# Technical report
# ULM A-014/2022

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## Accident on 5 June 2022 involving a TECNAM model P96-G aircraft, registration EC-FO7, in the municipality of Pilar de la Horadada (Alicante /Alacant, Spain)

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

# Notice

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 and its causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.6 of Regulation (UE) nº 996/2010, of the European Parliament and 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 civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it is 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, any use of this report for purposes other than that of preventing 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.

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# ABBREVIATIONS

| | |
|---|---|
| 00º 00’ 00” | Degrees, minutes and seconds |
| AEMET | State Meteorological Agency |
| AESA | Spain’s National Aviation Safety Agency |
| APP | Approach Control Service |
| CITAAM | Commission for the Technical Investigation of Military Aircraft Accidents |
| CTR | Control zone |
| FI(MAF) | Multi-axis fixed-wing aircraft instructor |
| ft | Feet |
| h | Hours |
| IGN | National Geographic Institute |
| kg | Kilos |
| km/h | Kilometres per hour |
| kt | Knots |
| m/s | Metres per second |
| MAF | Multi-axis fixed-wing |
| masl | Metres above sea level |
| QNH | Altimeter subscale adjustment to obtain elevation while over land (precision adjustment to indicate elevation above mean sea level) |
| R/TC | Spanish-speaking radio telephonist |
| RD | Royal Decree |
| rpm | Revolutions per minute |
| TBO | Time between overhaul |
| ULM | Ultralight motorised aircraft |
| UTC | Coordinated universal time |
| VFR | Visual flight rules |

# Technical report

# ULM A-014/2022

| | |
|---|---|
| **Owner and Operator:** | Aeroclub Mar Menor. |
| **Aircraft:** | TECNAM P96-GOLF, EC-FO7 (Spain). |
| **Date and time of the accident:** | 05 June 2022 at 20:50 h local time[1]. |
| **Site of the accident:** | Municipality of Pilar de la Horadada (Alicante / Alacant). |
| **Persons on board:** | 1 (crew member), 1 (passenger). |
| **Type of operation:** | General Aviation – Commercial – Others. |
| **Phase of flight:** | En route – cruising. |
| **Flight Rules** | VFR. |
| **Date of approval:** | 29 March 2023. |

# Synopsis

**Summary:**

On Sunday, 5 June 2022, at approximately 20:20 h, the TECNAM P96-G aircraft with registration EC-FO7 took off from Los Garranchos Aerodrome with the pilot and a passenger on board, intending to carry out a local flight and return to land at Los Garranchos.

During the cruise phase, the aircraft's engine cut out. After several unsuccessful attempts to restart it, the pilot carried out an emergency landing in an agricultural field.

As a result of the accident, the aircraft sustained significant damage to its landing gear, propeller, forward fuselage and engine.

Both the pilot and the passenger were uninjured.

The investigation has determined that the probable cause of the accident was the emergency landing carried out following an engine shutdown caused by a broken engine connecting rod.

The fact that the engine was fitted with a connecting rod-crankshaft assembly that had been declared non-airworthy by a specialist ROTAX engine workshop is considered to be a contributory factor.

The report contains four safety recommendations: one issued to the aircraft manufacturer (TECNAM), one to the AIR MONKEY MECH maintenance workshop, one to the engine manufacturer (ROTAX) and another to AESA.

[1] All times in this report are expressed in local time. UTC can be calculated by subtracting 2 h from the local time.

# 1. FACTUAL INFORMATION

## 1.1. History of the flight

On Sunday, 5 June 2022, at approximately 20:20 h, the TECNAM P96-GOLF aircraft with registration EC-FO7 took off from Los Garranchos Aerodrome with the pilot and a passenger on board, intending to carry out a local flight and return to land at Los Garranchos. The affected flight was an introductory flight.

It was the second flight of the afternoon and the fifth flight of the day for the aircraft. The four previous flights, each lasting approximately one hour, had passed without incident. Furthermore, according to the pilot, no abnormalities had been found during the pre-flight inspection in the morning or the afternoon, and the pilot had checked, among other things, that the oil level was adequate.

According to the pilot's statement, the flight proceeded normally until, at about 1,500 ft above the QNH of San Javier at a speed of about 160 km/h, flying over the estimated coordinates 37º 55' 19" north - 0º 51' 35" west and with the aircraft stabilised on the flight line and no action on the throttle, the engine suddenly and unexpectedly stopped with a dull and loud "clank" and without making any unusual noises beforehand.

After checking that the magnetos and the auxiliary fuel pump were on, that both fuel valves were open and that the throttle was at idle, the pilot turned the ignition key to try to start the engine, but the propeller would not turn.

Faced with this situation, the pilot maintained a glide speed of about 120 km/h and, after radioing the approach control service (APP) at San Javier Air Base to declare an emergency due to an engine shutdown, he began to look for a place to make an emergency landing. He spotted a suitable field about thirty degrees to the right of his course. It was an agricultural field with multiple ridges running transversally to his direction of travel. Once he had selected the field, he began to manage the emergency landing, telling the passenger that he was going to conduct a forced landing and to re-tighten their safety belt.

In the final phase of the emergency landing, the pilot maintained a speed of 120 km/h and, after avoiding the road and some trees close to the agricultural field, configured the aircraft with full flaps while instructing the passenger to prepare for the touchdown. The pilot readied to land perpendicular to the ridges, as landing parallel to them would not provide enough distance to land safely.

According to the pilot's statement, moments before touch down, he lifted the aircraft's nose slightly and slowed down to about 80 km/h before making contact with the main gear. With its main gear on the ground, the aircraft taxied, traversing the ridges until its nose wheel also made contact and dug into one of the ridges, bringing it to an abrupt stop.

With the aircraft at a standstill, the pilot closed the fuel valve, removed the key from the ignition to cut off the power, and checked that the magnetos and the fuel pump were switched off. After checking that the passenger was OK, the pilot opened the cockpit, and they exited the aircraft unaided.

As a result of the accident, the aircraft sustained significant damage to its landing gear, propeller, forward fuselage and engine.

It should be noted that, according to the pilot and the passenger, a couple of minutes before the engine shutdown, the pilot had shown the passenger the parameters to be checked in flight, particularly those relating to the engine and fuel, and had noted that they all displayed

the appropriate readings. In addition, after the engine shutdown, the pilot noticed that the propeller remained stuck and was not rotating.

