Technical report
A-039/2020

Accident involving a Diamond DA-20-A1 aircraft, registration EC-IIS, operated by Fundación REGO, on 16 September 2020 at Reus Airport (Tarragona – Spain).

Please note that this report is not presented in its final layout and therefore it could include minor errors or need type corrections, but not related to its content. The final layout with its NIPO included (Identification Number for Official Publications) will substitute the present report when available.

GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES Y MOVILIDAD SOSTENIBLE
SUBSECRETARÍA
COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

FOREWORD

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident the object of the investigation, its probable causes, and its consequences.

In accordance with the provisions of Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; Article 5.6 of Regulation (EU) No 996/2010 of the European Parliament and of the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety; and Articles 1 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent their recurrence. The investigation is not intended to attribute any blame or liability whatsoever, and it’s not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidence in a judicial process.

Consequently, the use of this report for purposes other than that of preventing of future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

CONTENTS

ABBREVIATIONS

° ‘ “	Sexagesimal degrees, minutes and seconds
°C	Degrees Celsius
AESA	Spain’s National Aviation Safety Agency
ARC	Airworthiness review certificate
ATO	Approved training organisation
ATPL	Airline transport pilot licence
CIAIAC	Civil Aviation Accident and Incident Investigation Commission
CPL	Commercial pilot licence
E	East
FI	Flight instructor
ft	Feet
ft/min	Feet per minute
h	Hours
HP	Horse power
hPa	Hectopascals
IR	Instrument rating
kg	Kilograms
KIAS	Knots indicated airspeed
km	Kilometres
kt	Knots
LERS	ICAO code for Reus Airport
m	Metres
m^2	Square metres
mb	Millibar(s)
MEP	Multi-engine piston rating
METAR	Aviation routine weather report (in aeronautical meteorological code)
MHz	Megahertz
N	North
NM	Nautical miles
QNH	Altimeter subscale setting that indicates elevation while on the ground
psi	Pounds per square inch
rpm	Revolutions per minute
SEP	Single-engine piston rating
SMS	Safety management system
SSEII	Rescue and Firefighting Service
TWR	Control tower
UTC	Coordinated universal time
VFR	Visual flight rules

SYNOPSIS

Owner and operator:	REGO Foundation (Fundación REGO)
Aircraft:	Diamond DA20-A1, registration EC-IIS
Date and time of the accident:	Thursday, 16 September 2020, at 09:15 h[1]
Site of the accident:	Reus Airport (Tarragona – Spain)
Persons on board:	1, seriously injured
Type of flight:	General Aviation – Instruction – Solo
Phase of flight:	Aerodrome traffic circuit – Approach – Uncontrolled descent
Flight rules:	VFR
Date of approval:	31 January 2024

Summary of the accident.

The DIAMOND DA-20-A1 aircraft, registration EC-IIS, took off at around 08:30 hours from runway 25 at Reus Airport (LERS - Tarragona) with a student pilot as the only occupant on board for a one-hour local flight consisting of practising landings and take-offs at said airport.

Approximately 30 minutes into the flight, after three touch-and-go landings, the pilot reported that he was having engine problems and that he was nearing the base leg of the aerodrome traffic circuit.

Shortly afterwards, having been cleared to land on runway 25, he reported that his engine had stopped and he couldn't make it to the runway; he struck the airport fence and landed in an area in front of the runway, close to the approach lights, at around 09:15 hours.

The pilot was seriously injured and the aircraft sustained significant damage.

The investigation has concluded that the accident occurred due to the emergency off-airfield landing following an in-flight engine shutdown with the aircraft in aerodrome traffic pattern and incorrect execution of standard operating procedures, in particular the accomplishment of the pre-flight inspection.

No safety recommendations have been issued as a result of the investigation into the accident.

[1] Unless specified otherwise, all times in this report are local. UTC can be calculated by subtracting 2 h from the local time.

1. FACTUAL INFORMATION.

1.1. History of the flight.

On 16 September 2020, the Diamond DA20-A1 aircraft, registration EC-IIS and callsign ROG1SSZ, took off from Reus Airport to carry out a one-hour local visual flight with a student as the only person on board. The flight consisted of practising take-offs and landings.

According to the information provided by the student pilot, he arrived at the airport and, along with the instructor supervising him and two other students, went to the aircraft.

The external check was carried out by the student pilot alone. He checked the oil level as per the procedure: he turned the propeller until he heard the two distinctive noises, then pulled out the dipstick and saw that the oil mark was on the narrowest part of it, which was within the limits. If there's not enough oil in the engine, they refill it themselves from the oil canisters in the aircraft's luggage compartment and make a note of it in the aircraft's logbook.

He also checked the fuel level and thinks he can remember departing with full tanks.

The exterior inspection was satisfactory, as was the taxi and engine test.

Usually, they fly the traffic circuit at 1,250 feet (approximately 1,000 feet above the ground), but on that day, there was a bit of fog, so he flew it slightly lower, at around 1,100 feet. On the take-off run, they wait for the anemometer to reach 40 kt, then go airborne at 55 kt, climbing to 500 ft above the ground at 65 kt; on reaching 500 ft, they turn crosswind and accelerate to 70 kt to continue climbing to the circuit altitude. When they reach the AP7 motorway, they turn downwind, maintaining 1,250 ft. On the downwind leg, they reduce power to 20 inches of manifold pressure and 2,260 rpm. Upon reaching the runway head, they reduce power to below 18 inches of manifold pressure, turn on the carburettor heater, and when the speed enters the white arc, set flaps to the take-off position, then re-apply power and turn off the carburettor heater.

On base, they cut the throttle to idle and start the glide towards the runway, and on final, they adjust the flaps to the landing position and the speed to 65 kt until the flare.

In his opinion, the first three landings went well.

On the fourth circuit, he noticed a burning smell, checked the engine parameters, and saw that the oil pressure gauge was reading 20 psi when it normally reads between 30 and 60 psi.

He called the operations office and spoke to his supervising instructor, who told him to do a full stop landing.

On the downwind leg, he reduced power and turned on the carburettor heater. Then, when the speed reached the white arc, he set the flaps to the take-off position, re-applied power and turned off the carburettor heater.

