic devices were connected to the same pair of static ports, one on each side of the aircraft at the rear of the fuselage which were connected in parallel. Total pressure was also provided to both devices from a single pitot tube located under the left wing.

Footnote

2 CAA July 2010, CAP 793: Safe Operating Practices at Unlicensed Aerodromes, Edition 1, https://www.caa.co.uk/our-work/publications/documents/content/cap-793/ [accessed March 2024].

G-RVSH was built in 2004 by the previous owner and owned and operated by the accident pilot since 2015. No aircraft logbooks were made available to the investigation however the LAA inspector who performed the last annual inspection confirmed that all the aircraft documentation was in order at the time of the inspection. The aircraft was fitted with the sliding style canopy and the AntiSplatAero nose strut brace.

Landing gear

The landing gear is a tricycle configuration with the struts manufactured from 6150 steel rods and a castoring nose wheel. The nose landing gear strut attached to the engine mounting frame and has a 47° bend at the lower end to align the wheel's castoring axis (Figure 10).

AntiSplatAero nose strut brace

The nose strut brace is an after-market modification to the nose landing gear to prevent it from bending excessively during ground taxiing. It was developed by AntiSplatAero Inc. after reports of multiple nose landing gear failures, some of which resulted in the aircraft becoming inverted. The modification is pre-approved by the LAA for use on the RV-6A.

The modification consists of a high tensile 4130 steel blade which is clamped to the nose landing gear strut but still allows it to bend as a spring providing shock absorption (Figure 10). It prevents the strut from over bending should the forces exceed the capability of the material. It is a popular modification that has been fitted to many aircraft worldwide. The manufacturer states that '*this device could help prevent a costly repair, a propeller strike, engine disassembly for inspection or other damage may be avoided not to mention a dreaded possible flip over*'.

Aircraft examination

Initial on-site inspection

The on-site inspection of the aircraft revealed the aircraft had been correctly configured for landing with the flaps fully extended, fuel mixture set RICH and the propeller in HI RPM (fine pitch). One propeller blade was bent rearwards and there was some damage to the leading edge of both blades. Both magnetos were on, along with all the required electrical system switches, but the aircraft key had been removed, presumably by a first responder. Approximately 50 litres of fuel was removed from the aircraft.

The aircraft structure was intact with crush damage to the top of the vertical fin and deformation of the canopy frame and the Perspex shattered. The main landing gear was intact and there was evidence on the tyres of skidding on earth and grass. The nose landing gear strut was bent rearwards, and the front of the spat was damaged with a section missing. The aircraft was recovered to the AAIB facilities for further inspection.

Figure 8
G-RVSH at the accident site

Detailed inspection

The aircraft structure, engine and systems were examined in detail and no pre-existing defects were found that would have contributed to the accident.

The nose landing gear was disassembled to enable inspection of the individual components and measurements to be taken. The landing gear usually has a 47° bend at the lower end and following the accident this had increased to 59°. An additional bend had occurred just before the mounting position of 55° (Figure 9). The blade of the strut brace had also been deformed rearwards.

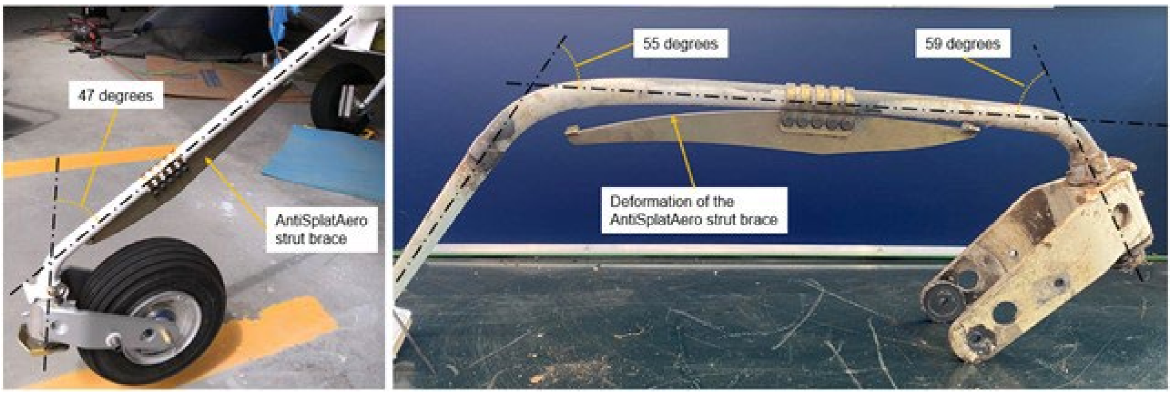

Figure 9
Nose landing gear damage detail

The change in the geometry of the nose landing gear strut resulted in the nose wheel no longer contacting the ground (Figure 10). This is consistent with the furrow that was created just prior to the aircraft becoming inverted. It was noted that despite the deformation of the strut brace, the centre portion of the landing gear strut had remained straight, but that the strut had bent beyond the ends of the brace.