The figure below shows the trajectory followed by the aircraft as provided by the pilot:

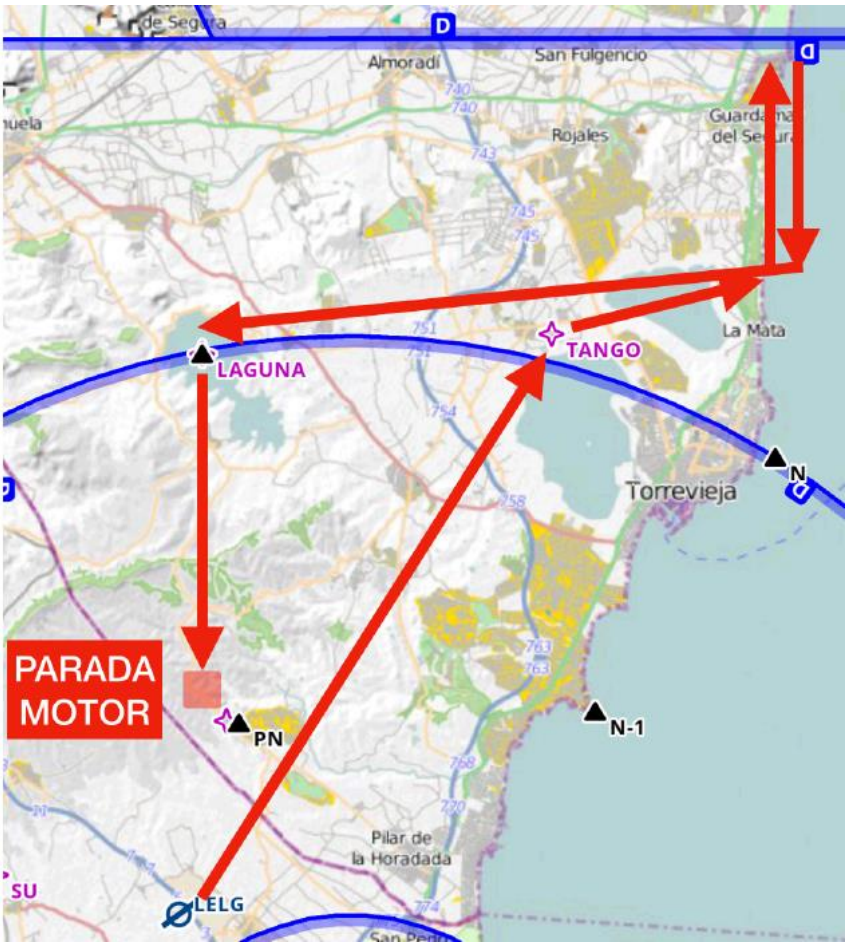


*Figure 1: Trajectory followed by the aircraft as provided by the pilot.*

## 1.2. Injuries to persons

| *Injuries* | *Crew* | *Passengers* | *Total in the aircraft* | *Others* |
|---|---|---|---|---|
| Fatal | - | - | - | - |
| Serious | - | - | - | - |
| Minor | - | - | - | - |
| Unharmed | 1 | 1 | 2 | - |
| TOTAL | 1 | 1 | 2 | - |

## 1.3. Damage to aircraft

The following parts of the aircraft were damaged during the incident:

- Landing gear nose leg.
- Right landing gear leg.
- Propeller.
- Forward part of the fuselage.
- Engine mount and various engine components.

## 1.4. Other damages

There was no other damage.

## 1.5. Personnel information

On the day of the accident, the pilot was 56 years old.

He held an ultralight pilot's license with the following ratings:

- MAF (Valid until 30-04-2023).
- FI(MAF) (Valid until 30-04-2023).
- R/TC (Valid indefinitely while his license remains in effect).

He also held the following medical certificates:

- Class 1 single pilot commercial operations carrying passengers (valid until 15-07-2022).
- Class 1 (valid until 15-01-2023).
- Class 2 (valid until 15-01-2023).

In terms of flight experience, the pilot had been an ultralight pilot as well as a general aviation pilot, a military aviation pilot and a civilian commercial pilot, having accumulated, at the time of the accident, more than 11,000 hours of flight time between the various modes.

In the two years prior to the accident, the pilot had accumulated 225:02 hours of flight time and 74:55 hours of instructional flight time, half of which were in the accident aircraft. With regard to his ultralight flight experience, he obtained his licence in 2003 and his instructor rating in 2006. He had renewed his pilot's licence at Los Garranchos in 2020.

In terms of his flight activity on the day of the accident, it was his third flight that day, and he had flown the previous flights in the same aircraft. The first flight began at 11:00 h and lasted for 42 minutes. The second began at 19:00 h and lasted 54 minutes. His most recent flight prior to that day was on 30-05-2022.

## 1.6. Aircraft information

### 1.6.1. General aircraft information

- Make: TECNAM
- Model: P96-GOLF
- Year of manufacture: 2008
- Serial number: P96-G-308
- Maximum take-off weight: 450 kg
- Type of engine: ROTAX 912 ULS2
- Information about the operator and the owner: Aeroclub Mar Menor

The TECNAM P96-GOLF ultralight aircraft with registration number EC-FO7 and serial number P96-G-308 is a single-engine low-wing aircraft with fixed tricycle-type landing gear and two side-by-side seats.

The aircraft has a wingspan of 8.4 metres, a length of 6.4 metres and a height of 2.3 metres.