He switched to tower frequency and requested a full stop landing; the tower asked him to extend the downwind leg, and then when they cleared him to land, he turned to base. He cut the throttle, turned to base, and a few seconds later, the engine stopped. The propeller came to a complete stop. He turned towards the runway and adjusted the speed to 70 kt because the flaps were in the take-off position; he kept correcting the nose position so as not to stall but fell short and didn't make it. On final, he turned off the magnetos, the electric fuel pump and the master. He hit the airport boundary fence and landed inside the airport perimeter. He thinks the impact occurred with the nose up and that the landing gear broke on making contact with the ground, causing the aircraft to hit the ground with its belly; when the aircraft stopped, he removed the avionics master and tried to shut off the fuel tank, but he can't remember if he eventually managed to do so, because he was in a lot of pain from his back.

The student pilot was seriously injured and the aircraft sustained significant damage.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious	1		1	
Minor				
None				
TOTAL	1		1	

1.3. Damage to the aircraft.

The aircraft suffered damage to the landing gear, propeller and canopy and cracks were identified in the fuselage and wings.

1.4. Other damage.

There was damage to the airport's perimeter fence.

1.5. Personnel information.

1.5.1. Information about the student pilot

The 20-year-old student pilot was enrolled on the integrated airline transport pilot programme (ATPL). His class 1 medical certificate was initially valid until 23 July 2020[2].

[2] Resolution adopted by the management of Spain's National Aviation Safety Agency on 18 March 2020 under Article 71 of Regulation (EU) 2018/1139, issuing an exemption to the periods of validity of the licences, ratings and certificates held by flight crews, instructors, examiners, aircraft maintenance licence holders and air traffic controllers, as well as an alternative method of compliance under ARO.GEN.120 of Regulation (EU) 965/2012, allowing a reduction of the minimum lead time required for the publication of crew duty rosters in response to the situation caused by the global COVID-19 coronavirus crisis.

However, due to the COVID-19 pandemic restrictions, its expiry date had been extended by 4 months to 23 October 2020.

He had 31:30 h of flight experience, all of which had been in the type of aircraft involved in the accident and 02:25 h of which had been flying solo without an instructor.

1.5.2. Information about the instructor

The flight was supervised by an instructor from the Rego Foundation ATO.

The 31-year-old instructor held a commercial pilot licence (CPL) issued by the Spain's National Aviation Safety Agency (AESA) on 21 March 2019, with a single-engine piston rating (SEP) valid until 31 March 2021, a multi-engine piston rating (MEP) valid until 30 June 2021, an instrument rating (IR) valid until 30 June 2021 and a flight instructor (FI) rating restricted to single-engine aircraft valid until 31 July 2022.

His class 1 medical certificate was also valid until 23 March 2021.

1.6. Aircraft information.

The DIAMOND DA-20-A1 aircraft is a single-engine, low-wing aircraft with a fixed, tricycle landing gear. Specifically, aircraft EC-IIS was manufactured in 1996 with serial number 10116. Its registration certificate was issued by AESA on 12 February 2003.

It has a 100 HP ROTAX 912-S3 engine with serial number 4924754 and a HOFFMAN HO-V352F/170FQ two-bladed variable-pitch propeller, serial number H245A/C.

Its general specifications are as follows:

- Wingspan: 10.9 m
- Wing area: 11.6 m^2
- Length: 7.2 m
- Height: 2.2 m
- Empty weight: 500 kg
- Maximum take-off weight: 730 kg
- Usable fuel capacity: 19.5 gallons
- Manoeuvring speed: 104 KIAS
- Approach speed with flaps in landing configuration: 57 KIAS
- Stall speed in landing configuration: 37 KIAS
- Maximum crosswind speed: 15 kt

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f) For Class 1 medical certificates issued under Part-MED to holders of ratings and certificates outlined in point (e), which do not include limitations other than visual limitations, valid on 14 March 2020, and whose regular period of validity is due to expire before 31 July 2020, the validity of these certificates is extended by 4 months.

The flaps lever has 3 positions: CRUISE (retracted), T/O (take-off position) and LDG (landing position, fully deployed).

The weight and balance of the aircraft, calculated by the student before the flight, was within the margins established by the manufacturer.

The aircraft had a Certificate of Airworthiness, issued by Spain's National Aviation Safety Agency on 13 August 2010, and an Airworthiness Review Certificate valid until 05 September 2021.

The aircraft's most recent maintenance overhaul was a 200-hour inspection conducted on 28 July 2020, when the aircraft had 10,253 flight hours and the engine had 1,460 h. The overhaul was carried out in accordance with the approved maintenance programme.

At the time of the accident, the aircraft had accrued 10,291 hours, and the engine had 1,498 hours.

1.7. Meteorological information.

There were no limiting meteorological conditions for visual flight.

The weather report at Reus Airport at the time of the accident was as follows:

METAR LERS 160700Z 02004KT 340V050 9999 FEW010 21/17 Q1019=

Reus METAR on the 16th at 07:00 UTC (09:00 local time). Wind direction 020º at 4 knots, wind direction variable from 340º to 050º. Visibility 10 km. Scattered clouds at 1,000 ft. Temperature 21ºC, dew point 17ºC, and QNH 1019 HPa.

1.8. Aids to navigation.

Not applicable. The flight was operating under visual flight rules.

1.9. Communications.

At the time of the incident, the aircraft was in the Reus Airport traffic circuit, so the student pilot was in communication with the Reus control tower on the 128.875 MHz frequency.

At 09:07:27 hours, the student notified that he was approaching left base for runway 25 for a full stop landing. The tower replied that he should continue the approach as there was departing traffic.

15 seconds later, the tower cleared the aircraft to land with a wind of 020º and 6 knots. The student acknowledged the clearance.

At 09:08:43 hours, the student pilot reported that his engine had stopped and that he didn't think he was going to make it to the runway.

Following this communication, the tower alerted the Rescue and Fire Fighting Service (SSEII), which deployed to the head of runway 25.

1.10. Aerodrome information.

Reus Airport (LERS) is located approximately 3 km east of Reus town. Its elevation is 233 ft, and it has an asphalt runway designated 07-25, measuring 2,459 m long by 45 m wide.

