



Air Accident Investigation Unit Ireland

FACTUAL REPORT

ACCIDENT

**Raj Hamsa X Air, 582(11), EI-CXC
Near Limetree Airfield**

7 September 2023



An Roinn Iompair
Department of Transport

FINAL REPORT

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13¹ to the Convention on International Civil Aviation, Regulation (EU) No 996/2010² and Statutory Instrument No. 460 of 2009³, safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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¹ **Annex 13:** International Civil Aviation Organization (ICAO), Annex 13, Aircraft Accident and Incident Investigation.

² **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.

³ **Statutory Instrument (SI) No. 460 of 2009:** Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.



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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI No. 460 of 2009, on 15 May 2024, the Chief Inspector of Air Accidents appointed Paul Farrell as Investigator-in-Charge, to complete an Investigation into this Accident, and prepare a Report.

Aircraft Type and Registration:	Raj Hamsa X Air, 582(11), EI-CXC	
No. and Type of Engines:	1 x Rotax 582/48	
Aircraft Serial Number:	KIT 333	
Year of Manufacture:	1998	
Date and Time (UTC)⁴:	7 September 2023 @ 16:06 hrs	
Location:	Near Limetree Airfield, Co. Laois	
Type of Operation:	General Aviation	
Persons on Board:	Crew – 1	Passengers – 1
Injuries:	Crew – Nil	Passengers – 1
Nature of Damage:	Substantial	
Commander's Licence:	European Union (EU) Flight Crew Licence (FCL), Private Pilot Licence (PPL), Aeroplane (A), issued by the Irish Aviation Authority (IAA)	
Commander's Age:	36 years	
Commander's Flying Experience:	250 hours, of which 86 were on type	
Notification Source:	Both the Pilot and the aircraft Owner	
Information Source:	AAIU Field Investigation	

⁴ **UTC:** Co-ordinated Universal Time. All times in this report are quoted in UTC unless otherwise stated; local time was UTC plus 1 hour on the date of the accident.

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SYNOPSIS

Following take-off from Runway 19 at Limetree Airfield, when the Raj Hamsa X Air aircraft was at 50 to 60 ft above the terrain of a hill on the take-off path, the engine 'coughed' several times and the aircraft lost height. An emergency landing was carried out into an agricultural field which resulted in substantial damage to the aircraft. The passenger was injured. There was no fire. The engine power interruption was subsequently determined to be due to a cold seizure in the engine's front cylinder and a loss of clearance in the rear cylinder.

NOTIFICATION AND RESPONSE

Both the Pilot and the aircraft Owner contacted the AAIU Inspector On-Call (IOC) by telephone on the day of the accident.

PREAMBLE

The Owner had offered to sell the aircraft to another individual (the Passenger). The Owner arranged for the Pilot to be listed on the aircraft insurance policy. On the day of the accident the Owner was present at the airfield and observed the take-off.

1. FACTUAL INFORMATION

1.1 History of the Flight

The Owner informed the Investigation that the fuel tanks had been fully drained in the summertime to remove any old fuel from the aircraft. The Owner said that the aircraft had been refuelled on the Sunday preceding the accident (four days earlier), using fuel purchased at a petrol station; such fuel is often referred to as motor gasoline or 'Mogas'. The Owner had mixed two-stroke oil (required for the aircraft's two-stroke engine) with the fuel prior to refuelling the aircraft.

During the afternoon of 7 September 2023, the Owner met with the Passenger at Limetree Airfield, and performed some engine running and taxi runs in the aircraft. The Owner informed the Investigation that he took fuel samples from the tank drains as part of a walk around inspection and noted '*no water present and colour and smell to be fresh and according to what would be expected*'. The Owner informed the Investigation that he had taxied the aircraft around the airfield and completed power checks and full power and low power taxiing for approximately 25 to 30 minutes. He said that the aircraft was at rest with the engine shutdown for about 30 minutes before the flight. The Owner informed the Investigation that no anomalies were noticed with the operation of the engine.

