# Technical report
# A-032/2019

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Accident on the 19th of July 2019, involving a Piper PA 28-140 aircraft, registration EC-GDC, in Villarrubia de Santiago (Toledo)

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GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
DEPUTY SECRETARY
CIVIL AVIATION
ACCIDENT AND INCIDENT
INVESTIGATION COMMISSION

## Notice

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

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with Articles 5.5 of Regulation (UE) no. 996/2010 of the European Parliament and the Council, of the 20th of October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1, 4 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 their recurrence. The investigation is not intended to attribute any blame or liability, nor to prejudge any decisions that may be taken by the judicial authorities. Therefore, and according to the laws detailed above, the investigation was carried out using procedures not necessarily subject to the guarantees and rights by which evidence should be governed in a judicial process.

Consequently, the use of this report for any purpose other than the prevention 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.

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## ABBREVIATIONS

| | |
|---|---|
| ° ' " | Sexagesimal degree(s), minute(s) and second(s) |
| °C | Degree(s) Celsius |
| ºF | Degree(s) Fahrenheit |
| AEMET | Spain's State Meteorological Agency |
| AESA | Spain's National Aviation Safety Agency |
| CAMO | Continuing airworthiness management organisations |
| EASA | European Aviation Safety Agency |
| ft | Feet |
| h | Hour(s) |
| Ha | Hectare(s) |
| HIC | Intracranial hypertension |
| HP | Horsepower |
| ICO | Idle cut-off |
| IR (A) | Instrument rating |
| kg | Kilogram(s) |
| KIAS | Knots-indicated airspeed |
| km | Kilometre(s) |
| km/h | Kilometre(s)/hour |
| kt | Knot(s) |
| l, l/h | Litre(s), Litre(s)/hour |
| LAPL | Light Aircraft Pilot License |
| LECU | ICAO code for Cuatro Vientos Airport (Madrid) |
| m | Metre(s) |
| mm | Millimetre(s) |
| m/s | Metre(s)/second |
| $m^2$ | Metre(s) squared |
| N | North |
| s/n | Series number |
| MEP | Multi-piston engine aircraft |
| W | West |
| PPL | Private pilot license |
| RCC | Rescue coordination centre |
| rpm | Revolutions per minute |
| SEP | Single-piston engine aircraft |
| THI | Traumatic head injury |
| US gal | American gallons |

| | |
|---|---|
| US quarts | American quarter gallon |
| UTC | Universal Time Coordinated |
| VFR | Visual Flight Rules |
| $V_{ne}$ | Never Exceed Speed |

## Synopsis

| | |
|---|---|
| **Owner and Operator**: | M Aerospace Fly, S.L. |
| **Aircraft**: | Piper PA-28-140, registration EC-GDC, s/n: 28-7125346 |
| **Date and time of accident**: | Friday the 19th of July 2019, 10:30 UTC |
| **Accident site**: | Vicinity of Villarrubia de Santiago - Toledo |
| **Persons on board**: | 1 pilot / 1 passenger |
| **Type of flight**: | General Aviation - Private |
| **Phase of flight**: | En route - cruising |
| **Flight rules:** | VFR |
| **Date of approval:** | 29/07/2020 |

**Summary of accident**:

On Friday the 19th of July 2019, the Piper PA-28-140 aircraft, registration number EC-GDC, took off from Madrid - Cuatro Vientos Airport (LECU) to make a local flight returning to the same airport.

During the return flight, while flying over the municipality of Villarrubia de Santiago (Toledo), the engine began to vibrate with a significant decrease in revolutions and the aircraft lost altitude without possibility of recovery.

Reacting to the situation, the pilot declared an emergency, landing on a nearby cornfield.

Both the pilot and his passenger suffered minor injuries.

The aircraft was significantly damaged.

The investigation has determined that the cause of the accident was the performance of an emergency off-airfield landing in a cornfield, due to an in-flight engine power loss.

No operational safety recommendations are proposed.