It is a controlled aerodrome that uses the 121.700 MHz frequency for ground communications and the 128.875 MHz frequency for communications with the aerodrome control tower and the approach control unit.

1.11. Flight recorders.

The aircraft was not equipped with flight recorders. They are not a requirement for the aircraft type.

1.11.1. Radar track

The information recorded by the air traffic control services made it possible to obtain the radar track of the aircraft's flight and reproduce its trajectory. The aircraft performed four circuits, the last three of which are shown in Figure 1; the accident occurred at the end of the last circuit, the trajectory of which is shown in red.

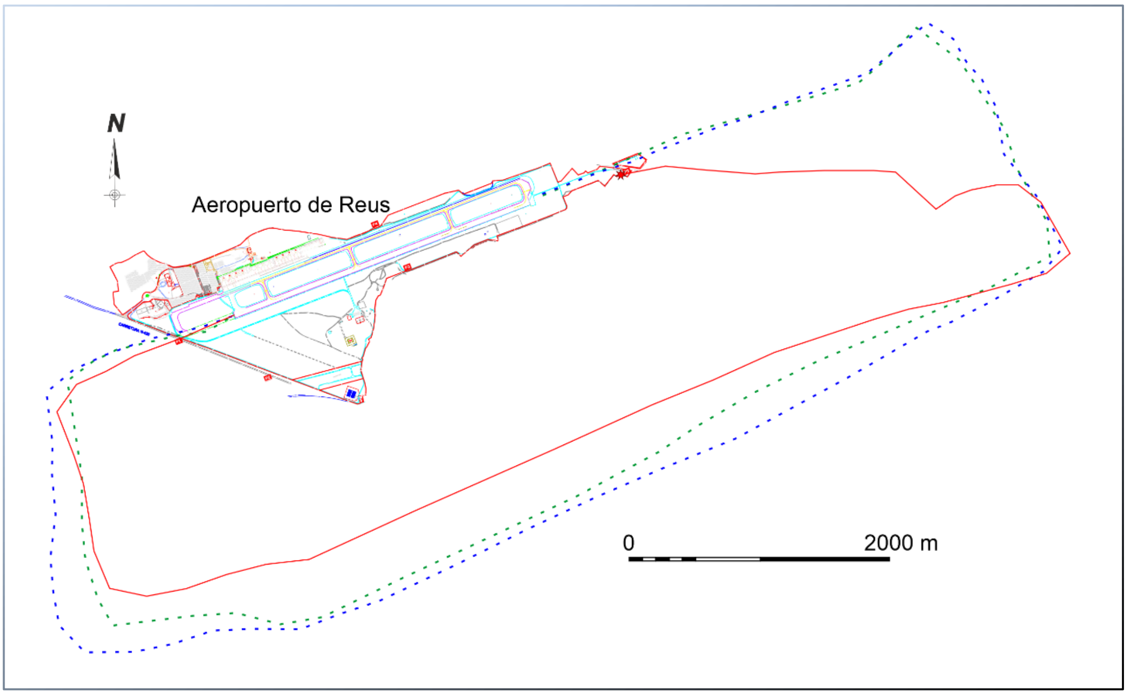


Figure 1.- The aircraft's trajectory.

The aircraft's actions during the last circuit are described below.

The track shows the aircraft performing four circuits for runway 25. In the last circuit, the one in which the accident occurred, the aircraft takes off and, on reaching 900 ft, turns onto the crosswind leg and continues with the climb. On joining the downwind leg, the aircraft had already reached 1,100 ft and is maintaining a speed of 100 kt.

When it draws level with runway head 25, the aircraft begins to reduce speed to 90 kt and descends to 1,000 ft.

The aircraft continues on the downwind leg until it's 1.9 NM away from the runway head, at which point it maintains 80 kt and 900 ft and begins the turn for base.

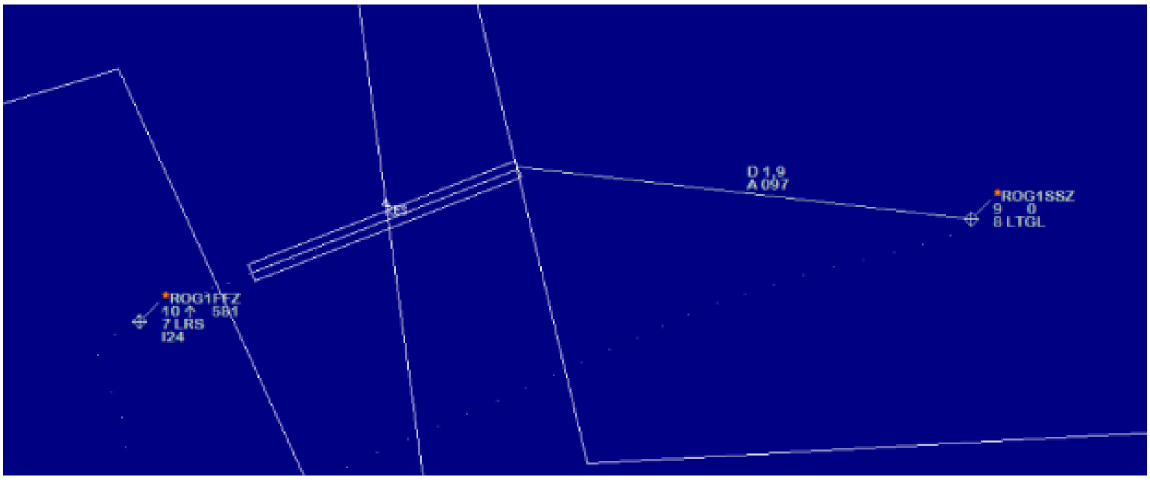


Figure 2.- Aircraft on the downwind leg

On the base leg, rather than maintaining a course perpendicular to the runway, the aircraft turns directly towards the runway, then turns perpendicular to the runway and finally turns onto final. On the base leg, the aircraft continues its descent at a rate of 569 ft/min, reaching 600 ft and a speed of 60 kt.