The Pilot stated that prior to boarding the aircraft he conducted a thorough walk around of the aircraft, with the Passenger in attendance, and pointed out to him certain areas (for example, where cables might chafe, etc), that might require attention if the Passenger proceeded with the purchase. The Pilot recalled that nothing about the aircraft gave him cause for concern, and in particular he remembered inspecting the engine and being satisfied with the integrity and attachment of the spark plug leads.



The Pilot recalled that he boarded the aircraft first, occupying the left-hand seat, followed by the Passenger, who occupied the right-hand seat, and that the doors were then closed and headsets donned. The engine was then started and allowed to warm up for *'five-ish'* minutes at the idle power setting, which the Pilot said was 2,200 Revolutions Per Minute (RPM) approximately.

The Pilot noted that *'the brakes were not good'* and that *'at about two and a half to three thousand revs they wouldn't hold the airplane in position'*. He said that he knew that the brakes had recently been adjusted to a point where they would hold the aircraft up to about 2,500 RPM, at which time the aircraft would start to pull away.

At 16:04 hrs, the Pilot, with the Passenger on board, taxied the aircraft out for take-off on Runway (RWY) 19. The Pilot described RWY 19 as an uphill runway with a hill ahead of the runway extended centreline and a large tree to the right of it. The Pilot said that it was a very hot day with temperatures at the airfield around 26 degrees Celsius at the time of take-off. He recalled that *'all temperatures and pressures were checked and noted to be ok [and] engine temperature in the green prior to take-off run during pre-take-off checks'*. He further recalled that the expected maximum engine speed of approximately 6,300 RPM⁵ was achieved during the take-off ground roll. He said that the aircraft got airborne about half-way along the length of the runway; he noted that on a warm day, with two persons on board, the particular aircraft type could be slow to climb, with a maximum rate of climb of between *'two to two fifty feet a minute'* which he said felt normal.

The Pilot recalled that within seconds of take-off, while the aircraft was *'just above the tree and the hill'*, the *'engine coughed and it [the aircraft] sank'*; the Pilot estimated that at that stage the aircraft was no more than 50 or 60 ft above the terrain of the hill.

The Pilot recalled that fairly quickly after the first engine *'cough'*, it *'coughed two or three more times'*. He said that at the first cough he looked out for a place to put the aircraft down. He recalled that the terrain to the left of the aircraft was *'hills'*, and ahead of the aircraft was a big farmhouse with a driveway to the right of it. On the right-hand side of the farmhouse the Pilot observed two fields with a gap in the hedge between them. He recalled pulling the throttle back to idle but did not recall if the engine had stopped. He then *'nosed'* the aircraft down and aimed towards the *'hole in the hedge'*.

He estimated that the aircraft landed 20 to 25 metres (m) before the hole in the hedge, at a speed of 50 to 55 miles per hour (mph). He said that he used the rudder to steer the aircraft as close to the centre of the gap as possible. The Pilot estimated that at the gap in the hedge the speed of the aircraft was 30-35 mph. He recalled that the right wing strut impacted with a stake in the ground and that an electric cattle fence spanned the gap in the hedge. He said that the impact of the right strut spun the aircraft to the right on the ground. He recalled that during this spin the right main wheel and the nosewheel separated from the aircraft and the aircraft travelled through the gap in the hedge and came to rest in the next field.

⁵ This expected maximum speed was based on the engine/propeller combination, rather than solely on the engine's maximum possible speed.

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The Pilot said that the engine had stopped at this stage, and he turned off the magnetos⁶ and battery master switch. He could smell fuel but could not see any leaks but that he did not know where the fuel shutoff valve was to turn it off.

The Pilot undid his seat belt and spoke with the passenger whom he described as *'fine but a bit shook'*. He recalled that the passenger was seated on the right, and with the right wheel having separated from the aircraft, the passenger seat was sitting low and egress through the right-side door was not possible. The Pilot said that because the aircraft was lying over to its right side due to the separated wheels, exiting the aircraft through the left-side door was more challenging.