# 1. FACTUAL INFORMATION

## 1.1. History of the flight

On the 19th of July 2019, the Piper PA-28-140 aircraft, owned by M Aerospace Fly, S.L., with registration number EC-GDC, was rented by a pilot and his passenger to make a local private flight with origin and destination at Madrid - Cuatro Vientos Airport (LECU), flying over the Buendía reservoir.

The pilot carried out the necessary pre-flight checks without finding anything out of the ordinary. The aircraft was located at the exit of a maintenance workshop following a routine maintenance inspection. He checked the oil and fuel levels, as well as their condition, not observing traces of water or other elements, and filling both tanks.

He started the engine at 10:00 local time, and take-off took place at around 10:30 due to airport traffic congestion at the time.

The engine test was correct, and take-off took place without incident. They flew towards the Buendia reservoir intending to fly over it and return to Madrid - Cuatro Vientos airport (LECU).


Photograph 1. Damaged aircraft at the accident site

The flight passed without incident until approximately 12:30 local time. When the aircraft was at about 3500 ft, it began to vibrate, and the engine revolutions decreased by about 600 rpm, standing at about 1900/2000 rpm. The speed was approximately 85 kts, the flight was straight and level, without flaps and with advanced power control to obtain between 2300 and 2350 rpm and maintain level flight.

According to his testimony, the pilot tried to recover the situation by using alternative air[1], connecting the fuel pump and changing fuel tank as well as making the mixture leaner. After a few seconds, the engine recovered some rpm, but a few seconds later they decreased again, so the pilot decided to remove the carburettor heater, keeping the mixture lean. After confirming the situation was not improving, he made the fuel mixture richer again.

Unable to maintain altitude, the pilot sent out a MAYDAY call on the emergency frequency while searching for an appropriate field to make an emergency landing. After assessing the surrounding fields, he chose the one that seemed more extensive and that, from the air, he thought was tall grass.

He made a controlled approach with the aircraft in flap 3 configuration and just before landing, cut off the engine and fuel mixture, landing on a cornfield.

The pilot and the passenger suffered minor injuries, being able to evacuate the aircraft without assistance and contact the 112 emergency services number.

The aircraft sustained significant damage.

### 1.2. Injuries to persons

| Injuries | Crew | Passengers | Total in the aircraft | Others |
|---|---|---|---|---|
| Fatal | | | | |
| Serious | | | | |
| Minor | 1 | 1 | 2 | |
| None | | | | |
| TOTAL | 1 | 1 | 2 | |

### 1.3. Damage to the aircraft

The aircraft suffered significant damage as a result of the accident, particularly to its landing gear, the aircraft nose and wings.

Without the knowledge or authorisation of CIAIAC, the owner of the aircraft, the M Aerospace Fly, S.L. school, having decided on using a metal recycling company to remove it, proceeded to disassemble the fuselage and destroy it by fragmenting it into small pieces.

[1] Alternative air: unfiltered air provided to the engine by a control located on the instrument panel in some aircraft models. This particular aircraft did not have an alternative air control knob, but in the same place and with the same type of control, it had a carburettor heating knob. During his statement, the pilot mistakenly referred to the carburettor heater control as the alternative air control, probably due to his experience flying in aircraft that did have such controls, like the PA-28 Arrow and PA-34 Seneca.

## 1.4. Other damage

The emergency landing on a field planted with corn resulted in damage to third parties. Given the impossibility of accessing the aircraft within the cornfield of approximately 60 ha, a combine harvester was used to cut a 4 x 300 m access road through the field, destroying the crop, removing the aircraft and depositing it in an adjacent field.

