ACCIDENT

Aircraft Type and Registration:	Europa XS, G-REJP	
No & Type of Engines:	1 Rotax 912ULS piston engine	
Year of Manufacture:	2007 (Serial no: PFA 247-14086)	
Date & Time (UTC):	25 November 2021 at 1305 hrs	
Location:	Nuthampstead Airfield, Hertfordshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Fractured fuselage, damaged propeller and main wings twisted on spar	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	63 years	
Commander's Flying Experience:	1,413 hours (of which 5 were on type) Last 90 days - 19 hours Last 28 days - 6 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

A significant left yawing tendency during the aircraft's takeoff roll resulted in the pilot rotating the aircraft early to avoid a lateral runway excursion, probably causing the wing to stall. The aircraft than struck a raised earth bank.

The report considers rule-based takeoff decision making, rejected takeoff considerations, and methods for self-briefing those items before departure.

History of the flight

The pilot reported that after applying full power to depart from Nuthampstead Airfield's grass Runway 05, the aircraft yawed left "slightly more than usual". He countered it with right rudder and brake, expecting rudder would compensate for the yaw as airspeed increased. However, later in the takeoff roll, even with full right rudder and right brake applied, the aircraft began departing left of the runway surface (Figure 1).

The pilot described reaching a "critical point" whereby to avoid damage related to a runway excursion, and with the aircraft "nearing its takeoff speed", he stopped applying right brake and rotated the aircraft into the air. It became airborne briefly but touched down adjacent to the runway and struck a raised earth bank.

Airfield information

Pilots describe Nuthampstead's runway as *'well-maintained'* but *'known to get waterlogged after several days rain'.*

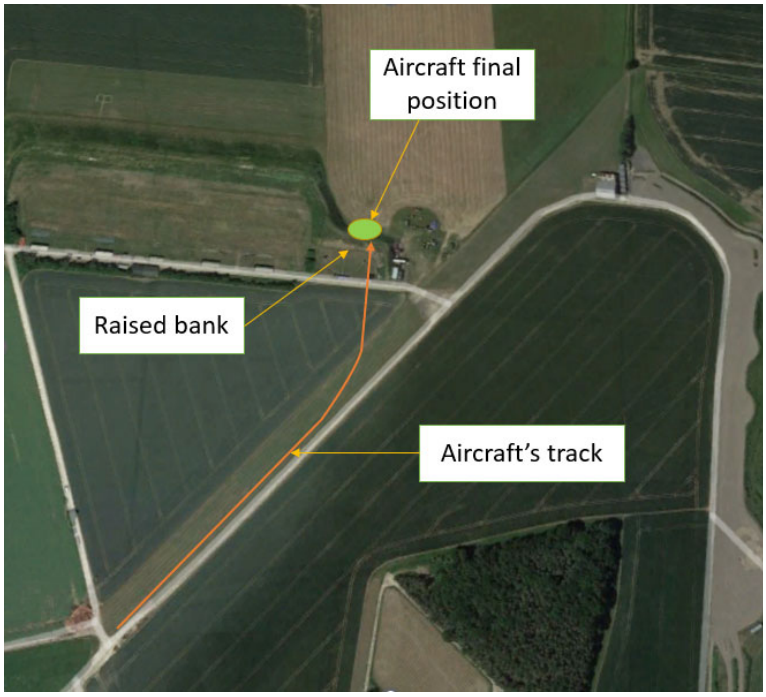

Figure 1
Approximate track for accident takeoff

Meteorology

Information from the pilot and weather reports from three adjacent aerodromes indicated that the wind at Nuthampstead at the time of the accident was from 340° at 10-11 kt.

Reports from those aerodromes showed intermittent periods of fog and mist, and drizzle and light rain, during the six days prior to the accident. Temperatures mainly varied between 2° and 7°.

Aircraft information

The Europa XS Trigear is a two seat homebuilt aircraft, with fixed main and nose landing gear. Its maximum gross weight is 621 kg.

The *'Europa XS Trigear Owners Manual'*[1] described the *'normal take off procedure'* as follows.

> *'Open throttle smoothly and keep the aircraft tracking straight with rudder pedals (be prepared to apply right rudder to counter blade effect).*

Footnote

[1] Issue 6, July 2012

The take off run should be commenced with the stick slightly aft of neutral to reduce the load on the nose wheel. Once elevator control has been achieved, which will be at about 30 - 35 kts, the nose can be raised slightly followed by a positive rotation at 50 kts…'

The *'Cross wind take off'* section stated:

'The Europa has quite a small, round, rear fuselage, a fairly small fin, and a powerful rudder.