The Pilot exited the aircraft through the left-side door and then assisted the Passenger with releasing his seat belt and exiting the aircraft, also through the left-side door. The Pilot said that the passenger mentioned that his back was sore when he exited the aircraft, and the Passenger lay down on the surface of the field near the gap in the hedge.

The Pilot then called personnel at the airfield, by phone, to summon an ambulance and assistance. A helicopter that had been operating from Limetree Airfield, brought a first aid kit, fire extinguisher and personnel from the airfield to the accident site. The Owner informed the Investigation that he arrived on scene immediately after the accident and called the ambulance, Gardaí and AAIU. Emergency services arrived thereafter. One of the personnel who arrived to assist, knew the location of the fuel shut-off valve on the aircraft and this was moved to the *'off'* position.

The Pilot informed the Investigation that the Passenger had been taken to hospital and that following examination there, he had been released from medical care.

1.2 Investigation

The AAIU IOC with whom the Pilot spoke following the accident gave permission for the wreckage to be recovered from the accident site to a shed at the airfield. On the following day (8 September 2023), a team of three AAIU inspectors travelled to Limetree Airfield and an Investigation was commenced.

1.3 Examination of Wreckage

The wreckage had been mounted on a trailer, secured with a tie down strap and stored in an agricultural shed. The wings of the aircraft had been removed; the forward strut from the right-side wing exhibited impact damage.

The wreckage on the trailer was inclined to the right (viewed from behind), with the right main wheel and the nosewheel having fractured from their mountings. The separated nosewheel remained loosely attached by the nosewheel steering cables, while the separated right main wheel remained loosely attached via the brake cable. One of the two propeller blades had fractured.

⁶ **Magneto:** A self-contained electrical generator providing the necessary high-voltage pulses for the ignition system spark plugs.



The Investigation examined the bowl of the forward carburettor and fuel was present; depression of the floats indicated that they exhibited buoyancy. The bowl of the rear carburettor could not be examined because of interference from an adjacent pipeline; however, when the bowl clip was released and the bowl was disturbed, fuel was seen to leak from the bowl, indicating that fuel was present.

The fuel tanks comprised two, linked, translucent plastic tanks, mounted side-by-side, behind the pilot seats. A refuelling neck was present on the right-hand side of the aircraft, accessible by a Velcro-secured flap in the aircraft fabric covering.

The fuel tanks were inspected and found to contain fuel. The fuel shutoff valve was noted to be in the off position; the Investigation was informed that it had been in the on position at the time of the accident. The inline fuel filter, which has a transparent casing, was inspected and the presence of fuel was noted, and no debris was observed.

At the top of each fuel tank, on its outboard corner, a vent port had been installed comprising a short section of semi-rigid pipe inserted through the top of the tank, which was then inserted into a more flexible pipe; the flexible pipe was coiled at the side of each tank inside the aircraft fabric. No evidence of blockage was found in either of these vents.

The main structural member, to which the engine, cockpit structure and tail structure were attached, is a circular member referred to as the keel tube. This keel tube exhibited bending with the rear portion (tail section), aft of the main cockpit structure attachment bracket, deformed to the right (as viewed looking forward from the cockpit).

The Investigation took a fuel sample from each fuel tank drain, and these samples were sent for laboratory testing. The test laboratory concluded that two stroke oil was added to the fuel with the dosage estimated to be not less than 50:1, which was the required mixing ratio. The testing laboratory noted that while the fuel samples passed the specification for appearance (clear and bright with no visible contaminants), and for density, the water content was considered to be high at 986ppm v/v, which the testing laboratory opined would have an impact on the fuel's performance and cause a lack of engine power.

