Accident

Aircraft Type and Registration:	Quik GT450, G-CEVW	
No & Type of Engines:	1 Rotax 912ULS piston engine	
Year of Manufacture:	2007 (Serial no: 8314)	
Date & Time (UTC):	17 May 2023 at 1215 hrs	
Location:	Lundy Island Airfield, Bristol Channel	
Type of Flight:	Private	
Persons on Board:	Crew – 1	Passengers – None
Injuries:	Crew – Minor	Passengers – N/A
Nature of Damage:	Extensive damage to wing and airframe	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	59 years	
Commander's Flying Experience:	134 hours (of which 107 were on type) Last 90 days – 11 hours Last 28 days – 9 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The pilot encountered significant control difficulties soon after takeoff. He was able to manoeuvre to return to Lundy Island but had great difficulty in controlling the aircraft, particularly in pitch. Control was lost close to the ground and the aircraft was extensively damaged in the touchdown. The pilot was taken to hospital by air ambulance but was discharged the same day having sustained only minor injuries.

The loss of a securing bolt had caused the roll bearing to move aft along the wing keel. This altered the trim of the aircraft inducing a significant nose-up pitch that was only marginally controllable.

History of the flight

The aircraft departed Park Hall Farm Airfield, near Nottingham, on the morning of the accident and flew to Lundy Island with a flight time of 2 hours 45 minutes landing at 1040 hrs The pilot stated that there were no issues with the aircraft, a Quik GT450 (Figure 1), during the flight from Nottingham to Lundy Island and that the weather was fine throughout. He refuelled the aircraft with approximately 20 litres of unleaded petrol as this would allow him to avoid a refuelling stop at Porthcawl on the return flight. The aircraft spent approximately 1 hour 35 minutes on the ground before departure for the planned return flight to Park Hall Farm Airfield.

Figure 1
Quik GT450

The aircraft took off from RWY 24 at approximately 1215 hrs and the pilot described that shortly after getting airborne the aircraft pitched up and the airspeed reduced. The pilot pulled the control bar rearwards to try and lower the nose as he was concerned about stalling the aircraft. He described the control forces as being much higher than normal. The pilot decided to return and land on Lundy Island and so commenced a left turn at approximately 300 ft agl. He selected the trim to fully nose down but this had no effect on the attitude or the control loads which the pilot now described as “extreme”. The speed remained low with the control response slow and heavy.

The aircraft turned through approximately 270° and flew north along the west coast of Lundy Island until abeam the airfield (Figure 2). The pilot then flew over the airfield and made a left turn to position for an approach to RWY 24. During these manoeuvres the pilot described control forces so high that he had to wedge the control bar under his arms to sustain the load. The pilot made a wide slow left turn to final approach for RWY 24. During the turn the aircraft came very close to the ground and the pilot added power to regain height. He described the final stages of the approach as follows:

> ”When I was ‘sort of’ lined up I pulled the bar in as much as I could and took the power off, and the nose dropped and I gained speed, but the line-up was poor,

to the left, due to the sluggish response to control. I let the bar out a little to flare, and rolled to the right to improve my line-up, although this left me heading off the strip to the right. I was just a few feet up, heading off right, and it felt too fast but I was aware the ground dropped away at the end of the strip, to a cliff edge, and my arms/hands were barely able to keep the bar back in a flying position making going around probably not possible, so I pulled in again just as I left the side of the strip and hit the ground hard, stopping almost immediately."

After the heavy touchdown the pilot heard the engine revving so he turned off the magnetos and electrical master switch and closed the fuel cock before releasing his harness and exiting the aircraft. Lundy Island staff were quickly on scene to assist the pilot and they called the Emergency Services. The pilot was taken to hospital by air ambulance due to concerns for a broken elbow but was discharged after examinations confirmed he had suffered only bruising.

Figure 2
Aircraft track

Accident site

The AAIB did not attend the accident site but was provided with images of the aircraft taken shortly after the accident. The aircraft had come to rest upright, north of the landing strip, but the wing had been destroyed. The nose landing gear had also collapsed.

The aircraft was disassembled and transported by ferry to the mainland by a third party on 22 June 2023.

Figure 3

G-CEVW after the accident (reproduced with permission)

Airfield information

The accident occurred at Lundy Island Airfield. It has a grass runway 400 m long orientated 060/240°. Details are shown at Figure 4.