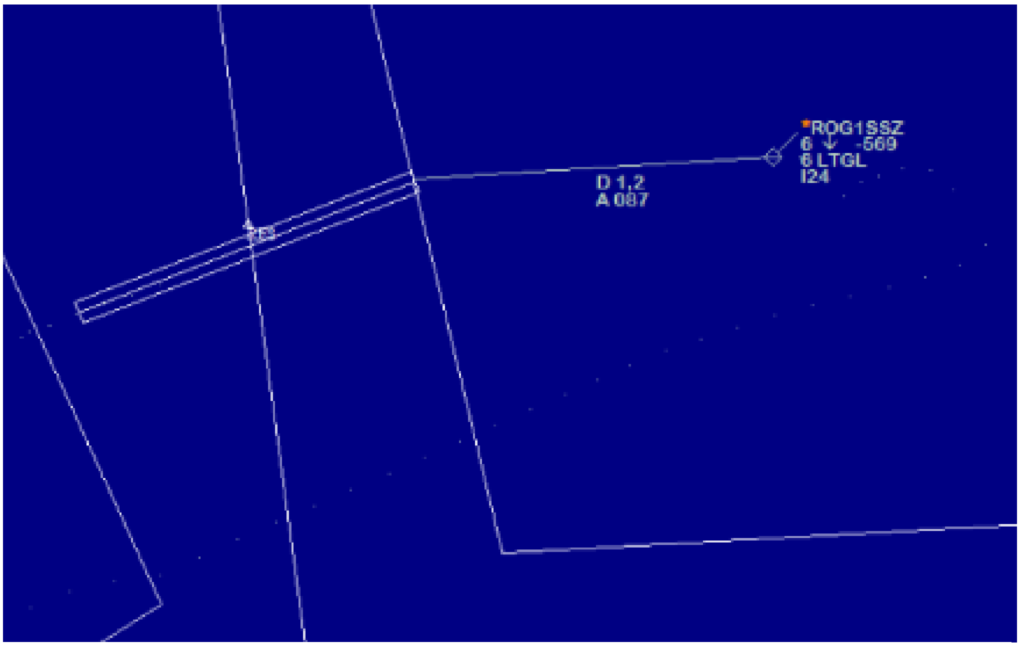


Figure 3.- Aircraft on the base leg.

The last radar track image shows the aircraft descending at a rate of 506 ft/min at an altitude of 300 ft, a speed of 60 kt and a distance of 0.6 NM from runway head 25 at Reus Airport.

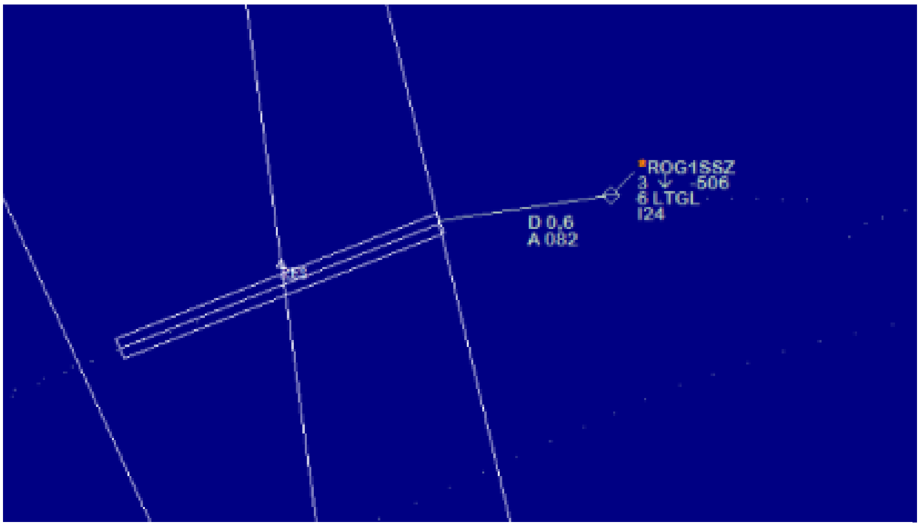


Figure 4.- Last image recorded by the radar track.

1.12. Wreckage and impact information.

The aircraft came to rest within the airport perimeter, 25.8 m from the perimeter fence, specifically at 41º09'07.7 "N 001º11'10.0 "E.