## 1.5. Personnel information

### 1.5.1. Pilot

The 27-year-old Spanish pilot had a private airplane pilot license, PPL(A), issued by Spain's National Aviation Safety Agency (AESA) on the 12/12/2016 with the following qualifications:

- SEP qualification (land) for single-piston engine aircraft valid until the 30/12/2020
- MEP qualification (land) for multi-piston engine aircraft valid until the 31/07/2020
- IR(A) instrumental flight qualification, valid until the 31/07/2020
- NIGHT qualification for night-time flying

He had a total of 161 hours and 43 minutes of flying time, of which 68 hours and 55 minutes were in the aircraft involved in the incident. He had also flown a Cessna C150, Cessna C172, PA-28 Arrow, and PA-34 Seneca.

He last flew on the 09/07/2019, in a flight that lasted 2 hours and 10 minutes.

His class 1 medical certificate was found to be valid until the 25/01/2020, and for classes 2 and LAPL until the 25/01/2024.

## 1.6. Aircraft information

### 1.6.1. Maintenance information

The aircraft was built in 1971 with series number: 28-7125346. Its maintenance was performed by an AESA-approved maintenance centre, as an EASA Part-145 organisation, SINMA AVIACIÓN, S.L. ref .: ES.145.113, and its maintenance programme was approved through a CAMO airworthiness maintenance management organisation. The latest approved maintenance programme was the IT-PA28140 edition 1, revision 0, on the 15/06/2017.

The revisions were managed individually by the owner with the EASA Part-145 organisation when necessary. According to the owner, he purchased the aircraft between 2013 and 2014.

According to the records of the engine booklet, it was issued on 06/26/2018, and it states that the engine was imported on 10/10/1995 from the USA when it had 5841 flight hours.

The last maintenance check was a 50 h inspection of both the fuselage and the engine, carried out on the 16/07/2019 when both the aircraft and the engine had 8523:50 flight hours. During this inspection, the fire extinguisher, battery and wiring, and the fuel filter were

checked, and the oil and oil filter were changed. Some screws were fitted to the left wing, and ground tests were performed satisfactorily.

The previous revision was on the 13/06/2019 when the aircraft and engine had 8477:45 hours, tasks corresponding to a 50-hour revision, 100-hour revision and annual revision were performed. Compliance with safety directives was also checked. A 50-hour revision was carried out on the 14/05/2019 when the aircraft and the engine had 8427:50 hours.

The maintenance checks referred to in the previous paragraphs were adequately documented in the aircraft book by the responsible EASA Part 145 organization.

At the time of the accident, the aircraft's airframe and engine both had a cumulative flight time record of 8526 hours and 30 minutes.

On the day of the accident, the flight took off at 8:30 UTC landing at 10:35 UTC after 2 hours 5 minutes of flight. The aircraft had only made one flight between the last maintenance overhaul on 16/07/2019 and the day of the incident. It took place the day before, on the 18/07/2019 and lasted 35 minutes.

According to the AESA-approved maintenance programme, ref: IT-PA28140 ed.1 rev.0 of 15/06/17, through a CAMO organisation, aircraft maintenance overhauls should be done every 50 h, 100 h, and annually.

### 1.6.2. Airworthiness status

According to the Spanish National Aviation Safety Agency (AESA)'s record of active registrations, the aircraft with serial number 28-7125346 and registration EC-GDC was registered on the 10/10/1995, with registration number 3705. The registration certificate issued on the 06/09/2016 states the aircraft's base as the Madrid Cuatro Vientos Airport (Madrid).

The aircraft had an airworthiness review certificate issued by the organization CAMO ITAER INGENIERÍA, S.L., authorized by AESA, that carried out the last review dated 04/30/2019 and valid until 04/17/2020, when the aircraft had 8,405 flight hours

The aircraft also had the following available authorisations:

- Aircraft station license issued by AESA including various pieces of equipment, among them two communications and navigations units, and transponder.

The aircraft had a valid insurance policy in force until the 26/11/2019.

## 1.7. Meteorological information

### 1.7.1. General situation

At low levels, there was an Atlantic anticyclone centred south of the Azores and stretching across the Cantabrian region. Low thermal relative pressures over the southwest of the

peninsula. Generalised stable conditions. Temperature surpassed 40ºC in various parts of the Guadiana and Guadalquivir floodplain.