The demonstrated cross wind component of the aircraft is 15 kts. With the Rotax engine fitted, which turns the propeller clockwise as viewed from the cockpit, the effect of engine torque, the rotating prop wash and gyroscopic precession of the propeller makes a cross wind from the port side the worst case[2]. If the wind is at 90° to the runway, take off with the wind from the right.

Be prepared to use substantial differential braking to keep the aircraft straight in the early part of the takeoff run.

Practice your cross wind takeoffs and landings on a wide runway and ***gradually*** *build up your experience.*

Europas have been operated in cross winds greater than 20 kts but pilot skill and experience is very important. Find the cross wind limit that you are comfortable with and stick to it.'

The *'Short or rough field take off'* section stated:

'…Do not try to fly the aircraft off the ground before flying speed has been reached. On a rough field where the aircraft is being thrown into the air by undulating ground, resist the temptation to over rotate. This will simply stall the main wing, create increased drag and slow down or even stop the acceleration. By trying to force the aircraft off the ground too early the takeoff distance can easily be doubled and in the worst case extended indefinitely.'[3]

The investigation did not determine if there was a pre-existing technical fault with G-REJP.

Information from the pilot

Additional information relating to the accident flight

The pilot reported he did not consider rejecting the takeoff. He rotated the aircraft and lifted off at 45 KIAS. He observed that G-REJP's airspeed indicator was of a different style than he was used to, which he found difficult to read as the aircraft accelerated on the runway.

Footnote

[2] For a propeller rotating clockwise as viewed from behind, 'prop wash' and gyroscopic precession cause left yaw, and engine torque increases the effective load on the left main landing gear. A port cross wind creates a yawing moment left, into wind.

[3] The text in this paragraph was already italicised in the original document.

The pilot stated that while inspecting the aircraft the following day he found no apparent obstruction in the rudder system. Muddy tyre tracks on the runway indicated the left main wheel had "not been rolling properly". He wondered if the left brake had been binding, but the subsequent damage prevented a determination.

He recalled the grass runway surface being damp but firm.

Relevant experience

The pilot stated he had owned the aircraft for around a month. Most of his flying experience was on a Mooney M20J[4], including operating from grass runways. He had completed 20 takeoffs and landings in G-REJP, including circuits at Nuthampstead on 23 November. He performed some of those flights with an LAA instructor.

The pilot had held a PPL since 1988 and could not recall receiving any training relating to takeoff decision making, rejected takeoffs (RTOs), or briefing[5,6] those prior to departure. He said he habitually self-briefed before departure his intended actions for an engine failure after takeoff and, for instrument departures, his planned departure route.

Takeoff decision making

Regulatory information from the CAA

The CAA's guidance document *'Class, Type and Instrument Rating Skills Tests and Proficiency Checks…'* for single pilot aeroplanes[7] included the following information in *'Abnormal and Emergency Procedures'*:

> *'Rejected takeoff… Recognise a situation where the safest course of action is to reject the takeoff… Take appropriate actions to stop safely within the remaining runway; inform ATC… Consider and demonstrate/discuss appropriate actions following RTO (e.g. engine shut down, evacuation, precautions for hot brakes etc).'*

The corresponding CAA *'Examiners Report…'* form[8] specified that an assessment of a *'Rejected Takeoff at a reasonable speed'* was a mandatory element of the check.

The CAA's policy and guidance document on *'LAPL and PPL Skill Test (Aeroplanes)'*[9] stated:

> *'…the applicant will be required to perform a rejected take-off… Shortly after the applicant starts his take-off run, the examiner will announce some form of emergency…; the applicant will be expected to discontinue the take-off and*

Footnote

4 A 4-seat aircraft with a maximum weight (takeoff and landing) of 1243 kg.
5 Departure briefing – Carried out prior to takeoff, and can include pertinent threats, weather, planned departure, emergencies and takeoff decision making.
6 While briefings are often performed in multi-crew operations, they are useful for preparation and rehearsal in single pilot settings, even if they are not vocalised.
7 Standards Document 14 v7_Nov 2014.pdf [accessed 3 March 2022]
8 SRG1157.fm (caa.co.uk) [accessed 24 March 2022]
9 Standards Document 19(A) v9.pdf [accessed 24 March 2022]

bring the aeroplane smoothly to a halt using all of the remaining runway without harsh use of the brakes; any appropriate touch drills should be completed and any radio calls should be made 'in cockpit' to the examiner.'