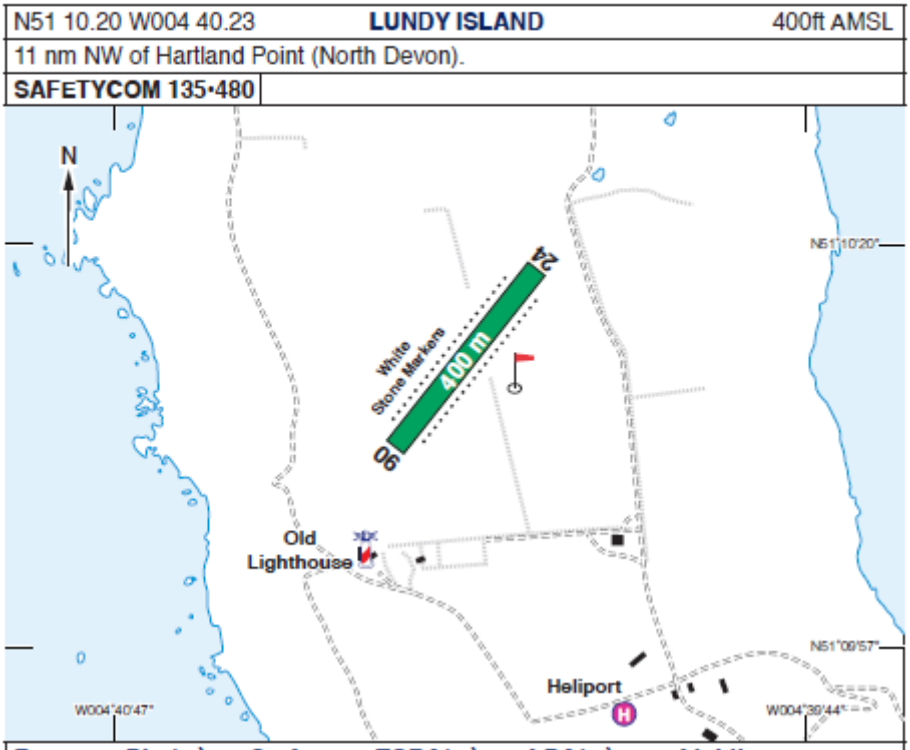

Figure 4

Lundy Island Airfield information

Aircraft information

The P&M Quik GT450 is a two-seat weight shift controlled flexwing microlight with maximum all up weight of 450 kg (Figure 5). The aircraft consists of a wing and trike connected by a front strut and pylon to the hang bracket located on the wing keel tube (Figure 6).

The wing is of tubular aluminium construction with the aerofoil section defined by pre-formed aluminium and pre-formed aluminium/composite ribs and a fabric skin. The skin consists of a Trilam sandwich leading edge, a Kevlar trailing edge and a spanwise Kevlar tape. The remainder of the wing sail fabric is polyester fabric.