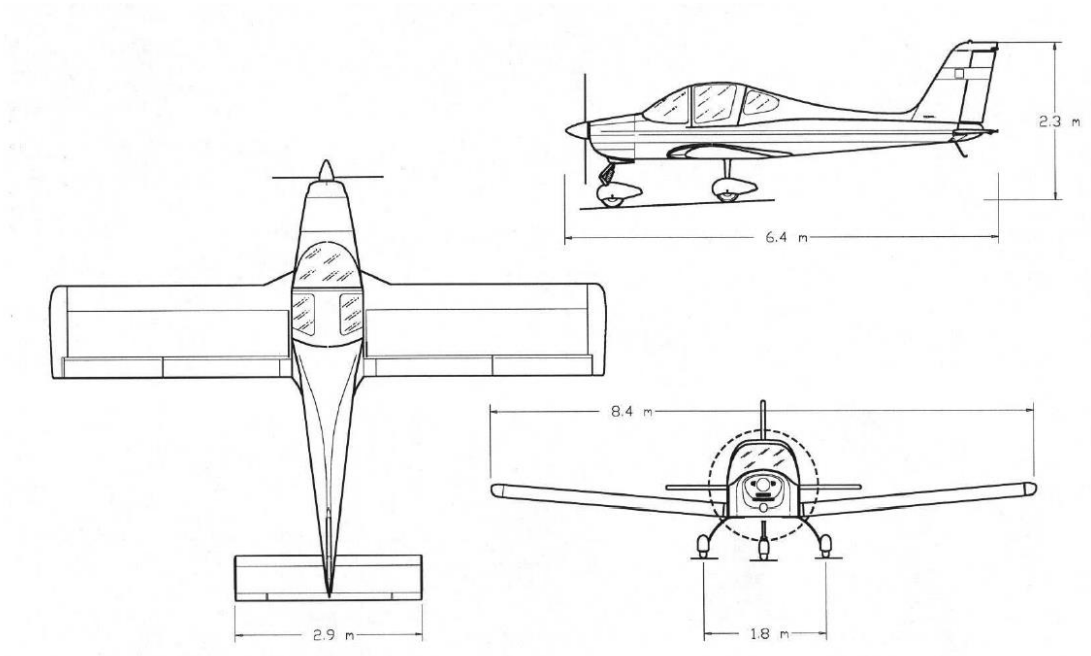


*Figure 2: Drawings of the TECNAM P96-GOLF aircraft.*

The aircraft is equipped with a ROTAX 912 ULS2 engine. This four-stroke engine has four horizontally opposed two-by-two cylinders capable of providing a maximum power output of 100 hp. It has the following relevant features:

- Liquid and air-cooled cylinders.
- Dry sump and forced lubrication via an external 3-litre oil tank.
- Integral connecting rod-crankshaft assembly.

At the time of the accident, as specified in the respective records, the airframe had accumulated 2,310 hours and 24 minutes of flight time, and the engine had 2,225 hours of operation.

At the time of the accident, the aircraft's hour meter read 1,923 hours.

The aircraft had a registration certificate and a school category restricted airworthiness certificate issued in November 2008.

### 1.6.2. Particular aircraft information

- The cabin's canopy slides on wheel bearings along tracks located on fuselage sides; canopy is made of composite material. Latching system uses a central lever located overhead and two additional levers positioned on canopy's sides.
- Flaps are extended via an electric servo actuator controlled by a switch on the dashboard. Flaps act in continuous mode, so it is necessary to maintain the switch activated until the desired flap position is reached.

### 1.6.3. Aspects related to the engine maintenance

The last engine maintenance inspection was carried out on 09-05-2022 when the aircraft's hour meter read 1,898 hours. The maintenance tasks, which were conducted by AIR MONKEY MECH, included the following:

- Full engine metrology
- Engine crankcase replacement
- Valve seating
- Cylinder head seat grinding
- Cylinder seat grinding
- Replacement of internal engine gaskets
- Replacement of crankshaft semi-bushings
- Replacement of complete set of hydraulic tappets
- Complete general overhaul of carburettors, mechanical and vacuum gauge tuning
- Replacement of connecting rod-crank assembly.

The two maintenance tasks immediately prior to 09-05-2022 were 100-hour inspections, with nothing to report.

### 1.6.4. Aspects related to the history of the engine

- On the day of the accident, the aircraft was equipped with a ROTAX 912 ULS2 engine with S/N 4428502. This engine was fitted to the aircraft in May 2017 with 450 accumulated operating hours.
- As indicated in the previous section and based on the information provided by the owner and operator of the aircraft, during the last maintenance inspection on 09-05-

2022, carried out 25 hours before the accident, the connecting rod-crankshaft assembly installed in the engine was replaced with a second-hand one. The S/N of this second-hand connecting rod-crankshaft assembly was 22133.

- The Civil Aviation Safety Investigation Authority of Austria was asked for information about the connecting rod-crankshaft assembly with S/N 22133. They reported that it was originally fitted to an engine with S/N 5645619, manufactured in October 2005.
- Information was then requested from the workshop where the engine with S/N 5645619 had been serviced. The workshop, which specialises in the maintenance of ROTAX engines, reported that maintenance work was carried out on that engine between 2008 and 2010 and that later, in August 2017, the owners took the engine back to the workshop because connecting rod-crankshaft assembly S/N 22133 was out of tolerance. After verifying that this was the case, the workshop staff replaced the connecting rod-crankshaft assembly with another one. The replaced connecting rod-crankshaft assembly with S/N 22133 was handed over to the owners.
- In May 2022, the AIR MONKEY MECH maintenance shop installed the connecting rod-crankshaft assembly with S/N 22133 in the engine fitted to the accident aircraft after verifying that it was within tolerances and conducting a favourable visual inspection. The flight hours and date of manufacture of the crankshaft assembly were not known. The aforementioned connecting rod – crankshaft assembly was installed in an engine which was supplied by the owner of the aircraft to AIR MONKEY MECH maintenance shop. That engine was second-hand and was purchased without knowing any information relating the history of the engine. Apart from the connecting rod – crankshaft assembly, the crankcase of this second-hand engine was also installed in the aircraft engine, as indicated in 1.6.3.

#### 1.6.5. Aspects related to the engine maintenance prescribed by the manufacturer:

The following relevant information is extracted from the engine manufacturer's manuals:

- For both the engine with S/N 4428502 and the engine with S/N 5645619, the engine overhaul is to be carried out every 1,500 hours or 12 years.
- The time intervals for carrying out the scheduled maintenance tasks specified in the Maintenance Manual are every 50 h, 100 h/yearly, 200 h, 400 h, 600 h and 1000 h. None of these tasks involves inspecting the connecting rod-crankshaft assembly.
- The connecting rod-crankshaft assembly is inspected during the engine overhaul, if the propeller strikes the ground or if a certain RPM is exceeded during operation. For the last two events, the inspection consists of a visual inspection and checking that the connecting rod – crankshaft assembly is within the permissible tolerances.
- Both line maintenance manual and heavy maintenance manual establishes that the connecting rod – crankshaft assembly must be replaced only in case of exceeding 6500 rpm or in case the oil pressure is lower than 0,5 bar during the flight.
- The overhaul manual establishes that the connecting rod – crankshaft assembly is a 100% replacement part and must be replaced in the engine overhaul.

It should be noted that the aforementioned overhaul manual is restricted (it is only available in ROTAX website upon request, contrary to the line maintenance manual and heavy maintenance manual, which are available in ROTAX website without restriction).

## 1.7. Meteorological information

There was no significant meteorological information for the vicinity of the aerodrome.

The 18 UTC low-level map provided by AEMET, shown in Figure 3 (valid three hours before and after 18 UTC), shows that no aviation-significant phenomena were expected over the accident area.