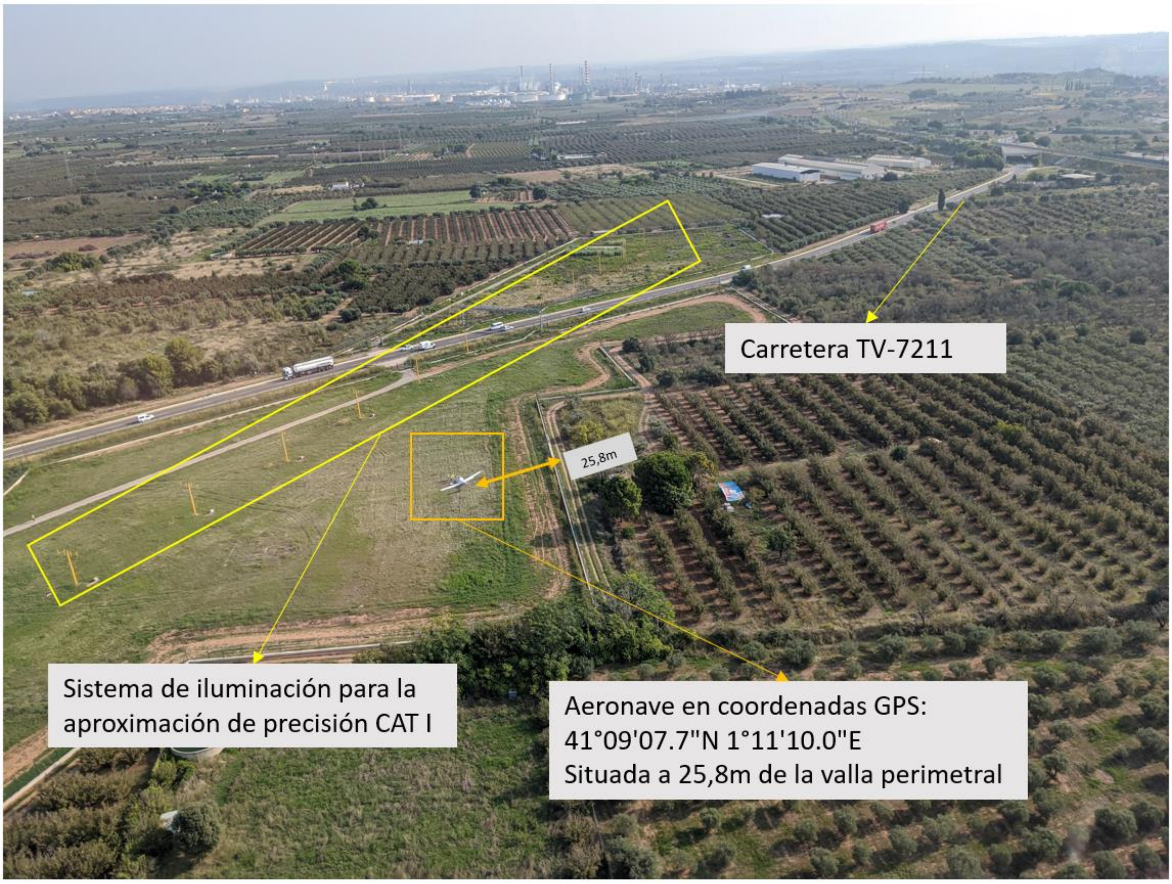


Figure 5.-: Final position of the aircraft after the accident.

The aircraft initially hit the fence that surrounds Reus Airport. It then impacted the ground. After this second impact, the aircraft slid sideways to the left, causing the left main gear leg and the nose leg to collapse before coming to a definitive stop.

The wing retained its shape, with some dents to the leading edge, possibly from the airport fence.

One of the propeller blades broke about a third of the way down from its attachment, while the other was intact, as was the propeller cone. The lower part of the engine cowling was severely dented.

The fuselage was undamaged, as was the tail empennage.

The cockpit retained its internal shape. The battery was switched off, the magneto key had been removed, the fuel shut-off valve was closed, and the flaps were in the take-off position.

Figure 6.- Aircraft after the impact.

The throttle lever was open to maximum, and the prop lever was fully forward (HIGH RPM).

On the instrument panel, the altimeter was set with a QNH of 1019 mb reading 230 ft, the variometer read zero, and the heading indicator read 330º.

1.13. Medical and pathological information.

The student pilot suffered serious injuries as a result of the accident.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

The harnesses and restraint systems worked adequately, and the cabin interior maintained its structural integrity.

1.16. Tests and research.

1.16.1. Inspection of the aircraft wreckage

The aircraft wreckage was inspected in a hangar at Reus Airport, to which it had been moved after the incident. The inspection was supported by personnel from the Rego Foundation's maintenance centre at said airport.

The landing gear exhibited deformations indicative of the aircraft's lateral displacement to the left: the left main gear leg and nose gear leg were displaced to the right, while the right main gear leg showed no apparent damage.

One of the propeller blades was intact, and the other was severed at a point close to its root. All the evidence suggests that it was not rotating when the aircraft hit the ground.

The lower engine cowling was scuffed and damaged due to slippage and impact with the ground.

The canopy had cracks on the lower left side, probably caused by the fuselage deformation in the area around the cockpit frame.

No other significant damage to the airframe was noted, and no traces of oil or coolant were detected on the exterior of the aircraft.

An attempt was made to rotate the propeller, confirming that it only moved in a particular sector; this angle of rotation probably corresponds to the play permitted by the engine clutch between the gearbox and the propeller shaft.

Figure 7.- Damage to landing gear, propeller, lower engine cowling, and cockpit.

The cowlings were removed from the engine. Except for one impact to the lower part, which had affected the radiator positioned in that area, the engine appeared normal, and no oil was found on the exterior of the engine.

Figure 8.- Views of the engine installed in the aircraft.

The cooling system components, excluding the damaged radiator, were in good condition, and no cracks or leaks were found anywhere in the system.

The lubrication system components were in good condition, and no cracks or leaks were found anywhere in the system. The dipstick was used to check the oil level in the tank, noting that it didn't show any oil at all. The engine sump was drained, and about a litre of oil was obtained.

The rocker covers of all four cylinders were removed; they were all apparently in good condition and well-lubricated.

The carburettor float bowls were opened; fuel was found in both, and the floats were in apparent good condition.

Lastly, the aircraft's engine was removed and prepared for transfer to suitable facilities for its disassembly and inspection.

1.16.2. Engine inspection

The aircraft's engine was inspected at the facilities of AVIASPORT, S.A., an official distributor and head of the Technical Service in Spain for ROTAX aviation engines.

Figure 9.- Views of the engine before its disassembly in the workshop.

Crankshaft rotation check

Torque was applied to the engine output shaft. It did not rotate freely, moving only in a sector of approximately 30º, corresponding to the play allowed by the engine clutch between the gearbox and the engine output shaft. This indicates that the crankshaft had seized.

Later, after removing the spark plugs and rocker covers, the check was repeated, and the same result was obtained, confirming that the crankshaft had seized.

Dismantling and inspection of components

The spark plugs were removed and found to be in good condition, with no evidence of improper combustion or excess oil in the cylinders.

The carburettors were opened and disassembled; fuel was found in the bowls, which were clean and in good condition.

The rocker covers of all four cylinders were removed; they were found to be in good condition and appeared well-lubricated.

The fuel pump was disassembled and inspected; there was no damage to the sensor and no evidence of the passage of any shavings dislodged from other parts of the engine.

The propeller governor was disassembled, inspected, and found to be in good condition.

The alternator was disassembled and inspected; there was no damage to the ignition housing or the alternator itself.

Lubrication system

The oil lines and radiator were inspected and found to be in good condition.

The magnetic drain plug was removed; a large quantity of ferromagnetic particles were found attached to it.

The oil filter was disassembled and opened; a large quantity of ferromagnetic particles were found attached to it.

The oil pump was dismantled and inspected; there was no evidence of the passage of any shavings dislodged from other parts of the engine, nor any other damage.

Gearbox

All the components were disassembled and inspected, confirming typical wear and tear consistent with normal engine operation.