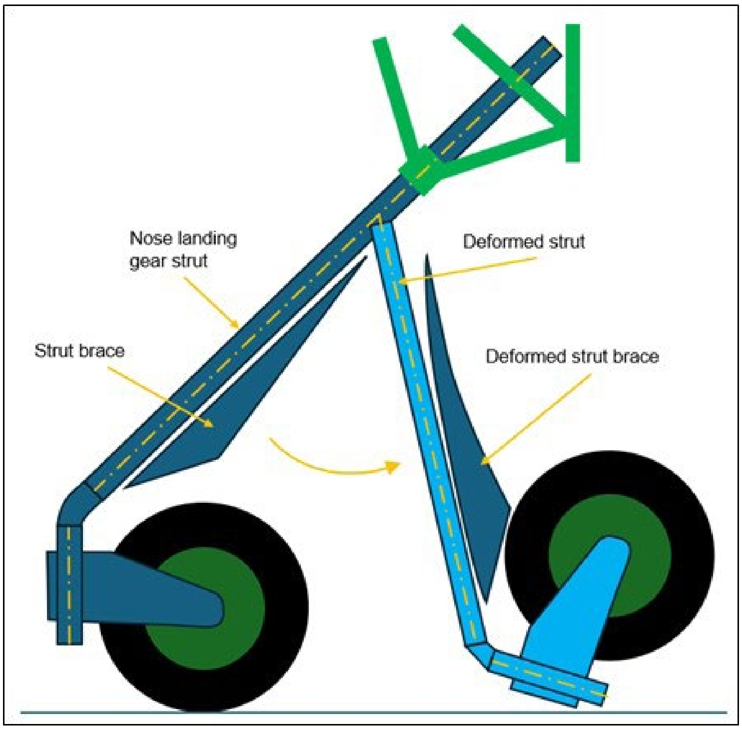

Figure 10
Deformation of the nose landing gear

Survivability

The RV-6A is available with a choice of two canopy types: a forward hinged and a sliding split canopy. G-RVSH was fitted with the sliding canopy with the forward part of the screen fixed and supported by a tubular steel hoop. During the structural inspection of the airframe, the deformation of the airframe and canopy was assessed to understand the change in the survivable volume for the pilot as the aircraft was inverted. When the aircraft was inverted it was resting on the front of the engine cowling and the vertical stabiliser. Analysis of the aircraft geometry showed that the top of the canopy would protrude approximately 35 cm above a line drawn between the engine cowling and the tip of the vertical stabiliser. The tip of the vertical stabiliser was damaged with a loss in height of approximately 5 cm.

Figure 11
Canopy frame deformation – note the pilot had been flying from the left seat

The shape of the steel hoop was examined and it was determined that the hoop had been deformed inwards and laterally to the right (Figure 11). From this it was concluded that as the aircraft became inverted, the left side of the canopy struck the ground first. The canopy continued to deform until the aircraft came to rest on the vertical stabiliser. There was evidence on the left wing tip of light abrasion and faint ground marks in the path of the tip indicating that just prior to the aircraft inverting, the left wing tip was touching the ground.

The pilot's seat belts had been cut by the first responders when he was removed from the aircraft, so it was not possible to determine how tight the shoulder straps had been. Anecdotal evidence suggested that if the shoulder straps were fully tightened it would not be possible for the pilot to reach the right side of the instrument panel and so it is possible that they may not have been tight enough to prevent the pilot moving out of the seat as the aircraft inverted.

The pilot's fatal injury was from a fracture of the cervical spine at the level of C3/4.

Meteorology

On the day of the accident, there was high pressure centred to the east of the country which would typically result in light winds and settled conditions. The actual reports from both Newquay airport to the north-east and RNAS Culdrose to the south gave light north-easterly winds at the time of the accident, with a temperature of 22°C at Newquay and 23°C at Culdrose.