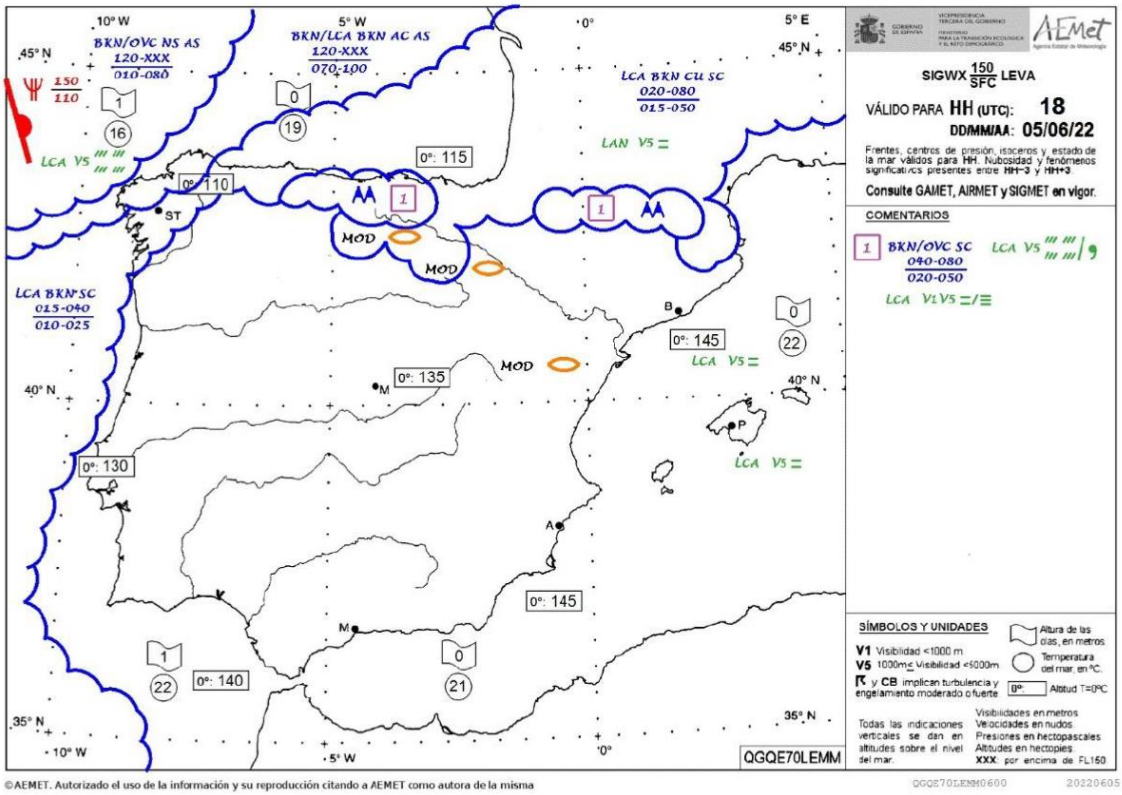


*Figure 3: Significant low-level weather map provided by AEMET.*

The information gathered by the pilot before the flight indicated that the weather conditions on the day of the accident were favourable. This information was gathered from the weather station at the aerodrome, which can be accessed through the aeroclub's website, and also from mobile weather apps.

Therefore, the weather conditions did not place any limitations on the operation.

Lastly, according to the IGN website, on 05-06-2022, sunset was at 21:24 h.

## 1.8. Aids to navigation

N/A.

## 1.9. Communications

The communications between APP at San Javier Air Base, the accident aircraft (EC-FO7) and another aircraft in the area (EC-FH8) were forwarded to the investigation by CITAAM.

At 20:50 h, the pilot of aircraft EC-FO7 contacted APP at San Javier Air Base, declaring an emergency due to an engine shutdown. The controller copied the information and asked about the occupants on board, to which the pilot replied that there were two.

Seconds later, the pilot of the EC-FH8 aircraft called the controller to report that he had heard the communication from the EC-FO7 aircraft. The controller gave him the approximate position of the EC-FO7 aircraft. After copying that information, the pilot of the EC-FH8 aircraft requested permission from the controller to proceed to that location and received an affirmative response.

Minutes later, after the accident aircraft had landed, the pilot of the EC-FH8 aircraft transmitted the coordinates of the accident aircraft's position to the controller.

## 1.10. Aerodrome information

Los Garranchos Aerodrome is a restricted-use aerodrome located in the municipality of San Javier (Murcia). It is a private aerodrome managed and run by Aeroclub Mar Menor.

It has an asphalt runway designated 06-24 and measures approximately 290 metres between thresholds. The airfield's elevation is 90 metres above sea level.

## 1.11. Flight recorders

The aircraft was not equipped with a flight data or cockpit voice recorder because they are not a regulatory requirement for this type of aircraft.

However, CITAAM provided the radar trace of the aircraft, which corroborated the information provided by the pilot and included in point 1.1 above.

## 1.12. Wreckage and impact information

The aircraft made an emergency landing in a field covered in multiple ridges, in the municipality of Pilar de la Horadada (Alicante/Alacant).

*Figure 4: Aerial view of the accident site provided by aircraft EC-FH8.*

When access was gained to the accident site, it was found that the Guardia Civil had cordoned off the aircraft and engine, holding the same position as they had been immediately after the accident.

*Figure 5: Aircraft after the accident.*

The following information was gathered during the inspection of the accident site:

- The oil tank was empty.
- The lubrication lines were in good condition, with no leaks, and securely fixed in position. On cutting one of the pipes to free the engine, oil came out of it.
- The engine was covered with oil.

- The coolant tank was full, as was the radiator. The coolant fluid appeared as expected.
- The aircraft's tanks contained fuel.
- There was fuel in the carburettor float chambers.
- There was a hole in the crankcase.
- Cracks were observed in the nose leg and right landing gear leg, the propeller, the forward part of the fuselage, the engine mount and various engine components.

The structure and characteristics of the rest of the aircraft remained intact, with no apparent damage.

After the field inspection, the engine was removed and subjected to a detailed inspection in a specialised ROTAX engine workshop. During the de-installation and transport, it was noted that there was oil inside the engine.

*Figure 6: Damage observed at the accident site.*

## 1.13. Medical and pathological information

There is no evidence of any physiological or psychological factors that may have affected the pilot's actions.

## 1.14. Fire

There were no signs of fire during the flight or after the impact.

## 1.15. Survival aspects

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

The following points are of note:

- During the emergency, the pilot did not follow the relevant procedure as per the Flight Manual (see section 1.18.2) in that he did not release door safety lock and unlatch doors of the cockpit canopy. When questioned about this, the pilot stated that if you comply with the procedure to unlock and open the cockpit canopy, it is free to slide back and forth as it is not locked. Thus, should an emergency landing involve sharp acceleration, the canopy would slide freely, putting the occupants at risk of receiving a severe guillotine-like blow to the head. The pilot also stated that while he is aware that leaving the canopy closed also carries a risk of injury because it could deform during a heavy landing, in his opinion, this outcome would be the lesser of two evils given the risk posed by a freely moving canopy during an emergency landing.
- The pilot noticed after the emergency landing that the fuel shut-off valves were open. He is aware that he should have closed them before landing.