Metal particles were found in the bottom of the housing and there was a significant accumulation of shavings in the area around the magnetic chip detector housing.

In addition, the overload clutch housing was displaced (rotated) away from its original position.

Crankcase and cylinders

Once all the external components of the engine had been disassembled, a crack in the wall of the crankcase itself was found on the upper surface of the right half-crankcase, in the area corresponding to the movement area of cylinder no. 1; the connecting rod of piston no.1 was visible through it, protruding from the wall.

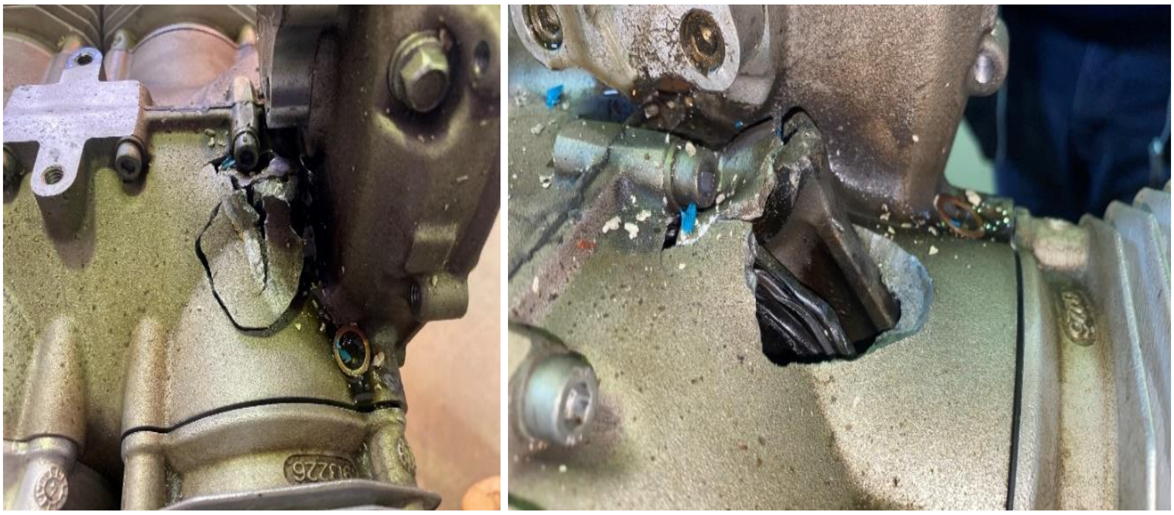


Figure 10.- Crack in the upper surface of the right half-crankcase and the connecting rod of piston no. 1 protruding.

The cylinders and pistons were disassembled, and the following observations were made for each one:

Cylinder no. 1:

- Cylinder skirt damaged and with material loss.
- Piston degraded and with material loss from the skirt.
- Connecting rod in two parts, with signs of plastic deformation due to overheating. The larger part was attached to the piston, exhibiting evidence of severe stretching and deformation in the head area. The other part remained on the crankpin and also displayed signs of severe stretching and deformation.

Figure 11.- Connecting rod, piston and crankpin of cylinder no. 1

Cylinder no. 2:

- Cylinder skirt with damage at the ends.
- Piston degraded with material loss from the skirt and residue deposits in the head.
- Connecting rod intact, with signs of overheating at the foot.

Cylinder no. 3:

- Cylinder skirt with damage at the ends.
- Piston degraded and with material loss from the skirt.
- Connecting rod intact, with signs of overheating at the foot.

Cylinder no. 4:

- Cylinder skirt damaged and with material loss.
- Piston degraded with material loss from the skirt and residue deposits in the head.
- Connecting rod in two parts, with signs of plastic deformation due to overheating. One part was attached to the piston and the other remained on the crankpin with signs of severe stretching and deformation.

Figure 12.- Connecting rod, piston and crankpin of cylinder no. 4

The two half-crankcases were separated; shavings and loose material were found inside, and damage was identified in different areas. No oil flow holes were found to be clogged.

The camshaft was in its housing and intact. There was no malfunctioning damage to the camshaft and tappets, nor any damage caused by lubrication deficiencies. No oil flow holes were found to be clogged.

The crankshaft was supported in its bearings and remained intact, with all three bearings exhibiting heavy wear. No oil flow holes were found to be clogged.

Figure 13.- Crankshaft and camshaft.

1.16.3. <u>Recording of the oil consumed by the engines.</u>

The operator records the quantities of oil added to each engine by making entries in its Aircraft Technical Log. To this end, the pilot conducting the pre-flight inspection must note whether the amount of oil in the tank is adequate or not and the amount of oil added if it is not.

As of the date of this accident, the operator did have a procedure to monitor the oil consumption of the engines fitted to the aircraft in its fleet, based on the notes made by the pilots in the Aircraft Technical Log and without verification of the oil levels in the engines by maintenance personnel.

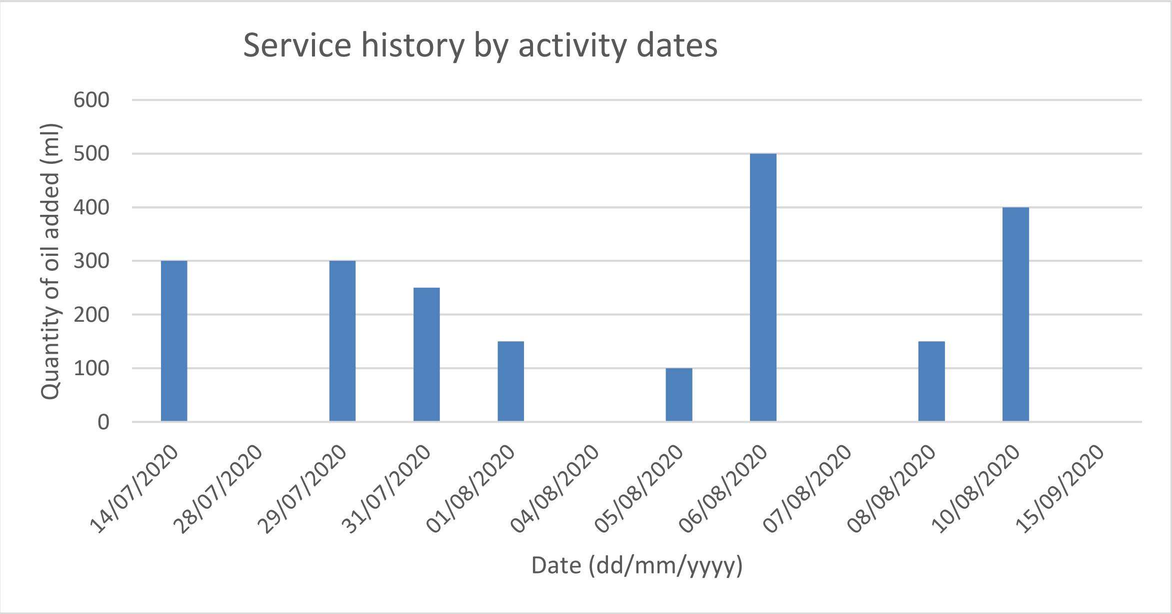
As a consequence of this accident, the operator took the following action:

> *Whenever aircraft equipped with a Rotax engine are put into operation, a maintenance technician will perform an* ***oil level check*** *every morning. This check responds to the need to ensure the correct oil level before each flight. A technician will carry out the first check, and the subsequent checks will be carried out by the student under the supervision of an instructor and in coordination with the training department.*

With regard to the aircraft involved in the accident, based on the corresponding flight logs completed between 14/07/2020 and the time of the accident (16/09/2020), the oil consumption values, and service frequencies were calculated as follows:

Total flight cycles in the period	48
Total flight hours in the period (hours:minutes)	40:55
Total flight hours in the period (decimal hours)	40.92
Oil consumed in the period (l)	2.15
Average oil consumption in the period (l/h)	0.053[3]
Average number of flight cycles between oil additions (Flight cycles)	3.4
Average number of flight hours between oil additions (Flight hours)	2.9

Furthermore, the oil service history during this period was as follows:



[3] According to OPERATOR MANUAL FOR ROTAX ENGINE TYPE 912 paragraph 2.5) Operating media-Lubricants, the maximum allowed oil consumption is 0.06 l/h (0.13 liq pt/h).

1.17. Organisational and management information.

1.17.1. The operator's landing procedure

The operator of the accident aircraft was CESDA-REGO Foundation, a training organisation approved by Spain's National Aviation Safety Agency (E-ATO-247). Its base is at Reus Airport.

The operator's checklist sets out the following approach procedure:

1. Safety belts	fastened.
2. Flaps	as required.
3. Speed	Flaps CRUISE 69 KIAS Flaps T/O 65 KIAS Flaps LDG 60 KIAS
4. Electric fuel pump	on
5. Carburettor heating	on below 18” of manifold pressure (MAN)
6. Propeller control	2,260 RPM

On final:

1. Propeller control	full forward.
2. Flaps	as required.
3. Speed	Flaps CRUISE 69 KIAS Flaps T/O 65 KIAS Flaps LDG 60 KIAS
4. Landing lights	check on
5. Fuel pump	check on
6. Landing clearance	received
7. Brakes	check free

The operator's procedure sets out the following landing procedure in the event of engine failure:

1. Speed	Flaps CRUISE 65 KIAS. Flaps T/O & LDG 57 KIAS
2. Fuel shut-off valve	closed.
3. Magnetos	off.
4. Safety belts	fastened.
5. Radio transmission	notify intentions and location.
6. Flaps	as required.

7. Battery off.
8. After landing apply brakes.

1.17.2. Measures taken by the operator.

The Rego Foundation has adopted a series of short-term measures designed to improve the skills of its instructors and the training given to its students, in order to enhance the safety of solo student flights.

With regard to the instructors, they will run two refresher courses that are to include training in various areas (safety, ATO, maintenance, etc.), a theory exam and a flight or simulator test.

The students will also be given refresher courses – both theory and practical – before returning to solo flight.

Additionally, the Foundation has drawn up an internal action plan that includes the adoption of measures focused chiefly on the medium and long term. This plan is based on four key concepts: training, operational safety, compliance and airworthiness. In relation to said plan, the following should be highlighted:

Training

- Bolster the structure of the training department through the recruitment of additional staff.
- Standardise procedures.
- Bolster solo flight operations.
- Bolster the human factors.
- 80% of students' training flights will be with the same instructor (junior) until their first solo flight, while the remainder will be with a senior instructor for the checks.
- Efforts will be made to ensure that the times between flights for each student are as short as possible, to prevent situations in which a student has to fly solo after a long period without flying.
- Review the DA20 course. Includes the extension of the students' safety course from 2 hours to 6 hours. The aim of this measure is to improve the students' capacity to identify emergencies.
- Impose the requirement to carry out all landings while gliding (i.e. with the engine idling) once the approach is assured, in order to improve students' awareness of how an aircraft behaves during an engine failure.

Operational safety

- Increase the size of the Safety Department.
- Plan a new safety course as part of the course for the DA20 aircraft. The aim of this measure is to improve the students' capacity to identify emergencies.
- Implement a new safety management system (SMS).

Compliance

- Recruit a pilot with experience and knowledge of the regulations that apply to the ATO.
- Draw up an annual audit plan so that all of the organisation's departments can be audited on an annual basis.
- Draw up plans for corrective and preventive actions based on the information arising from the audits.

Airworthiness

- Perform oil changes in ROTAX engines every 25 hours of flight, instead of the 50 hours of operation recommended by the engine manufacturer.
- Reduce the time between general overhauls of ROTAX engines from 2,000 hours to 1,000 hours. This measure was implemented in September 2021 and was carried out in cooperation with the CAMO manager and with the approval of the Rego Foundation management.

1.18. Additional information.

On 19 April 2021, a DIAMOND DA20-C1 aircraft, registration EC-LAO, operated by the Rego Foundation, was involved in an accident during a solo student flight. The CIAIAC conducted an investigation into the event, reference A-011/2021, and the resulting final report has been published and contains a Safety Recommendation (REC 18/22) addressed to the Rego Foundation ATO.