### 1.7.2. Situation at the time and place of the accident

AEMET does not have a station in Villarrubia de Santiago; the nearest stations are located in Belmonte de Tajo (10 km northwest of the accident site), Ocaña (20 km southwest) and Tarancón (25 km east of the accident site). The data from said stations at the time of the accident was as follows:

Belmonte de Tajo: Average wind speed 14 km/h from the southeast, maximum 27 km/h from that same direction. Temperature 31ºC, relative humidity 31%.

Ocaña: Average wind speed 9 km/h from the east, maximum 21 km/h from that same direction. Temperature 32ºC, relative humidity 30 %.

Tarancón: Average wind speed 14 km/h from the southeast, maximum 26 km/h from that same direction. Temperature 31ºC, relative humidity 23 %.

In the remote sensing images, no cloudiness was observed in the area, nor any other relevant meteorological phenomenon.

Based on this information, no adverse conditions affected the flight.

## 1.8. Aids to navigation

Not applicable.

## 1.9. Communications

Communications were established with Cuatro Vientos airport from whence the flight departed and to where it was headed at the time of the accident.

The pilot's call to 112 activated the Ministry of Defence's RCC in Madrid, and a rescue helicopter took off at 11:10 UTC. The crew was evacuated at 11:59 UTC with two slightly injured. Search and rescue was suspended at 12:16 UTC.

Madrid Control's H24 network executives received the MAYDAY call from the aircraft at 10:22 UTC, and at 10:33 UTC it crash-landed in a cornfield near the town of Villarrubia de Santiago in the province of Toledo.

## 1.10. Information about the accident site

The aircraft made an emergency landing in a cornfield of about 60 Hain the municipality of Villarrubia de Santiago, in the province of Toledo, whose cultivation was around 2 m high.
.
The geographical coordinates of the accident site were:
N 40º 2' 43.411" ; W 3º 18' 10.558"


Photograph 2. Geographical coordinates of the accident site

## 1.11. Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, as the aeronautical regulations in force do not require any recorders on such aircraft.

## 1.12. Wreckage and impact information

Significant damage to the aircraft, particularly the landing gear, aircraft nose and wings, will occur.

Photograph 3. Aircraft at the accident site

Photograph 4. Aircraft in the field adjacent to the accident site


Photograph 5. Left fuselage-wing joint


Photograph 6. Engine cowling

Photograph 7. Main landing gear

- Deformation and breakage of anchors of the upper engine cowlings.Deformed and eroded propeller.
- Wing deformation and separation of the left fuselage-wing joint.
- Landing gear: the main gear was damaged and deformed and the nose gear destroyed.

### 1.13. Medical and pathological information

Both the pilot and the passenger suffered minor injuries as a result of the emergency landing. They were taken to hospital but hospitalisation was not required.

### 1.14. Fire

Not applicable.

### 1.15. Survival aspects

Both the pilot and the passenger were wearing safety seat belts. The height and leafiness of the crop cushioned the landing but did not prevent the impact of the aircraft's nose against the ground. This caused minor injuries to the crew but did not prevent them from being able to leave the aircraft on their own and communicate with the 112.

They walked to get away from the aircraft, although safe, to leave the growing area, but due to the type of vegetation, they were disoriented until they were located by rescue teams and evacuated in a helicopter.

## 1.16. Tests and research

### 1.16.1. Interviews with the crew

#### 1.16.1.1. Information provided by the pilot

According to the pilot's statement, the aircraft was at the exit of the maintenance workshop. The pre-flight checks didn't reveal any abnormalities. He checked the fuel didn't contain any traces of water or other elements, and they filled the tank. He also checked the oil level, which was approximately 6.5, and added the final part of an oil can he had left in the back of the aircraft.

The flight plan was to fly over the Buendía reservoir and return to Cuatro Vientos airport. He started the engine at 10:00 local time, although they didn't take off until 10:30 due to airport traffic congestion at the time. The engine test was correct, and they took off without incident.