1.4 Site Survey

Although the wreckage had been removed from the accident site, it was possible for the Investigation to identify and survey prominent aspects of the aircraft's ground track from its point of landing to its final resting position. This survey revealed that the aircraft travelled approximately 50 m before the right-hand wing strut struck a vertical stake, and another 20 m approximately before it came to rest in an adjacent field (**Photo No. 1**).



Photo No. 1: Aircraft as it came to rest following the accident

1.5 Personnel Information

The Pilot held an EU FCL, PPL (A), issued by the IAA, with a Single Engine Piston (SEP), Land, that was valid until 31 March 2025. The Pilot's Class 2 medical certificate was valid until 26 February 2024. The Pilot had a total of 250 hours of flying time, of which 86 were on the accident aircraft type.

1.5.1 Injuries to Persons

Extant legislation governing Accident and Incident Investigation defines a Serious Injury as:

'An injury which is sustained by a person in an accident and which:

a) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; or

b) results in a fracture of any bone (except simple fractures of fingers, toes or nose); or

c) involves lacerations which cause severe haemorrhage, nerve, muscle or tendon damage; or

d) involves injury to any internal organ; or

e) involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface; or

f) involves verified exposure to infectious substances or injurious radiation.'



The Investigation was informed that the Pilot was uninjured. The Investigation was also informed that the Passenger felt lower back pain and was taken to hospital by ambulance from where he was discharged later on the night of the accident; the Investigation was informed that the back pain was due to soft tissue injury.

Table No. 1 sets out the injury details for this accident.

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor /None	1	1	

Table No. 1: Injuries to persons

1.6 Aircraft Information

The aircraft, a Raj Hamsa X Air, 582(11), registration EI-CXC, was factory-built in France in 1998 and had the serial number KIT 333. It was registered as EI-CXC in Ireland on 6 September 2002. It was powered by a two-stroke, two-cylinder (in line), Rotax 582/48 engine, which drove a Duc Windspoon two-blade propeller via a Rotax B-Type reduction gearbox with a gearing ratio of 2.58:1. The engine's cylinders and cylinder heads were liquid cooled. The engine version was Rotax 582 UL Mod. 90, and the engine Model Number was 305820010. The aircraft's extant IAA Certificate of Registration was dated 24 January 2020. The IAA register of aircraft quoted the aircraft Maximum Take-Off Weight (MTOW), as 450 kilograms (kg).

The aircraft was operating on an IAA Flight Permit. This was issued on the basis of an IAA approved airworthiness scheme for the inspection and testing of Microlight aircraft by authorised persons for the purpose of issuing/renewal of Flight Permits for such aircraft.

Under the scheme, the National Microlight Association of Ireland (NMAI) makes applications to the Irish Aviation Authority, on behalf of microlight owners, for the issue/renewal of Flight Permits for microlight aircraft. The aircraft's Flight Permit had been issued by the IAA on 16 April 2021, and had an expiry date of 15 April 2022. Two 12-month extensions to the Flight Permit were allowable. The aircraft's second Flight Permit extension was issued on 13 June 2023, with an expiry date of 16 April 2024. This second Flight Permit extension was certified by an NMAI inspector after the aircraft had undergone a satisfactory permit inspection and was found, at the time of inspection, to be in a satisfactory and airworthy condition.

The Owner informed the Investigation that '*Brakes had been fully upgraded IAW manufacturer specifications with new shoes and drums.*'

The Pilot estimated the operating mass of the aircraft for the accident flight as 427 kg – this comprised the aircraft empty mass of 240 kg, 17 kg of fuel, 100 kg for the Pilot and 70 kg for the Passenger. Subsequently, the Pilot noted that the empty mass from the extant aircraft weighing report quoted a figure of 250 kg for the empty mass. The Investigation was also informed that the Passenger's mass at the time of the accident was 78 kg. Therefore, the estimated take-off mass of the aircraft at the time of the accident was 445 kg.