The pilot and passenger walked away from the accident unharmed and did not require medical attention.

## 1.16. Tests and research

After the wreckage inspection at the accident site, the aircraft engine was removed from the aircraft and disassembled and inspected at a specialised ROTAX engine workshop.

The most relevant findings are outlined below:

- The magnetic plug had some chips.
- The spark plugs were of acceptable colour and appearance.
- There was little oil inside the oil filter.
- The oil pump was disassembled. It was noted that there was little oil inside. The pump appeared to be in good condition.
- The gearbox was disassembled. It was noted that there was an acceptable amount of oil inside. The gearbox appeared to be in good condition.
- The crankcase had two holes in the area of cylinder #2, one at the top and one at the bottom:

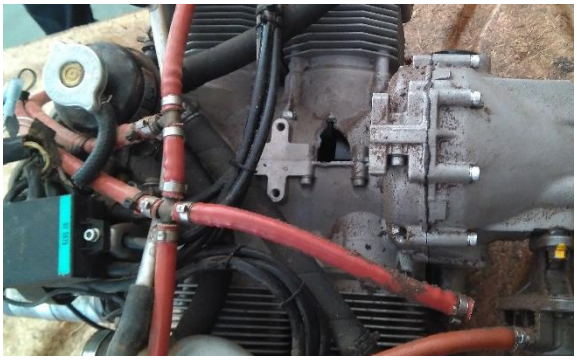

*Figure 7: Close-up of crankcase rupture (1).*

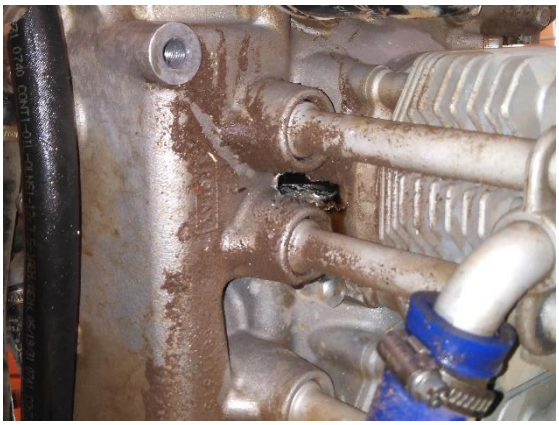

*Figure 8: Close-up of crankcase rupture (2).*

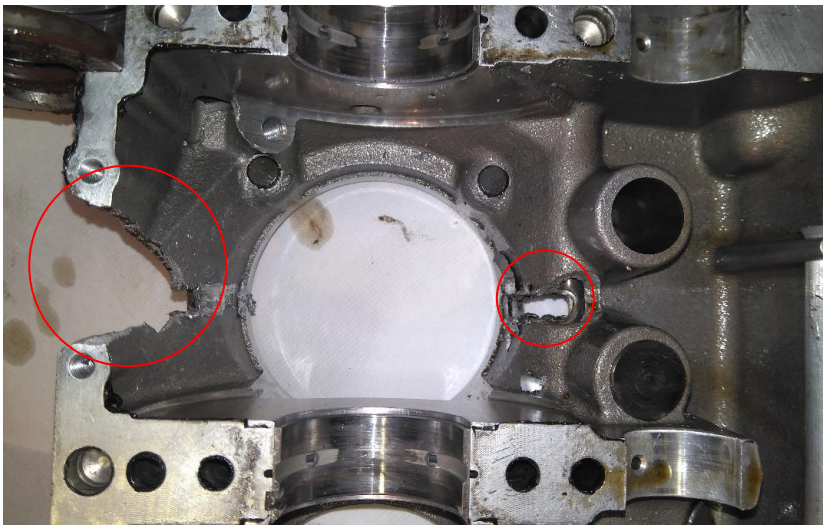

*Figure 9: Close-up of crankcase rupture (3).*

- On opening the crankcase, it was noted that the connecting rod of cylinder #2 was broken off at the small end. In addition, it was twisted and interfering with the crankshaft. The connecting rod of cylinder #1 was also twisted around its axis.

*Figure 10: Close-up of connecting rod rupture (foot end).*

*Figure 11: Close-up of connecting rod rupture (body end).*

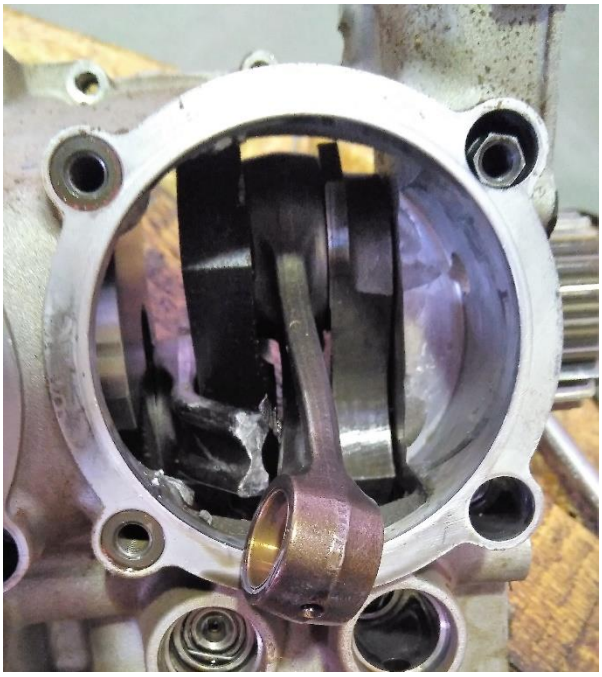

*Figure 12: Close-up of connecting rod #1 and the interference of connecting rod #2 with the crankshaft.*