The flight proceeded normally until approximately 12:30 local time when they were flying at about 3500 ft, and the aircraft began to vibrate. According to the pilot, the revolutions dropped to 1900/2000 rpm. He reacted by switching on the carburettor heater, the fuel pump and swapping the tank. According to his statement, he reduced the mixture in case the spark plugs were dirty, although he had already covered part of the journey with a lean mixture.

He didn't notice any immediate change. After a few seconds, the aircraft recovered some rpm but failed in the same way again a few moments later. He switched off the carburettor heater maintaining the lean mixing ratio. As the situation didn't improve, he enriched the mixture again.

He made a MAYDAY call on the emergency frequency while looking for a place to land. They informed control of their decision to land in a farmland.

According to the pilot, he chose the cornfield because, from above, it looked like a field of high grass, the other fields seemed small or inappropriate, and he considered that they did not have much time since with the rpm of the engine could not maintain the height.He approached the field with flaps 3, in his words, trying *to hold* the plane just above the cornfield and cutting off the engine and the mixture just before touching down.

The pilot stated in his testimony that, at the time of the engine failure, the position of the engine control was advanced to obtain between 2300 and 2350 rpm, necessary to maintain level flight. The oil pressure was located in the first half of the green area of the instrument panel indicator; the oil temperature was slightly above the 180 ºF mark; the available fuel was between 15 and 20 gallons per wing, and at no time did he perceive any kind of audible or visual alarm.

According to the pilot's testimony, after landing and leaving the aircraft, he and his passenger walked through the vegetation, disoriented and requesting help by phone. The

search operation was made more difficult by the height of the corn. They were finally rescued by an RCC helicopter.

#### 1.16.1.2. Information provided by the passenger

The passenger stated that they left Cuatro Vientos airport after performing the pre-flight inspection of the aircraft and refuelling. They headed to the Sacedón area in Guadalajara, and when they were about to return to the airport, the pilot told him they had an engine problem.

On observing the propeller still turning, the passenger did not think it was a serious problem and understood they were to make an emergency landing.

The pilot told him, according to his testimony that the engine revolutions were going down, that they could lose lift and the engine could stop. For a moment, as the pilot informed him, it looked like the engine had recovered, although the aircraft was vibrating quite a bit. After a few minutes they had the same problem again, but now at a lower altitude.

According to the passenger, the pilot alerted control to their problem by radio, and as they were approaching more populated areas, with power lines and smaller areas of cultivated land, he decided to land in a field that turned out to be a cornfield, from where they were later rescued.

### 1.16.2. Related reports/communications

#### 1.16.2.1. Airport manager's report

The airport manager notified the accident to this Commission, providing the flight plan and reporting the emergency landing of an aircraft in a cornfield west of Villamanrique del Tajo in the province of Madrid, for unknown reasons. They had established communications with the pilot confirming that both he and the passenger were fine, although he had suffered a blow to the head, and that the aircraft was severely damaged but perfectly visible from the air.

They alerted 112 and the Guardia Civil.

#### 1.16.2.2. Guardia Civil report

The 112 emergency service and Air Rescue reported, at 12:50 local time, that there had been a forced landing of an aircraft occupied by two people, one of which had minor injuries but was in a stable condition. They liaised with Madrid Air Rescue and activated the fire service, the local police and various teams from the Guardia Civil. By 13:50 local time, Air Rescue had rescued the two people and transferred them to the designated Toledo hospital.

Later, the owner of the cornfield where the aircraft landed, used a combine harvester to cut a path through the field to access the plane, moving it about 200 m, to the side of the

cornfield. The aircraft owner was informed of the obligation to keep the wreckage intact until further notice from the CIAIAC.