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The IAA informed the Investigation that the applicable Data Sheet for the aircraft was the British Microlight Aircraft Association (BMAA), Homebuilt Aircraft Data Sheet (HADS), NO: HM1 Issue: 30. The BMAA HADS specified a permitted weight range of occupant weights as *'Min 55 kg total weight, Max 90 kg per seat'*.

The IAA informed the Investigation that, as listed in the BMAA HADS, the applicable Flight Manual/Pilot Operating Handbook was the BMAA Raj Hamsa X'Air (UK) Operators Manual (OM), Issue 1 to AL1. The OM stated, *inter alia*, *'All pilots should read this manual before flying as pilot in command of the aircraft to which it refers'*. One of the stipulated *'Operational Limitations'* in the OM stated *'At least 55kg (121lbf / 8 stone 9lbf) must be in the cockpit for flight, no more than 90kg (198 lbf / 14 stone 2 lbf) may be carried in each seat.'* The OM's final pre-take-off check states *'Power checked, and the pilot is satisfied that the aircraft can sustain take-off power'*.

On 25 July 2023, the IAA issued an Advisory Memorandum designated AAM No. 7, Revision: 03, titled *'Use of alternate fuel in light aircraft'*. AAM NO. 7 lists a number of precautions to be observed when using Unleaded Motor Gasoline (Mogas); one of the precautions states *'The ability to maintain take-off power must be verified before the aircraft is committed to completing a take-off'*.

The Rotax 582 Operators Manual contains, *inter alia*, the following (**Figure No. 1**):

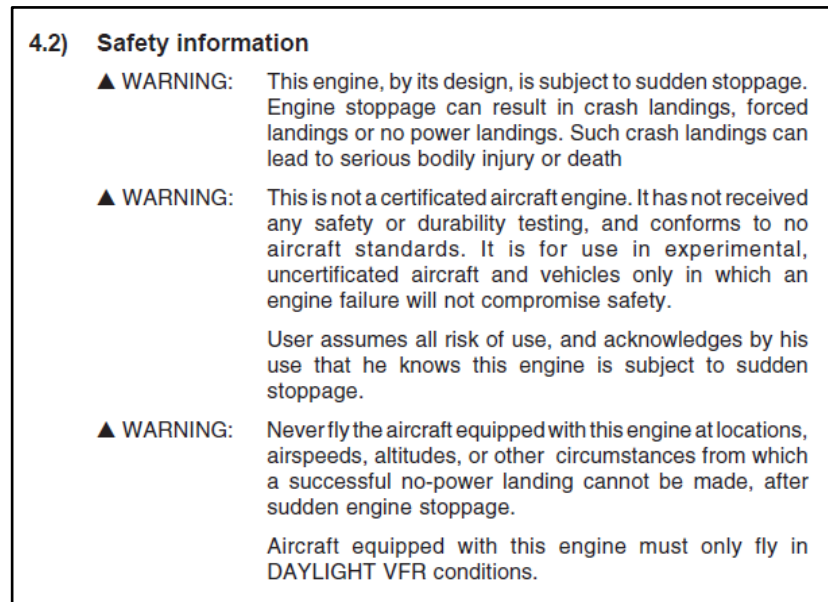


Figure No. 1: Rotax manual Safety Information

The BMAA informed the Investigation that *'The Rotax manual is very clear (and [BMAA] pilot training provides a constant reminder) to expect an engine failure at any moment/stage of flight.'*



The Rotax Operators Manual contains a section titled *'Operating Parameters'* which stipulates various engine speeds during operation as follows: Take-off speed 6,800 rpm max. 5 min.; Cruising speed 6,500 rpm; Idle speed ca. 2,000 rpm. The Rotax manual also includes a check which states *'Verify that the engine reaches full power rpm during take off roll'*. The Investigation notes that the BMAA Flight Manual stipulates that brake wear is an item to be checked and repaired/replaced as necessary, on a monthly basis.