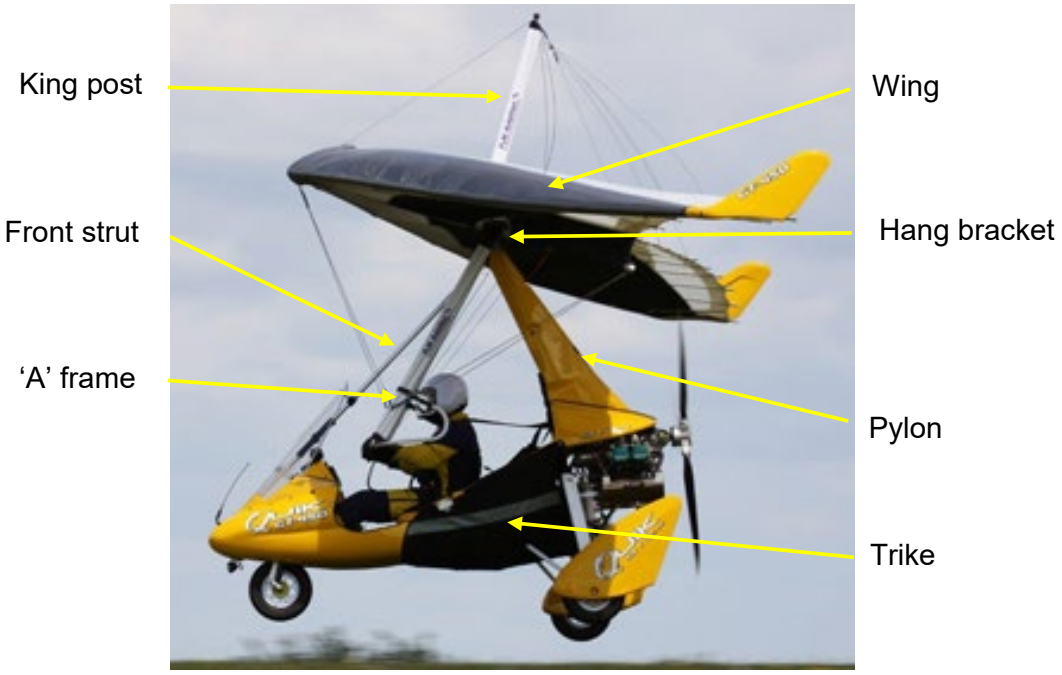

Figure 5
P&M Aviation GT450

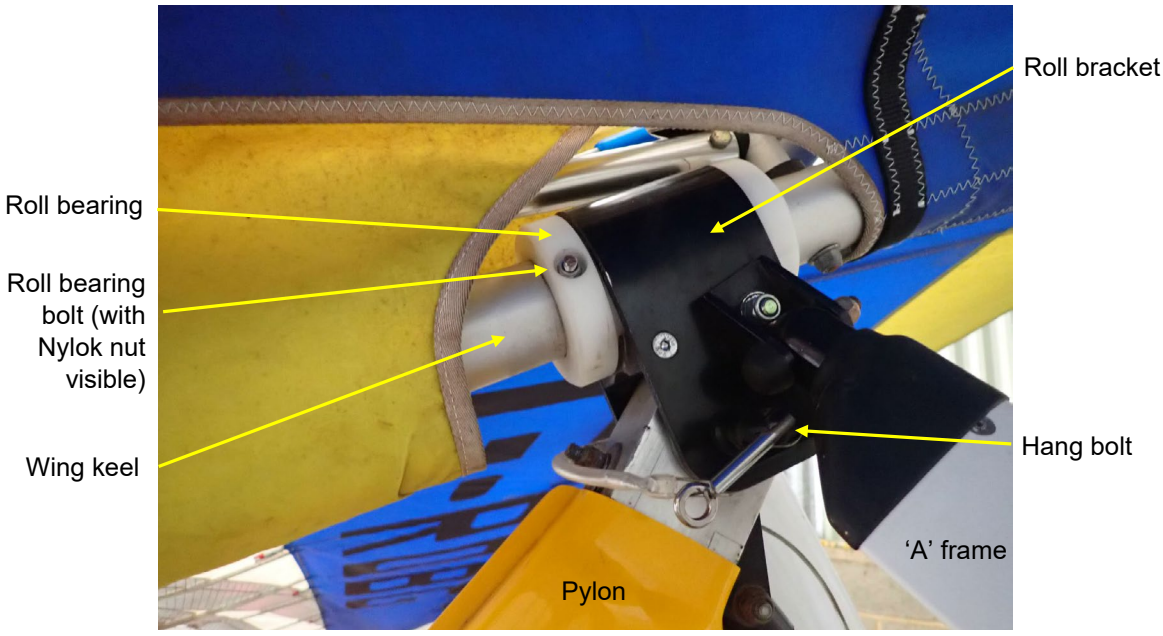

Figure 6
GT450 wing keel and hang bracket viewed from the right

The main structure of the trike is of square section high strength aluminium alloy tube, on which a rigid composite tandem seat is located. The trike has a tricycle landing gear; the nose landing gear of which is steerable. A Rotax 912 engine with a fixed pitch three-bladed propeller is fitted to the rear of the trike.

The pilot controls the microlight through an 'A' frame, which consists of a basebar connected to the wing keel tube by two uprights and a number of wires. Under normal conditions, the pilot controls the pitch of the wing by moving the base bar forward to pitch up or rearward to pitch down. Roll is controlled by moving the basebar to the left to roll right and to the right to roll left. Essentially, the movement of the basebar moves the weight of the trike in the direction of intended travel.

The trike is connected to the hang bracket through the hang bolt, about which the wing pitches. A roll bearing is incorporated in the hang bracket assembly and allows the wing to roll in relation to the trike. The roll bearing consists of a cylindrical nylon inner journal which is fixed to the wing keel tube with a single M6 caphead bolt and Nylok nut. This runs against the roll bracket and spacer block.

The GT450 incorporates an electric trim system. An electric winch, mounted to the pylon and controlled by a pilot operated switch on the throttle box, acts on an arrangement of bungees and cords connected to a bracket on the wing keel. The bracket is approximately 300 mm aft of the roll bearing. With the cord wound in fully the wing is pitched up in the 'slow' configuration and, with the cord wound out, the wing is in the 'fast' configuration.

The aircraft was first registered in September 2007 and had completed 371 hours at the time of the accident. The aircraft's Permit to Fly was valid and had been revalidated by a BMAA inspector on 1 March 2023. The aircraft had flown 8 hours and 30 minutes since the permit revalidation.

In March 2022 the wing was stripped and rebuilt for its 500 hour / 4 year assessment. Once the wing had been re-fitted to the trike, a permit revalidation inspection was completed. During the inspection it was noted that an incorrect nut was fitted in the bottom of the king post. This was rectified and the aircraft's permit was revalidated. No work was recorded as having been completed on the wing or hang bracket after the 2022 permit revalidation.

Aircraft examination

The aircraft components were examined by the AAIB at the third party's storage facility.

The trike's nose landing gear frame had sheared at its bearing. The direction of the failure was in line with its longitudinal axis and associated with the heavy landing on the nose.