#### 1.16.2.3. Information provided by the Network Executive

The information provided by the network executive of Cuatro Vientos airport confirmed that at 10:22 UTC, Madrid Control received an emergency MAYDAY call from an aircraft with registration EC-GDC. The aircraft had two occupants, and its departure and destination was Cuatro Vientos airport.

At 10:33 UTC, the aircraft crash-landed into a cornfield near the town of Villarubia de Santiago (Toledo) sustaining damage to the landing gear and nose and injuring one of its occupants.

#### 1.16.2.4. Information provided by the Rescue Coordination Centre

At 10:59 UTC, once the aircraft involved was located, the two occupants were rescued. They had sustained minor injuries and were evacuated to an area accessible for transport by emergency personnel.

At 12:16 UTC, the search and rescue activity was terminated..

### 1.16.3. Tests/Inspections

On inspecting the aircraft, the owner had already dismantled the engine from its mounting structure and disconnected the cockpit instruments. The fuselage and wings had been fragmented with a radial saw and piled up in a hangar awaiting removal by a metal recycling company.

The various components of the engine were disassembled to carry out an in-depth inspection of their maintenance status and operation.

#### 1.16.3.1. Engine inspection

The owner, M Aerospace Fly, S.L., moved the aircraft from the crash site to a hangar at Cuatro Vientos Airport where it was inspected.

The engine was disassembled from its mount, and the aircraft was fragmented into multiple pieces.

The only remaining part of the cabin was the lower fuselage, without the cover. The indicator panel was missing the instrumentation but did have the power controls.

The actions carried out during the inspection, and the findings found, were as follows:

Photograph 8. Aircraft wreckage after its fragmentation

Photograph 9. Aircraft cabin wreckage

Photograph 10. Engine from the damaged aircraft

Photograph 11. Mixture knob in the flight cabin and detail

1. Induction system:

The oil lines and fuel hoses were sectioned, no obstructions were observed inside, and no engine stains were observed due to possible leakage. The motor clamps were properly adjusted.The exhaust and intake manifolds were unobstructed and free of carbon deposits. The mixture knob in the cockpit had mobility and was unblocked but wasn't correctly connected to the engine because the connecting cable wasn't crimped, the protective sleeve was loose, and the cable elbowed by an inadequate position maintained, showing permanent deformation.

When the mixture knob was moved to the lean position, the cable offered no resistance and pulled the carburettor rod, making the mixture leaner. However, because the cable was not clamped and bent into a deformed position when the mixture knob was operated to the rich mixture position, the cable didn't push the connecting rod forward to allow more fuel through and enrich the mixture. As a consequence, the mixture controller worked to make the mixture leaner but not to enrich it.

Photograph 12. Mixture controller cable in the lean mix position

Photograph 13. Mixture controller cable in the rich mix position

Photograph 14. Detail of the non-crimped mixture controller cable

- The cylinder compression and operation of the intake and exhaust valves were checked and found to be acceptable in all four cylinders.
- The condition of the spark plugs was also checked. They were found to be new and in good condition except for those of cylinder number 3, where both the upper and lower spark plugs were blackened and had excess oil.

Photograph 15: Cylinder n.3 spark plug

2. Fuel system:

- The carburettor was dismantled, and it was confirmed there was no fuel inside. The floats were new and in good general condition, no dirt was detected, the venturi was clean, and the butterfly valve was unobstructed.
- The pipes could not be checked in their layout to the fuel tanks given the fragmentation of the aircraft.

Photograph 16: Carburettor

- The fuel tanks were in good condition.
- An inspection of the remaining fuel did not reveal the presence of any water or contamination.
- The mechanical fuel pump was inspected. It contained no fuel residue and was in a good general condition.
- The electrical fuel pump was inspected. Visually it appeared to be fine, but its operation could not be verified because the engine could not be started. There was no fuel inside.

3. Ignition system:

- The wiring was checked, the connection between the magnets and the spark plugs was in good condition.
- The gap setting for spark plugs were checked and found to be in good order.