1.7 Engine Examination

The engine from the accident aircraft was subsequently sold and the new owner sent it to a specialist workshop for examination and re-working. The Investigation contacted the workshop that conducted the engine work and received the following detailed description of work carried out and findings:

- When the engine was stripped it was observed that the front piston had seized. The piston and rings were unserviceable (**Photo No. 2**). There was some light scoring on the barrel, but these were not deep.
- The rear cylinder had not seized, but there was evidence of the piston & bore clearance coming close to zero (**Photo No. 3**).
- The B gearbox had to be stripped for removal from the engine crankcase. There were no defects and all looked normal.
- The carbs [carburettors] and the jets were free of any blockages, the floats looked satisfactory and the rubber carb sockets had no splits in them.
- The ignition timing was checked with a dial gauge and again this was set to the correct advance.



Photo No. 2: Damaged forward piston



Photo No. 3: Rear piston exhibiting loss of clearance damage

The engine specialist informed the Investigation that from his experience, at least five minutes are needed to warm up a Rotax 582 engine. He said that he would normally run the engine at a high idle (2,500/3,000 rpm) for a few minutes to let the water temperature rise. He said that he would then hold the aircraft on its brakes and increase the engine power to at least 4,000 rpm for more than a minute before take-off to make sure that the whole engine was up to operating temperature.

The engine specialist opined that in the case of the subject engine, five minutes idling at 2,200 rpm was not sufficient and that when full power was applied for take-off, the aluminium piston expanded faster than the steel liner in the barrel, causing the front cylinder to seize (a condition known as a cold seizure) and the piston/bore clearance in the rear cylinder to come close to zero.

2. **AAIU COMMENT**

The aircraft was operating at approximately 445 kg which was close to its MTOW of 450 kg, on a warm evening. The Pilot recalled that the aircraft's rate of climb following take-off was low and that when the aircraft was at 50 to 60 ft above the terrain of a hill on the take-off path from RWY 19, the engine coughed several times and the aircraft lost height. An emergency landing was carried out into an agricultural field, during which there was substantial damage to the aircraft, and a minor injury to the passenger.

Subsequently, the engine was dismantled, and it was found that a cold seizure had occurred in the forward cylinder with the piston expanding faster than the cylinder liner, resulting in contact between the piston and the cylinder wall. There was also evidence of a loss of clearance between the piston and the cylinder liner in the rear piston.



The prevention of cold seizure requires that an engine be progressively warmed up at higher than idle speeds over a period of time before fully opening the throttle to commence a take-off run. Running the engine at such higher speeds is only possible when the aircraft brakes can hold the aircraft stationary at these higher engine speeds.

The Pilot informed the Investigation that the accident aircraft's brakes could not hold the aircraft at engine speeds above 2,500 rpm. This meant that a progressive engine warm up was not possible, and a pre-take-off power check/full throttle check could not be performed before commencing the take-off run and committing to taking off. Furthermore, when an emergency landing was required, effective braking action was not available to slow the aircraft to reduce ground roll (and impact forces). The Flight Manual stated that brake wear was an item to be checked and repaired/replaced as necessary on a monthly basis. The Owner informed the Investigation that *'Brakes had been fully upgraded IAW manufacturer specifications with new shoes and drums.'*

Other factors that may have had an adverse effect in this accident include the uphill nature of the take-off runway, and the high water content in the aircraft fuel (at 986ppm v/v) which the testing laboratory indicated would have impacted on the fuel's performance and cause a lack of power.

The engine manufacturer's manual warns that the engine, by its design, is subject to sudden stoppage. Moreover, it warns *'Never fly the aircraft equipped with this engine at locations, airspeeds, altitudes, or other circumstances from which a successful no-power landing cannot be made, after sudden engine stoppage'*. On this occasion, the sudden interruption of engine power while departing from an established runway at the airfield, the low height above terrain, the nature of the terrain available for executing an emergency landing, and the lack of effective braking action, all contributed to the accident sequence.

- END -

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

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