The CAA's webpage on *'Single engine piston rating for aeroplanes'*[10] explained that, to revalidate the rating, a pilot must either pass a proficiency check or complete 12 hours of flight time in a relevant aircraft within specified time periods; the 12 hours of flight time to include a training flight of at least one hour[11] with a flight instructor.

The training flight is also referred to as 'refresher training'.

CAA guidance to flying training professionals

The CAA's 'TrainingCom Autumn 2019'12 newsletter contained guidance on 'Aeroplane Skill Tests and Proficiency Checks'13.

'Both Skill Tests (ST) and Proficiency Checks (PC) require the candidate to demonstrate a REJECTED TAKE-OFF (RTO). It is insufficient for the examiner conducting the test to just discuss this element. The examiner should include the RTO procedures in the pre-flight briefing and then during the flight the examiners should ideally scenario [sic] to introduce the RTO. The candidate should be allowed to demonstrate their practical skills in the detection, diagnosis and performance of the appropriate actions to the point of aircraft evacuation when appropriate.'

The *'TrainingCom Autumn 2019 update'*[14] included *'Suggestions for the content of refresher training'*. It stated:

'The average private pilot once qualified will probably only fly with an instructor during refresher flight training, therefore, the flight is a valuable opportunity to evaluate common points of weakness as well as including exercises that the pilot may want to cover, with emphasis on good practice.'

The article listed *'Common points observed by instructors conducting check flights'*, including:

'The Threat and Error Management (TEM)[15] *concept is very rarely used, many PPL holders have not heard of, or do not understand, the concept…*

Lack of departure brief and passenger safety briefing.'

Footnote

[10] Single engine piston rating for aeroplanes | Civil Aviation Authority (caa.co.uk) [accessed 10 March 2022]
[11] Or specified equivalent.
[12] The CAA's Training news update for flying training professionals.
[13] TrainingCom_Nov2019_CAP1853_corr.pdf (caa.co.uk) [accessed 10 May 2022]
[14] TrainingComUpdateAutumn2019(CAP1860).pdf (caa.co.uk) [accessed 23 March 2022]
[15] TEM involves pilots thinking ahead to identify threats and specify ways to avoid or deal with potential errors associated with those threats.

Suggestions for related training included:

> *'Discuss with your pilot the use of threat and error management and get them involved. For example, ask them about any threats to their safety during their flight with you and how they can be mitigated, such as a wet grass runway or a crosswind…*
>
> *Use of the WANT mnemonic: Weather, Aircraft, NOTAM's and Threats…*
>
> *Do they give a take-off/eventualities brief? If not, discuss one suitable for them.'*

Safety Sense Leaflet

The CAA's *'Safety Sense Leaflet 7c Aeroplane Performance'*[16], Section 6 *'Takeoff - points to note'* stated:

> *'Decision point: you should work out the runway point at which you can stop the aeroplane in the event of engine or other malfunctions, e.g. low engine rpm, loss of ASI, lack of acceleration or dragging brakes. Do NOT mentally programme yourself in a GO-mode to the exclusion of all else. If the ground is soft or the grass is long and the aeroplane is still on the ground and not accelerating, stick to your decision-point and abandon take-off. If the grass is wet or damp, particularly if it is very short, you will need a lot more space to stop…'*

Interviews with PPL pilots, instructors, and examiners

During the investigation the AAIB interviewed PPL holders, PPL flight instructors (FI), flight instructor and examiners (FI/FE), and flight instructor examiners (FIE)[17] at different locations. These indicated that training and awareness of RTOs and related decision making was variable. Several long-term PPL holders said they could not recall initial RTO training, nor subsequent refresher training regarding RTOs. One FI/FE suggested that flight instructors may benefit from more knowledge in that area.

All the instructors interviewed indicated that pilots commonly focus on "getting into the air", rather than considering an RTO, when preparing for taking off.

One FI/FE said RTOs were one of the most commonly repeated test items, mainly to address decision making. Consequently, the associated pilot training organisation (PTO) had developed a structure for takeoff decision making: after applying takeoff power students would check that engine instruments and ASI were indicating normally, and that the aircraft was tracking the runway centreline. Thereafter they would make a 'stop or continue' takeoff decision. An FIE reported that pilots starting FI training commonly did not perform departure briefings. Therefore, their PTO produced an aide memoire for departure briefings, which included determining:

Footnote

[16] SafetySense Leaflet 07 (caa.co.uk) [accessed 9 February 2022]

[17] A 'Flight instructor and examiner' trains and examines student pilots, whereas a 'Flight instructor examiner' trains and examines those 'Flight instructors and examiners' for them to perform their role.