On 8 May 2021, a Diamond DA20-A1 aircraft with registration EC-MOF and callsign ROG5FFZ took off from Reus Airport (Tarragona) to carry out a one-hour local flight with a student as the only person on board. The CIAIAC conducted an investigation into the event, reference A-014/2021, and the resulting report was published in May 2023.

Investigations A-011/2021, A-014/2021 and the investigation that forms the basis of this report (A-039/2020) have several factors in common, which have been previously outlined in investigation A-014/2021 and which are recalled here again:

- the operator was the same (the Rego Foundation ATO) for both flights.
- the aircraft model was the same (DA20), although they had different engines.
- in all the cases, the pilot was a student pilot flying solo.
- the student pilots experienced difficulties in resolving the emergency that had occurred.
- the student pilots executed turns and manoeuvres close to the ground that ended in an accident.

During the investigations into the three accidents, several deficiencies that affected operational safety came to light. As a result, the ATO that operated the aircraft adopted a number of corrective measures, which have helped to improve the safety of the operations carried out by the Rego Foundation ATO. These measures are detailed in point 1.17.2.

In report A-011/2021, the following safety recommendation was issued to the Rego Foundation ATO, recommending it bolster its students' training in said aspects:

REC 18/22. It is recommended that the Rego Foundation ATO bolster its students' training with a view to perfecting their skills in the following areas:

- Identification and confirmation of emergencies/anomalies during a flight.
- Selection of emergency landing sites and techniques for the early detection of obstacles.
- Performance of turns/manoeuvres close to the ground with and without engine power.

1.19. Useful or effective investigation techniques.

None applied.

2. ANALYSIS.

2.1. Operational analysis

According to the student's statement, on the day of the accident flight, the visibility was poor at the circuit altitude, so he decided to fly the traffic circuits at 1,100 ft in order to fly in visual conditions. This meant that at the time of the emergency, the aircraft was 150 ft below the circuit altitude.

In the traffic circuit in which the engine failure occurred, the student reported that the controller asked him to extend the downwind leg. However, this did not happen, as confirmed by the transcript of the communications included in paragraph 1.9. Therefore, it was the student who decided when to turn to the base leg.

In terms of identifying the engine failure, the student did not appear to have any doubts about what was happening. According to his statement, he initially noticed a smell of burning, checked the engine parameters and saw that the oil pressure gauge was below the lower limit, indicating that something was wrong with the engine; shortly afterwards, he noticed that the propeller had stopped turning, a clear sign that the engine had stopped.

The radar track images show that when the student initiated the turn from the downwind leg to the base leg, the aircraft was 1.9 NM from the runway. By this point, the engine failure had already occurred, as evidenced by the fact that the aircraft had descended to 900 feet while maintaining a speed of 80 kt.

It should be noted that at this point, the student had the aircraft configured with the flaps in the take-off position; to achieve maximum range in this configuration, he should have set the speed to 57 kt, as per the procedure for landing in the event of engine failure (see section 1.17.1). In fact, in the situation he was confronted with, to achieve the longest possible range, he should have first retracted the flaps and adjusted the speed to 65 kt and then, with the runway in reach, adjusted the speed to 57 kt with the flaps in the take-off position.

To summarise, the student flew further away than necessary before turning to the base leg; the aircraft was flying below the circuit altitude at the time of the engine failure; and, lastly, the student did not trim the aircraft or adjust the speed to achieve the optimum glide angle. These factors combined to prevent the aircraft from reaching the runway, forcing the pilot to land inside the airport perimeter.

Moreover, the runway at Reus is 2,459 m long, which would have been more than enough distance for the student to have landed safely on the runway if he had turned to the base leg earlier, when he became aware of the engine's oil pressure issue.

2.2. Analysis of the operator’s procedures

The investigation revealed that, as a rule, the students did not perform a sufficient number of landings with the throttle at idle. As a result, the students were not able to establish the distance required for the aircraft to reach the runway in a glide from any given point in the circuit.

With regard to this point, the operator has already taken the measures outlined in paragraph 1.17.2, specifying an "Obligation to perform all landings in glide (engine idle) once the landing is assured, in order to improve the students' awareness of how the aircraft behaves in an engine failure", and therefore, given that it has taken the appropriate preventive measures, no safety recommendation will be issued.

Additionally, without prejudice to the measures adopted in the internal action plan, it should nevertheless be clarified that the proposed plan to improve the trainees' awareness of how the aircraft behaves when landing with an engine failure should be understood as complementary to the performance of landings in accordance with normal procedures.

2.3. Analysis of the engine failure

The student stated that during the pre-flight inspection, he followed the manufacturer's procedure for checking the engine oil level before start-up and that it was within the specified limits.

Furthermore, prior to the date of the accident, the operator did have a method to monitor the oil consumption of the engines fitted to the aircraft in its fleet, based on the notes made by the pilots in the Aircraft Technical Log and without verification of the oil levels in the engines by maintenance personnel. After the accident, the method was changed to specify that a maintenance technician would be responsible for checking the oil level of the engines before the first flight of the day. This allows the operator to monitor how much oil the engines are consuming and identify any consuming more oil than normal.

During the inspection of the engine, it was found that the engine was operating at a higher temperature than usual due to the limited amount of oil in the engine, which was estimated at one litre and clearly below the minimum required, preventing the engine from being properly cooled and lubricated.

3. CONCLUSIONS.

3.1. Findings.

- The student pilot was flying 100 ft below the circuit altitude.
- The student pilot realised on the downwind leg that he was having engine problems.
- The student pilot turned to base at a distance of more than 45º from the runway centreline.
- The engine stopped during the turn to base.
- The student pilot maintained the flap setting after the engine failure.
- The engine was operating with less than the minimum amount of oil required for adequate operation.
- The engine failure was caused by insufficient lubrication of the internal engine components.

3.2. Causes/contributing factors.

The investigation has concluded that the accident occurred due to the emergency off-airfield landing following an in-flight engine shutdown with the aircraft in aerodrome traffic pattern and incorrect execution of standard operating procedures, in particular the accomplishment of the pre-flight inspection.

4. SAFETY RECOMMENDATIONS.

No safety recommendations have been issued as a result of the investigation into this accident.