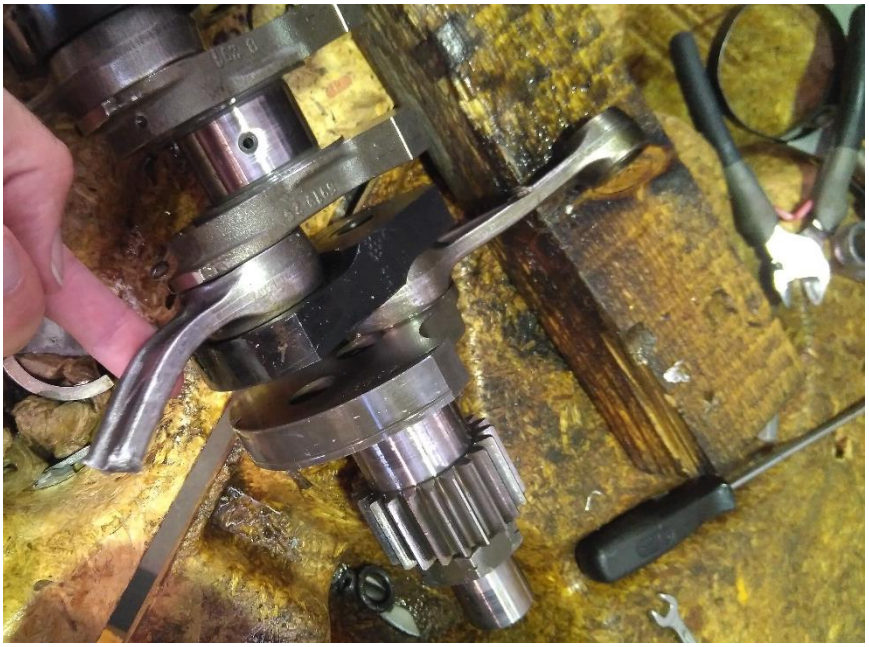

*Figure 13: Connecting rod rupture (overview).*

- There were clamp imprints on the crankshaft:

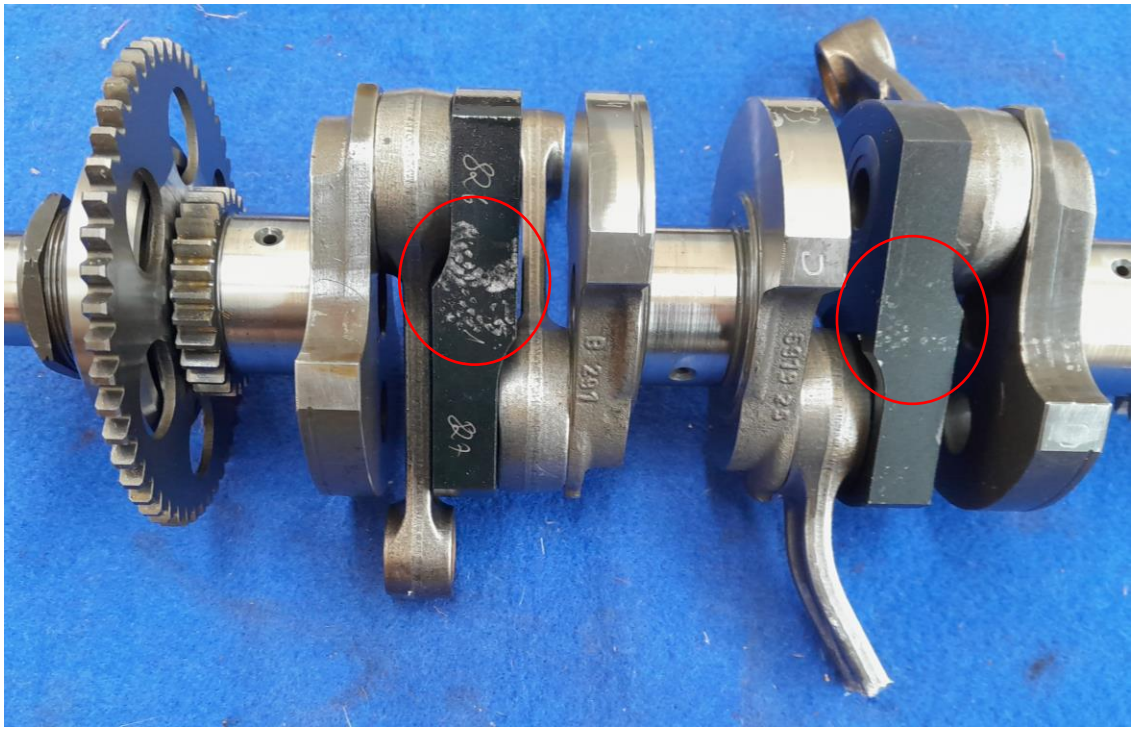

*Figure 14: Close-up of the crankshaft.*

- Several breakages were noted on the lower part of the cylinder on cylinders #1 and #2 and the skirt on pistons #1 and #2:

*Figure 15: Close-up of breakages on cylinder sleeve and piston #2.*

*Figure 16: Close-up of breakages on cylinder sleeve and piston #1.*

- The head of piston #2 showed signs of knocking against the intake and exhaust valves.
- Cylinders #1 and #3 were covered in oil.
- All eight hydraulic tappets were found to be in good condition.
- The cylinder heads and pistons were found to be in good condition (apart from the cracks resulting from the engine shutdown).
- There were no signs of engine seizure. The rotation of the connecting rod small end was smooth around their respective pins, as was the rotation of the connecting rod big ends around the crankshaft, with oil present at these points. Traces of oil were also observed around the camshaft.
- There were no signs of engine overheating.

## 1.17. Organizational and management information

The owner and operator of the aircraft is Aeroclub Mar Menor.

Aeroclub Mar Menor conducts ULM training activities (AESA approval ULM-0039) and offers tourist and introductory flights, among others.

They fly within the San Javier CTR with a letter of agreement.

## 1.18. Additional information

### 1.18.1. Information obtained from a workshop authorised by ROTAX to carry out maintenance work on ROTAX engines:

The connecting rod-crankshaft assembly does not need to be extracted from the engine to check if it is within tolerances.

### 1.18.2. Aspects related to the Flight Manual's emergency procedure for engine shutdown:

In the event of an engine shutdown emergency, the aircraft Flight Manual stipulates that the following steps should be followed:

1. Set glide speed to optimal value (60 kt / 111 km/h).
2. Select terrain area most suitable for emergency landing, possibly upwind.
3. Fuel shutoff valves: OFF.
4. Magnetos: OFF.
5. Tighten safety belts, release door safety lock and unlatch door.
6. Flaps: As needed.
7. When ready to land, Master switch: OFF.

Regarding the fifth step, it should be noted that the cockpit of the TECNAM P96 GOLF aircraft is opened by sliding it backwards and does not have a locking mechanism to keep it open.