- takeoff runway
- wind information
- relevant airspeeds for takeoff and climb
- a 'stop or continue' decision point in the event of a problem
- actions in the event of stopping
- actions in the event of a minor or a major problem after becoming airborne
- departure information in the event of a normal takeoff

An FIE familiar with the Europa Trigear indicated it has challenging cross wind handling characteristics.

Other guidance

EHEST's training leaflet[18] relating to decision making for single pilots, suggested that the 'skill, rule and knowledge' model of information processing[19] can refer to the amount of conscious effort a person exerts in making a decision.

An academic paper on *'Understanding human behaviour and error'*[20] described those behaviours as follows:

- 'Skill' based behaviours are *'highly practiced'* and automatic in nature.
- 'Rule' based behaviours require more conscious effort. They are *'Pre-packaged units of behaviour'* which are *'released when* [the] *appropriate rule is applied'.* For example, *'IF the symptoms are X THEN the problem is Y… IF the problem is Y THEN do Z'.*
- 'Knowledge based behaviours are *'almost completely conscious'*. For example, when a *'beginner'* performs a task, or an expert experiences a *'novel situation'*.

Analysis

The accident takeoff

The combined effects of the propeller and crosswind, and any tendency of the left wheel to dig into the grass surface, would have produced a left yawing tendency requiring a counteracting right rudder input throughout the takeoff roll, and possibly some right brake in the early part of the takeoff roll.

The wet and cool weather conditions preceding the accident may have meant the grass was unexpectedly wet, affecting the aircraft's handling characteristics. If, as the pilot suggested, the left brake was binding, the left yawing tendency may have exceeded the available aerodynamic control.

Footnote

[18] en (europa.eu) [accessed 17 May 2022]
[19] Developed by Rasmussen (1979)
[20] The Skill, Rule and Knowledge Based Classification (humanreliability.com) [accessed 25 March 2022]

In order to prevent a runway excursion, the pilot rotated the aircraft before its takeoff speed had been reached, probably causing one or both of the wings to stall. He had not considered stopping.

Takeoff decision making, rejected takeoffs, and departure briefings

The pilot habitually considered his actions in the event of an engine failure after takeoff. However, like others consulted during the investigation, he had not recently considered the decision making aspect of the takeoff roll, or his intended actions for rejecting a takeoff. He could not recall any training he may have received in those areas.

Regulatory guidance and relevant academic works indicate a simple, rule-based structure for decision making is appropriate for the takeoff roll, during which decisions and resulting actions must be clear and prompt. Given that an abnormal event during takeoff would be novel for most pilots, a rule helps to avoid an unreliable automatic response, and reduces the conscious effort required by a more knowledge-based response.

Regarding the accident takeoff, the decision-making structure suggested by one FI/FE would indicate rejecting the takeoff if the aircraft was not tracking the runway centreline or if there were a lack of acceleration. Other indications that an RTO might be necessary would include using *'substantial differential braking to keep the aircraft straight'* beyond the *'early part of the takeoff run'.*

The likelihood of a successful outcome can be increased by using a briefing structure to rehearse rules and relevant responses; this might include actively considering the possibility of stopping as well as continuing the takeoff, and managing the hazard of wet grass or a crosswind.

Flight training

Although it is mandatory for examiners to assess RTOs, the investigation revealed that many PPL holders did not regularly consider takeoff decision making or their actions for an RTO. The attention given to those items during training appeared variable.

The CAA's TrainingCom publication indicates that refresher training presents an opportunity to brief and practice takeoff decision making, RTO techniques, and threat and error management.

As a result of this accident the CAA intends to produce an article in its *'Clued Up'* magazine about takeoff decision making and RTO considerations in general aviation; to include, for example, encouraging pilots to specify, before each takeoff, a runway decision point, and to consider the actions required to stop the aircraft. It has stated that it intends to explore other methods of promoting that guidance and new ways of engaging with the general aviation flight training community in this context.

Flying a new aircraft type

There was no evidence of a technical fault. The Europa is considered by some to have challenging handling characteristics in moderate crosswinds. This accident highlights the

benefit of pilots reviewing the characteristics of a new aircraft type and identifying differences with those they've flown before, such as instrumentation and handling. It can be beneficial to apply more conservative operating limits, such as for crosswind component, while gaining experience on a new type.

Conclusion

To avoid a runway excursion the pilot rotated the aircraft before a safe flying speed had been reached, probably causing the wing to stall. The pilot described having been unable to overcome a left yawing tendency during the takeoff roll, the cause for which was not established.

Structured self-briefing before takeoff can assist clear decision making and prompt action in the event the takeoff does not proceed normally.