A wind turbine on the airfield recorded a wind speed of about 3.25 m/s, or about 6 kt, at the time of the accident. The turbine did not record any parameters associated with the wind direction or orientation of the turbine nacelle. A video of the aircraft recorded by the airfield owner shortly after the accident showed the blades of wind turbines nearby to the north and north-east. Wind turbines are designed to face into wind and rotate clockwise when viewed from the direction of the wind. The turbines in the video indicated a wind direction from the north/north-east.

Sun position

At the time of the accident, the sun was in the south-west at an elevation of about 40° above the horizon, slightly below its maximum elevation of around 46° for that time of year.

Personnel

The pilot had held a PPL(A) since 1997 and had flown a total of 261 hours. The SEP (Land) rating had been revalidated by experience in March 2022. The pilot had completed a Pilot Medical Declaration (PMD) in May 2023 and 2021, with records indicating he had last seen an AME in 2019.

He had owned G-RVSH since 2015 and his total time on the Vans RV-6A type was 115 hours, with 7 hours flown since February 2023. He originally flew at Blackbushe Airport but had been based at White Waltham, a licensed airfield with grass runways, since 2016. His logbook showed that he had flown to a variety of airfields with both asphalt and grass runways. There was no evidence he had flown to Truro Airfield prior to the accident.

Eyesight

A PMD requires that a pilot meets the minimum DVLA eyesight requirements to drive[3]. This includes the requirement to have a minimum binocular visual acuity of at least 6/12[4]. The pilot would have met the eyesight requirements to make a PMD without the need for the use of corrective lenses.

Medical records from 2019 recorded that the pilot's uncorrected eyesight was 6/7.5 in the right eye and 6/24 in the left eye[5]. A medical examiner advised that his distant and intermediate vision would likely have remained stable, although his near vision may have further deteriorated with age (presbyopia). He assessed that the pilot likely experienced uncorrected binocular vision similar to 6/9; namely at 6 m he could view the same level of detail that a person with eyesight assessed as 6/6 can see at 9 m.

Footnote

[3] https://www.gov.uk/guidance/visual-disorders-assessing-fitness-to-drive#minimum-eyesight-standards--all-drivers [accessed July 2024].

[4] This is the measurement based on the Snellen scale.

[5] 6/6 is considered to be normal vision. With that vision, using only his left eye he would be able to see the same level of detail at 6 m which a person with uncorrected eyesight of 6/6 could see at 7.5 m. In the left eye, the pilot would only be able to see the same level of detail at 6m which a person with 6/6 could see when 24 m away.

Corrective glasses were found amongst the pilot’s personal possessions. It was reported to the AAIB that he had multiple pairs of glasses, including for flying and protection against the sun, and that he would wear glasses for driving at night but not necessarily during the day; he did not use reading glasses.

Figure 12 represents the vision of someone who had 6/9 binocular vision and illustrates the level of visual acuity and detail that the pilot was likely able to see on the approach had he not been wearing corrective glasses. A medical examiner stated that the pilot had mild short-sightedness where he “would not be able to see some small typeface on a PowerPoint presentation from the back of the lecture theatre.” However, the medical examiner stated that the pilot should have been able to identify the airfield, make a circuit and approach, and see the vehicles in the field, but perhaps not any people working on them when he was at the 500 ft agl. His vision would have made identification of the threshold numbers and runway from this point difficult due to the lack of contrast.

Figure 12

View of airfield as per Figure 1, with image refracted to approximate the pilot’s uncorrected eyesight (Note the comparison with Figure 1 might not be valid if viewed with low resolution devices or printed copies)

Other Information

G-RVSH performance data

No pilot operating handbook was found for G-RVSH, but flight test data of G-RVSH from 2016, following the fitting of a Hartzell constant speed propeller, recorded an unstick speed of 65 kt. A clean stall speed of 52 kt was recorded during the flight test for revalidation of the aircraft's permit to fly in April 2022.