### 1.18.3. Relevant national regulatory aspects currently applicable to the continuing airworthiness of ultralight aircraft:

The current national legislation provides for the following relevant points of interest:

- Article 10b of the Order of 14 November 1988, which establishes the airworthiness requirements for Motorised Ultralight Aircraft (ULM), states that there must be *"A maintenance book, in which the user shall record important operations affecting maintenance, such as assemblies, disassemblies, propeller and engine replacements or repairs. The noted information must specify the date and aircraft flight hours at the time of the recorded event".*
- Article 12 of the Order of 14 November 1988, which establishes the airworthiness requirements for Motorised Ultralight Aircraft (ULM), states that *"The owner shall be fully responsible for the maintenance and upkeep of the airworthiness of their aircraft" and that "The Civil Aviation Authority reserves the right to inspect the aircraft's condition to check its airworthiness whenever it deems it appropriate".*

- Article 1 of Royal Decree 765/2022 of 20 September[2], which regulates the use of motorised ultralight aircraft (ULM), establishes a new maximum weight for an aircraft to be classified as ultralight, increasing it from 450 kg (+10% for amphibious aircraft) to 600 kg (650 kg for amphibious aircraft).
- The first additional provision of Royal Decree 765/2022 of 20 September, which regulates the use of motorised ultralight aircraft (ULM), establishes that *"The head of the Ministry of Transport, Mobility and the Urban Agenda is authorised to issue the implementing provisions of this Royal Decree, specifically in regard to airworthiness".*

Finally, it should be noted that the current national legislation makes no distinction between privately operated ultralight aircraft and those operated by flight schools or used for any other commercial purpose in terms of continuing airworthiness.

#### 1.18.4. Information in relation to the meeting held with AESA:

A meeting was held with AESA to gather more information regarding the information provided in the previous point. The most relevant information is outlined below:

- With reference to the first additional provision of RD 765/2022, of 20 September, which regulates the use of motorised ultralight aircraft (ULM), AESA is preparing a draft RD to implement RD 765/2022, which is expected to include several points relating to the continued airworthiness of ultralights.
- In this draft RD to implement RD 765/2022, AESA has contemplated distinguishing between the continuing airworthiness maintenance applicable to a privately operated ultralight and that applicable to an ultralight operated by a school.
- As a general rule, AESA does not inspect the continuing airworthiness of ultralight aircraft, irrespective of whether they are operated privately or by a school. However, occasionally, if AESA considers it appropriate (e.g., authorising the entry into service of an aircraft after an accident), it does carry out an airworthiness inspection.

## 1.19. Special investigation techniques

N/A.

[2] Royal Decree 765/2022 of 20 September had not come into force yet by the time the accident took place. It came into force three months after the date of the accident.

## 2. ANALYSIS

The following points were analysed:

- Analysis of the management of the emergency.
- Analysis of the engine shutdown.
- Analysis of the current national regulations applicable to the continued airworthiness of ultralight aircraft.

### 2.1. Analysis of the management of the emergency:

Regarding the management of the emergency, it should be noted that the pilot did not carry out three of the steps required by the emergency procedure for an engine shutdown (see section 1.18.2), specifically, closing the fuel valves, shutting down the aircraft's electrics and opening the cockpit canopy.

With regard to the first and second, closing the fuel valves and ensuring that there is no electrical power to the aircraft is considered of paramount importance to minimise the risk of a fire caused by a fuel spillage and a spark that could ignite the gasoline. Nevertheless, regarding the disconnection of the aircraft's electrics, taking into account, on one hand, the approach circumstances that did not make possible to extend the flaps until the pilot avoided the obstacles close to the field where the emergency land took place, and, on the other hand, the way flaps are actuated (see paragraph 1.6.2), it is considered that the pilot had not enough time to shut down the aircraft's electrics before the emergency landing, taking into account the distance between the aforementioned obstacles and the place where the aircraft landed and the time needed for the flaps to become full extended.

With regard to the third, as stated by the pilot (see paragraph 1.15), opening the cockpit canopy when there is no locking mechanism to keep it in place may be counterproductive given the pronounced accelerations that an aircraft can experience during an emergency landing and the consequent risk of it hitting one of the occupants' heads. A safety recommendation will be issued to the aircraft manufacturer in this regard.

### 2.2. Analysis of the engine shutdown:

Despite the fact that the oil tank was empty and the pump and filter had little oil, engine seizure was ruled out because:

- Evidence was found that the engine was internally lubricated.
- The nature of the damage identified and outlined in point 1.16. does not indicate a seizure.
- The chips found on the magnetic plug were within the acceptable limits.

Therefore, it is believed that the low level of oil in the tank, filter and pump was a consequence of the accident and the position in which the engine was left after the accident and/or the position in which the engine was stored prior to its inspection.

On the other hand, as stated in paragraph 1.6.3, the connecting rod-crankshaft assembly with S/N 22133 (which was in the aircraft's engine on the day of the accident) was originally factory fitted to another engine, with S/N 5645619. This engine (S/N 5645619) was taken in

August 2017 to a specialist ROTAX engine workshop for inspection due to the connecting rod-crankshaft assembly being out of tolerance. Following an inspection in the workshop, it was concluded that the condition of the connecting rod-crankshaft assembly was indeed inadequate, and it was therefore removed and replaced with another one.

Although the maintenance workshop did not record the S/N of the connecting rod-crankshaft assembly removed in August 2017 from the engine with S/N 5645619, it is considered likely that it was the connecting rod-crankshaft assembly with S/N 22133 (the one originally factory fitted), given that:

- As discussed in section 1.6.4, the connecting rod-crankshaft assembly is only inspected as part of the engine overhaul every 1,500 hours, 12 years, or if the propeller strikes the ground or the engine exceeds a certain level of RPM.
- As explained in section 1.18.1., the connecting rod-crankshaft assembly does not need to be extracted from the engine to check if it is within tolerances.

Therefore, it is understood that the connecting rod-crankshaft assembly removed in August 2017 was the connecting rod-crankshaft assembly with S/N 22133.

As of August 2017, this connecting rod-crankshaft assembly with S/N 22133 defined as non-airworthy by the authorised ROTAX engine workshop, was no longer part of the engine with S/N 5645619, to which it was factory fitted.

Between 2017 and 2022, there was no trace of the connecting rod-crankshaft assembly with S/N 22133 until, in May 2022, it was installed, during a general maintenance overhaul, in the engine that was on the aircraft on the day of the accident (engine with S/N 4428502) after checking that it was within tolerances and completing a favourable visual inspection. However, neither the flight hours, the date of manufacture, nor the maintenance history of the aforementioned connecting rod-crankshaft assembly were known.

After 25 hours of flight following this general overhaul, connecting rod #2 of the connecting rod-crankshaft assembly with S/N 22133 failed. This then led to a further chain of internal failures and deformations which caused the connecting rod-crankshaft assembly to jam and, therefore, the engine to cut out.

It is considered that the connecting rod-crankshaft assembly with S/N 22133 was probably within tolerances when it was installed in the engine in May 2022 because, as the clamp marks identified on it suggest, (see Figure 14) it was very likely tampered with to correct the existing deviations and bring it back within tolerances.