The trim mechanism was in the full fast / nose-down position, commensurate with the pilot's recollection.

The wing was destroyed. Most of the wing structure was deformed or fractured. The sail material had ripped in numerous locations, associated with the wing structure damage.

A series of rips and bunched fabric was noted on the keel pocket (Figure 7), indicating that the hang bracket had moved rearward along the wing keel.

Figure 7

Underside of G-CEVW wing material showing rips around the keel beam pocket

Examination of the wing keel confirmed that the roll bearing had migrated rearwards. The M6 cap head bolt, which retained the roll bearing in position, and its associated Nylok nut were missing and were not recovered. Fretting was observed on the bolt head side of the bushing through which the bolt would have passed through the wing keel (Figure 8). The trim cable attachment bracket was deformed and the inner diameter of the roll bearing had worn, indicating that the roll bearing had moved rearwards down the wing keel and struck the trim attachment bracket during flight (Figure 9).

Figure 8

Wing keel bushing showing fretting around bolt hole

Figure 9

Roll bracket bearing showing witness marking from contact with trim bracket

Weight and balance

The aircraft was below the weight limit of 450 kg at the time of the accident. By the nature of the aircraft design, there are no balance limits.

With a rearward movement of the hang-point of approximately 300 mm, it was estimated that a rearward force of approximately 300 N (30.59 kg-force) would need to have been applied to the control bar to remain straight and level.

Analysis

The investigation was not able to positively determine the exact time that the roll bearing bolt separated from its intended location. No work had been conducted on the wing assembly since the Permit to Fly revalidation in March 2022. That Permit to Fly had a further revalidation in March 2023 and the aircraft had flown 8 hours 30 minutes since that examination. It is likely that the roll bearing bolt was present at the date of the revalidation. As there is no other means of restraining the roll bearing position apart from the bolt, the investigation considered it probable that the bolt separated from the aircraft during the takeoff for the accident flight.

The pilot conducted the pre-flight checks as specified in the POH, but the roll bearing bolt was not a specific item in the checklist and he could not be certain if it was present at the time of the walk-around checks. The taxi-out and takeoff roll were entirely normal, but shortly after becoming airborne the aircraft pitched up and the speed reduced. Concerned about a stall the pilot made a control movement to lower the nose. The pilot described the control loads as much higher than normal and he had significant difficulty in controlling the aircraft.

The examination of the aircraft indicated that the trike hang-point had moved aft by 300 mm and this would have induced a significant pitch up tendency in the aircraft. Calculations by the manufacturer estimated that it would require a pull force of approximately 30 kg on the pilot's control bar to overcome the induced pitch-up tendency. This is far more than the usual loads and proved almost unsustainable for the pilot despite the short flight time. At some points the pilot had to hook the control bar behind his elbows to enable him to exert the requisite force and his capacity to accurately control the aircraft was severely diminished. He decided to return immediately to the airfield but even during the short flight had great difficulty in maintaining a safe flightpath. The pilot recognised that his approach to the airfield was not accurately aligned with the runway but felt that due to the high control loads he would not be able to execute a go-around. With the airspeed higher than ideal the pilot was also concerned that endeavouring to better control the landing would cause him to overrun the airfield towards ground that sloped down to a cliff edge. He therefore accepted the poor alignment and the high speed as more survivable. The aircraft touched down heavily and stopped very quickly but the pilot was able to leave it without assistance.

Conclusion

The trike roll bracket slid aft by approximately 300 mm due to the loss of the securing bolt. This induced very large pitch control loads for the pilot which jeopardised safe control of the aircraft. The pilot was able to return to the airfield but control was lost during landing and the aircraft was extensively damaged. The pilot was able to extricate himself from the aircraft and sustained only minor injuries.

Safety action

Following this accident, the manufacturer issued Service Bulletin (SB) 160 with the text below:

'INTRODUCTION

An accident to a GT450 was caused by the 6mm keel roll bearing CG cap head bolt coming out, allowing the roll bearing, hang bracket and control frame top to move back causing a severe pitch up.

ACTION

An additional daily inspection check item has been introduced to specifically inspect that the bolt is present and secure before flight.

The roll bracket assembly must be inspected to ensure it moves freely on the roll bearing and that the bearing is not loose on the keel. Nylon roll bearings (dark colour) can swell with moisture over the years, causing friction which puts more stress on the CG bolt and keel hole.

Genuine replacement roll bearings are made from Acetal (bright white colour) which is not so affected.

If not already fitted, it is strongly recommended to fit the longer bolt, item 13, part no. FCM6-80 with securing M6 T type Nylok nut, item 10, part no. FNM6-NT.'

The manufacturer also introduced, via SB 160, a clamp that is fitted to the wing keel aft of the roll bearing to prevent its rearward movement in the event of a roll bearing bolt failure or loss.

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