RV-6A landing technique

The aircraft manufacturer's Build Manual (applicable to all RVs except RV-12/12iS)[6] provided the following guidance on landing technique:

> *'Make your approach speed 1.5 times the approach to stall speed you noted earlier, usually around 80-90 mph for a typical RV. The 80-90 mph approach is a little faster than ideal approach speed but will be best for the first landing attempt because it will permit more time to execute the landing flare.*
>
> *If you should accidentally hit hard enough to cause a sharp bounce back into the air, apply power and make a go-around for another landing attempt. Unless the runway is very long, it is probably better to start over rather than to try to salvage a bad landing out of an abnormal condition (bouncing back into the air at an unusual attitude or speed.)*
>
> *On tri-gear planes, land on the mains and hold the nose wheel off as long as possible. The nose wheel is taxiing gear, not landing gear. Keep the stick full aft while you taxi.'*

The LAA provide guidance on[7] the landing technique to be used for an RV6-A:

> *'It is also important to land the aircraft on the mainwheels first and hold the nosewheel off the ground during the initial part of the landing roll, rather than landing on all three wheels together which encourages wheelbarrowing and overloading the nosewheel.'*

The NTSB published Structures Study Case No: ANC05LA123 in July 2007 looking at the causes of multiple rollover accidents and incidents with the Vans RV-6A, RV-7A, RV-8A and RV-9A aircraft. In conclusion, they stated '*that the nose gear strut has sufficient strength to perform its intended function*' but there were several factors which could reduce the ground clearance of the wheel fork. This reduction in clearance could cause the strut to bend backwards during landing or taxiing and combined with aerodynamic loads, result in the aircraft nosing over.

Footnote

6 Section 15: Final Inspection And Flight Test, revision 9 dated 7 December 2023, https://www.vansaircraft.com/service-information-and-revisions/manual-section-15/ [accessed March 2024].

7 LAA type acceptance data sheet TADS 181A VAN's RV-6 & 6A. Issue 16 dated 2 March 2023.

Other Vans tricycle landing gear aircraft accidents

A review of the AAIB investigation database of all accidents involving Vans aircraft configured with tricycle landing gear was conducted, and the results filtered to only those in which the nose landing gear had been damaged. Further analysis was conducted to determine the landing surface, if the aircraft had bounced on landing, whether the AntiSplatAero mod was fitted and the type of canopy. Several of the AAIB reports refer to other accident reports and the LAA advice regarding holding off the nose landing gear for as long as possible. The list is included in Appendix A to provide a reference point for this type of accident at the time of publication. It is noted that this was the first fatal occurrence of this type of accident in the United Kingdom involving a Vans RV-6A.

Strip Flying

There are various open-source materials on the web or through apps that can assist with the identification of an airstrip and the hazards that may exist. In addition, the CAA has published a Safety Sense Leaflet 12 on Strip Flying[8]. This provides guidance to pilots on planning considerations and how to identify the hazards and manage the threats that may exist or the errors that may occur when landing at an airstrip.

The leaflet emphasises the importance of knowing the slope of a runway and explains how it can be calculated. It also highlights that:

> *'Most normal approaches in light aircraft are flown at around a 4° angle, but some strips may require more than this to land in the available space. Steep approaches and/or 'short field' takeoffs and landings require different techniques from normal and should be practised with an instructor who is familiar with strip operations.'*

It further emphasises that:

> *'The speeds and approach profile need to be very accurately flown. Landing distance required is very sensitive to technique – crossing the threshold too high or a 10 kts increase over the optimal speed may go unnoticed at a normal aerodrome, but at a strip you may not stop in the available distance.'*

The leaflet also provides 'Recommended Performance Factors' to be applied to the landing distance required. These include increases for temperature, long grass, aerodrome elevation, slope and tailwind component. When applied, these factors typically increase the overall landing distance required by affecting the energy at the point of touchdown and the rate in which that energy is dissipated through braking and the effects of the landing surface.

Footnote

8 CAA Safety Sense leaflet 12, Strip Flying, Safety Sense 12 - Strip Flying (caa.co.uk) [accessed March 2024].

Effect of Slope on pilot perception

A slope on the runway will alter the pilot's visual perception of the aircraft's approach path angle. A downhill slope has the effect to make the approach appear flatter than the actual flight path flown. This can be interpreted by the pilot that the aircraft is lower than it actually is; as a result, there is a tendency to fly a steeper approach and land long.

Analysis

Overview

The pilot of G-RVSH made an approach to Runway 14 at Truro airfield offset by about 20 m to the right of the edge of the runway. The aircraft landed deep and off the runway. There was evidence that at, or shortly after touchdown, the nose landing gear wheel was in contact with the ground. Ground marks indicated that the nose wheel fork dug into the ground, causing the nose landing gear strut to bend and resulting in the aircraft coming to rest inverted. There was some evidence that the left wingtip contacted the ground which either coincided with the right landing gear wheel running over the edge of a small mound or when the nose landing gear deformed. The canopy struck the ground when the aircraft rolled over and was significantly deformed above where the pilot was seated, causing the pilot to sustain a fatal neck injury.