Given that the maintenance workshop would not have installed a connecting rod-crank assembly declared non-airworthy by a specialist ROTAX workshop years earlier, even if it was within tolerances and visually acceptable, it can only be assumed that a lack of knowledge of the provenance of the connecting rod-crankshaft assembly led to a part lacking the necessary documentation to prove its airworthiness being installed in the engine of the accident aircraft.

### 2.3. Analysis of the current national regulations applicable to the continued airworthiness maintenance of ultralight aircraft:

As detailed in point 1.18.3, the current Spanish regulations basically provide for the following in regard to the continuing airworthiness of ultralight aircraft:

1) The owner of the aircraft is responsible for its continuing airworthiness maintenance.

2) The authority responsible for the inspection of ultralight aircraft (currently AESA) reserves the right to conduct inspections to determine the airworthiness of the aircraft. Based on the information from the meeting with AESA, these inspections are generally only performed in specific situations, such as, for example, the commissioning of an aircraft after an accident.

3) Moreover, there is no difference between the continuing airworthiness requirements imposed on privately operated ultralight aircraft and those imposed on ultralight aircraft operated by schools or for other commercial uses. Thus, as it stands today, the regulatory requirements applicable to the continued airworthiness maintenance of a privately operated ultralight are exactly the same as those applicable to the continued airworthiness maintenance of an ultralight operated by a school, which generates an economic return for the school and involves the aircraft being used by students and third parties outside the organisation.

4) The aircraft owner is legally obliged to keep a log (maintenance book) in which all maintenance work, repairs, assemblies, disassemblies and replacements carried out on the aircraft and its components must be recorded.

5) There is no requirement to check the airworthiness, provenance and lifetime of a used component before installing it on an ultralight aircraft, regardless of whether it is a privately operated ultralight aircraft or one used by a school or for other commercial purposes.

Therefore, based on the above, it is considered inappropriate that the current national regulations do not distinguish between the private use and the commercial use of an ultralight aircraft in terms of continuing airworthiness requirements, given that:

- Commercial operations involve third parties outside the organisation (students, customers...).
- Royal Decree 765/2022 of 20 September, regulating the use of motorised ultralight aircraft (ULM), has increased the weight range so that aircraft not previously considered ultralights now fall into the category, thereby indirectly increasing the number of ultralight aircraft in the national airspace.

Accordingly, given this increase in the number of ultralight aircraft in operation and, consequently, the number of ultralight aircraft used for training and commercial purposes, it is deemed appropriate, within the framework of the new draft RD being prepared by AESA to implement the recent RD 765/2022, of 20 September, on the use of ULMs, to issue a safety recommendation to AESA, as the body in charge of developing and establishing aeronautical rules for air safety, in relation to the continued airworthiness of, as a minimum, ultralight aircraft used for commercial activities (flight training, tourist flights, introductory

flights, etc.), with the aim of including it in the draft implementing decree as mentioned above.

Lastly, it is considered appropriate that AESA should draw up and disseminate a leaflet outlining the most relevant requirements laid down in the regulations and a series of best practices in relation to the continued airworthiness of ultralight aircraft, taking into account the current applicable regulations and the future RD implementing RD 765/2022, of 20 September, which regulates the use of motorised ultralight aircraft (ULM).

# 3. CONCLUSIONS

## 3.1. Findings

- The connecting rod-crankshaft assembly installed in the engine of the accident aircraft was not the original factory-fitted part and lacked documentation attesting to its provenance.
- The connecting rod-crankshaft assembly installed in the engine of the accident aircraft was originally installed in a ROTAX 912 ULS2 engine manufactured in October 2005.
- The connecting rod-crankshaft assembly fitted to the engine of the accident aircraft was inspected at a specialist ROTAX engine workshop in 2017, where it was found to be unsuitable for service and was therefore removed from the engine in which it was installed at the time and replaced with another one.
- One of the connecting rods in the connecting rod-crankshaft assembly fitted to the engine of the accident aircraft broke at its small end, which led to a series of internal failures and deformations that ultimately caused the connecting rod-crankshaft assembly to become jammed and unable to rotate.
- The engine showed no signs of seizure.

## 3.2. Causes/contributing factors

The investigation has determined that the probable cause of the accident was the emergency landing carried out following an engine shutdown caused by a broken engine connecting rod.

The fact that the engine was fitted with a connecting rod-crankshaft assembly that had been declared non-airworthy by a specialist ROTAX engine workshop is considered to be a contributory factor.

# 4. SAFETY RECOMMENDATIONS

4.1. The aircraft's Flight Manual provides a series of steps to be followed in the event of an emergency landing due to engine shutdown, which are indicated in point 1.18.2, one of which indicates that the safety belts must be tightened, the door safety lock released and the doors unlatched. As stated in point 2.1, given that this aircraft does not have a locking device to prevent the cockpit canopy from moving when open, it is believed that opening the cockpit during an emergency landing due to engine shutdown, which may involve pronounced accelerations, could be dangerous for the aircraft's occupants. Therefore, the following recommendation is issued to the aircraft manufacturer:

> **REC 39/23.** It is recommended that Costruzioni Aeronautiche TECNAM consider modifying the emergency landing without engine power emergency procedure so as to mitigate the risk that the free movement of the canopy under pronounce accelerations could involve.

4.2. It is considered that workshops servicing ultralight aircraft should not install parts without knowing their provenance and maintenance history, and therefore the following safety recommendation is issued to AIR MONKEY MECH:

> **REC 40/23.** It is recommended that AIR MONKEY MECH, in accordance with aeronautical standards, refrain from installing any component in any aircraft without obtaining the documentation necessary to ascertain its airworthiness, provenance and lifetime and that this information should be duly recorded in the maintenance book of the aircraft and/or engine.

4.3. Based on the information provided in point 2.3, the following safety recommendation is issued to AESA, as the body responsible for developing and establishing the air safety regulations and the procedures for their application:

> **REC 41/23.** It is recommended that AESA include in the future Royal Decree implementing RD 765/2022 the need for AESA to draw up a continuous airworthiness inspection plan for all ultralight aircraft operated by schools or for commercial purposes, whereby all aircraft complying with the above would be subject to a physical and documentary inspection that includes a review of their maintenance, particularly regarding the installation of used parts.

4.4. It is considered to issue a safety recommendation to ROTAX in order to include or emphasise the warnings existing in both line maintenance manual and heavy maintenance manual relating some maintenance tasks that must be only accomplished by companies that are directly qualified by ROTAX to carry out such tasks. Therefore, the following recommendation is issued to ROTAX:

**REC 42/23.** It is recommended that ROTAX include, in those sections of both line maintenance manual and heavy maintenance manual relating tasks that must be only accomplished by companies that are directly qualified by ROTAX, reminders warning about that, or emphasise them in case they already exist.