Strip flying

The CAA has published guidance to pilots for operating to or from landing strips in Safety Sense Leaflet 12. The appearance of grass runways and the contrast between them and the surrounding field will vary depending upon the time of year and can be influenced by how recently the grass has been cut. This can present a challenge for the correct identification of the location of the grass runway. Furthermore, any obstacles in adjacent fields may be temporary.

Whilst the pilot had operated routinely from White Waltham, and to other grass airfields, each grass airstrip presents their own unique challenges. These demand appropriate planning and continued risk assessment by the pilot to determine whether it is appropriate and safe to land, especially if the pilot is landing at a strip for the first time.

The investigation could not establish the degree of pre-flight planning the pilot had conducted to land at Truro, apart from the phone call with the airfield owner.

Choice of runway

The choice of runway seems to have been in contradiction to the recommendation given over the phone by the airfield owner. However, it has not been possible to determine why the pilot elected to land in the direction of Runway 14.

There may have been an expectation that the wind favoured a landing on Runway 14, set by the earlier phone call made by the pilot to the airfield owner. While the pilot flew past the airfield to the left of Runway 14, his view of the runway and the windsock may have been limited since he was in the left seat. It is possible that, had the pilot been able to see the windsock clearly, he would have interpreted that the wind was mainly a cross wind from the left. However, he may not have recognised that there was also probably a slight tail wind. This likely difference of interpretation between the pilot and the airfield owner would have been due to the differing perspectives from which each viewed the windsock. Consequently, the recce may have confirmed the pilot's expectation and contributed to his decision to land on Runway 14.

It could not be ascertained whether the pilot had consulted a guide providing airfield information. While the slope at the threshold end of the Runway 32 was likely to have been obvious to the pilot, the downward slope on Runway 14 may not have been discernible to him from the air. It is, therefore, possible that he had not considered slope in his decision to land on Runway 14.

Alignment with the runway

Whilst the investigation could not determine if the pilot had been wearing corrective glasses at the time of the accident, it concluded that it was reasonable to presume that he was. However, the investigation explored whether his eyesight may have been a factor which contributed to landing off the runway had he not been wearing glasses at the time of the accident.

Figure 12 indicates that his uncorrected vision would not likely have affected his ability to discern the airfield. However, it would likely have made identification of the threshold numbers and runway difficult due to the lack of contrast seen from the 500 ft point.

The loss of colour and texture from the mowing of the grass of the runway and the harvesting of the field, along with tramlines formed when harvesting, would have reduced the clarity of the cues available to discern the actual runway. This may have led to confusion by the pilot. The hay bales to the left of the runway may also have influenced the pilot to align to the right of the actual strip and for him to believe he was landing on the actual runway.

The AAIB also considered whether the sun position may have had an influence on the ability for the pilot to discern the actual runway strip. However, the sun was to the right as the pilot made the approach and just passed its zenith in the sky. It is not considered that the sun and light levels at the time of the accident would have resulted in glare or diminished the contrast between the runway strip and the field in which it was situated.

Touchdown point

The approach data indicates the pilot started his approach at about 90 kt and gradually reduced it to about 65 kt at the start of the flare. The higher speed at the start of the approach would have required an increased rate of descent to be able to commence the flare at the threshold of the runway. The higher speed probably contributed to the pilot starting the flare approximately a fifth of the way down the runway.

The Flight Path Angle (FPA) is a correlation of approach speed and rate of descent. Throughout the approach the FPA was steeper than the 4° that is normally flown by light aircraft. The downslope of the runway likely contributed to the steeper approach, although it would have looked normal to the pilot. The result would have been extra energy at the start of the flare. The presence of a light tailwind would also have added to this extra energy. At the point of the flare, this extra energy probably resulted in float or ballooning and, consequently, the aircraft landing further along the runway length than normal.

Whilst the witnesses stated they saw the aircraft bounce, it was unlikely they would have been able to actually see the aircraft's wheels touch the ground from their position, and they may have interpreted a float, or even a ballooning of the aircraft, as a bounce. The absence of ground marks prior to the touchdown point suggests the aircraft did not bounce, although it could not be determined from the data whether the aircraft floated, ballooned or bounced. The data shows an unstable flare with a decrease in vertical g associated with a pitch down suggesting a "bunt" (Figure 5, point A), followed by a pitch up and further pitch down just prior to touch down. This corresponds with the evidence of the start of the tyre tracks.

If a pilot is faced with an unstable approach or landing, the advice is to go-around. The manufacturer states:

> *'…it is probably better to start over rather than to try to salvage a bad landing out of an abnormal condition…'*

Nose over

Both the aircraft manufacturer and the LAA documentation for this aircraft type highlight the need to keep the nosewheel off the ground on landing. The aircraft manufacturer's documentation emphasised *'the nose wheel is taxiing gear, not landing gear'*, while the LAA documentation highlights the risk of wheelbarrowing and overloading the nosewheel. There was strong evidence that all three wheels were in contact with the ground at the point of landing and throughout the ground roll. This would have increased the load on the nose gear and increased the risk of the aircraft becoming inverted.

At the point that the aircraft began to nose over, it would not have decelerated to the same extent as it would have if it landed on the runway. In addition, there were other performance factors present due to the slope and tailwind, as well as the airfield elevation and temperature. These would not only have likely affected the energy of the aircraft at the start of the flare but also reduced the rate of deceleration of the aircraft during the landing roll.

Nose over events of this aircraft type have not typically resulted in a fatal outcome. Tight shoulder harnesses reduce movement of the occupant and possible contact with the canopy or other areas within the cockpit. The combination of the level of energy at the point that G-RVSH nosed over, and the deformation of the canopy's steel hoop likely contributed to the fatal outcome. The degree to which the shoulder harnesses were fully tightened could not be determined.

Conclusion

The aircraft landed deep and 20 m to the right side of Runway 14, and the evidence indicated that it touched down on all three wheels. As a consequence, the nose wheel dug in, the strut deformed, and the aircraft rolled over onto its canopy.

The investigation did not determine why the aircraft landed deep and off the runway to the right. There were a number of factors that led to the aircraft's energy being sufficient for the aircraft to nose over, and the canopy being significantly deformed.

Safety Actions

Following the accident, the following safety actions have been taken:

- The airfield owner has instructed the farmers to remove the hay from the airfield as soon as it is baled and not to store it on the airfield.
- The airfield owner has provided additional guidance in the Pooley's Plate on which runway to use depending upon the wind conditions.
- The airfield owner has removed the training mound.

Appendix A

AAIB investigations of Vans aircraft with tricycle landing gear which damaged the nose landing gear

Aircraft Reg	Type	Location	Event Date	Event description	Surface	Inverted	Bounce	Speed	Nose strut brace fitted	AAIB safety comment
G-RUSL	RV-6A	Westonzoyland Airfield, Glastonbury	03/09/2023	Made a heavy landing, bent the nosewheel which dug into the ground and the aircraft flipped over.	Grass	Yes	Yes	Roll out	Yes	No
G-RVSH	RV-6A	Truro Airfield, Cornwall	03/09/2023	Aircraft turned over on landing – see above.	Grass	Yes	Yes	Landing	Yes	Yes
G-RVCE	RV-6A	Rendcomb airfield, Gloucestershire	13/08/2023	After landing nose wheel dug in and aircraft flipped over	Grass	Yes	Yes	Landing	Unknown	No
G-RVEE	RV-6A	Eshott Airfield, Northumberland	09/07/2022	Aircraft flipped on landing.	Grass	Yes	No	Landing	Unknown	No
G-CKTF	RV-6A	Holmbeck Farm, Leighton Buzzard, Bedfordshire	08/08/2020	Aircraft turned over on landing.	Grass	Yes	Yes	Landing	Unknown	No
G-CKTF	RV-6A	Stapleford Aerodrome, Essex	31/03/2019	Taxiing on soft ground the nose wheel collapsed causing aircraft to tip forward.	Grass	No	No	Taxi	No	No
G-CCVS	RV-6A	Old Sarum Airfield, Wiltshire	15/08/2017	Nosewheel collapsed on landing, dug in and aircraft became inverted.	Grass	Yes	Yes	Landing	Yes	Yes
G-CCVS	RV-6A	Sywell, Northampton Airfield, Northamptonshire	02/09/2011	Aircraft appeared to touch down heavily and bounced before coming to a halt.	Grass	No	Yes	Landing	Yes	No
G-RVSA	RV-6A	Fishburn Airstrip, Co. Durham	30/08/2008	Nose wheel hit ground and aircraft flipped over on landing.	Grass	Yes	Yes	10 kt	Yes	No
G-RVPW	RV-6A	Netherthorpe Airfield	07/06/2008	Nose gear collapse on landing.	Grass	No	No	25 kt	Yes	No
G-EDRV	RV-6A	Northampton (Sywell) Aerodrome	29/10/2006	Nose gear collapse on landing.	Grass	No	Yes	25 kt	Yes	Yes
G-RVCG	RV-6A	Wellesbourne Mountford	01/09/2004	Nose gear collapse on landing.	Hard	No	No	Touch and go	Unknown	Yes
G-BVRE	RV-6A	Barton - Manchester Rwy 32	21/04/2001	Nose gear collapse on landing.	Grass	No	No	Roll out	Unknown	No
G-HOPY	RV-6A	Dunkeswell Airfield Nr Honerton, Devon EX14	04/09/1999	Nose gear collapse on landing.	Hard	No	Yes	Landing	Unknown	No

Appendix A cont

Aircraft Reg	Type	Location	Event Date	Event description	Surface	Inverted	Bounce	Speed	Nose strut brace fitted	AAIB safety comment
G-ELVN	RV-7A	Drayton St Leonard Farm Strip, Oxfordshire	21/05/2019	Nose gear collapsed on landing.	Grass	No	Yes	Landing	Yes	No
G-ELVN	RV-7A	Sywell Aerodrome, Northamptonshire	12/08/2017	Nose gear collapsed on landing.	Grass	No	Yes	Landing	Yes	Yes
G-IIRV	RV-7A	Goodwood Aerodome (Chichester), West Sussex	31/05/2014	Nose gear collapsed on landing.	Grass	No	No	Landing	Unknown	No
G-MROD	RV-7A	Sittles Farm Strip, Lichfield, Staffordshire	08/11/2009	Aircraft probably stalled on landing, nose gear dug into soft ground and gear leg bent.	Grass	No	No	Landing	Yes	No
G-CDRM	RV-7A	Crofts Farm, 10 miles north of Gloucester	09/06/2007	Nose gear dug in during landing and aircraft flipped over.	Grass	Yes	Yes	Roll out	Unknown	No
G-HCCF	RV-8A	Old Sarum Airfield, Wiltshire	21/02/2018	Aircraft flipped over on landing.	Grass	Yes	Yes	Roll out	Unknown	Yes
G-RVCH	RV-8A	Cranfield Airfield, Bedfordshire	08/09/2012	Nose gear leg collapsed on landing.	Hard	No	Yes	Roll out	No	No
G-CGXR	RV-9A	Kirkbride Airfield, Cumbria	15/08/2020	Nose gear collapsed on landing.	Hard	No	Unknown	Landing	Unknown	No
G-CFMC	RV-9A	Yeatsall Farm Strip, Abbots Bromley, Staffordshire	29/07/2019	On rollout aircraft suffered collapsed nose gear leg.	Grass	No	Unknown	Roll out	Unknown	No
G-RPRV	RV-9A	Nympsfield Airfield, Gloucestershire	23/08/2016	Nose gear collapse on landing and the aircraft inverted.	Grass	Yes	Yes	20 kt	Yes	Yes
G-XSAM	RV-9A	Old Sarum Airfield, Wiltshire	18/09/2015	Nose gear collapsed on landing.	Grass	No	No	Roll out	Yes	Yes
G-CGXR	RV-9A	Carlisle Airport, Cumbria	24/07/2013	Nose gear collapsed on landing.	Hard	No	Yes	Landing	Unknown	No
G-HUMH	RV-9A	Runway 25, Shoreham Airport	22/05/2009	Nose gear collapsed on landing.	Grass	No	Yes	Landing	Unknown	No
G-CDMF	RV-9A	Oaksey Park Airfield, Wiltshire	02/09/2007	Aircraft bounced on landing, nose gear dug in and aircraft tipped over.	Grass	Yes	Yes	Landing	Unknown	No
G-CCZY	RV-9A	Caernarfon Airfield	24/02/2007	Nose gear collapsed on landing.	Hard	No	Yes	Landing	Unknown	No
G-CCZT	RV-9A	Bicester Airfield, Oxfordshire	14/04/2005	Nose gear damaged on landing.	Grass	No	Yes	Roll out	Unknown	No

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