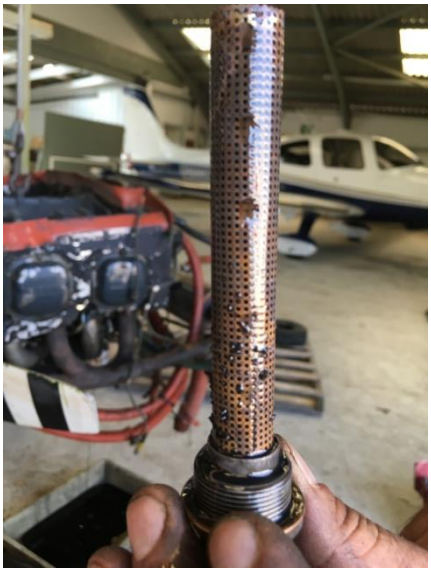
Photograph 17: Oil dipstick and remaining oil in the float bowl

- The two Slick magnets were checked and found to be in good condition.
- The spark plug cable connections and the distributor were checked and found to be in good condition. The distance between contacts and the engine timing was also checked and found to be correct, with no dirt observed. The cam was also in a satisfactory condition.
- The spark plug insulators were found to be in good condition with no impacts or deformities.

4.Lubrication system:

Photograph 18: Oil filter

- The oil level in the tank was checked; the rod was extracted completely clean; there was no oil and no evidence of possible leaks in the area.
- The oil filter was disassembled and metallic (steel) particles were observed inside.
- The remaining oil was drained from the sump. Approximately 2 litres of extremely dirty and dark-coloured oil were obtained.
- The condition of the engine oil lines was checked. There were small remnants of oil in the intake hoses but no obstructions. The insulating joints were in good condition.
- The condition of the radiator was checked. It appeared adequate, although it contained traces of soil from the scene of the accident.



Photograph 19: Oil filter with metallic particles

5. Other components:

- The gascolator was in good condition and the filter was clean, but with no fuel remaining.
- The carburettor heating controller was very stiff, making it difficult to switch on, although it could be connected. Improper operation of this controller may result in an in-flight loss of power between 300 and 400 rpm.
- The propeller was checked. Its setting and operation were found to be in order.

### 1.17. Organisational and management information

Not applicable.

### 1.18. Additional information

Not applicable.

### 1.19. Useful or effective investigation techniques

Not applicable.

## 2. ANALYSIS

### 2.1. Analysis of the meteorological conditions

The meteorological conditions in the area of the accident site around the time of the event (12:30 local time) were suitable for the flight, and no unexpected adverse conditions that could have contributed to the accident were recorded.

### 2.2. Operational analysis

According to the pilot's testimony, after carrying out the pre-flight inspection, which included a review of the fuel and oil levels, he proceeded to refill the corresponding tanks, started the engine, and kept it running for half an hour until he took off. To start it, he had to perform various actions according to the applicable procedures. One of them was to move the mixture controller to the FULL RICH position, i.e. the maximum amount of fuel and, therefore, an enriched mixture. He didn't observe anything unusual and took off without incident. From this, it follows that the control cable of the mixture control lever was working properly at that time. Therefore, the de-crimping of the cable sleeve must have occurred later in the flight.

According to the information provided by the pilot, the flight proceeded normally until approximately 12:30 local time, two hours into the flight. He stated that during that time, the aircraft was mostly flown on a lean mixture, although at the moment it lost power, the mixture was enriched. They were flying at approximately 3500 ft and between 2300 and 2350 rpm when the aircraft began to vibrate, and the rpm decreased to between 1900 and 2000 rpm.

The oil pressure was located in the first half of the green area of the instrument panel indicator; the oil temperature was slightly above the 180 ºF mark; the available fuel was between 15 and 20 gallons per wing so, initially, the engine seemed to be operating without issue.

The loss of power could have been due to flying with an over-enriched mixture at 3500 ft; the air density decreases significantly above 3000 ft and could have caused a noticeable loss of power, erratic performance or even total engine failure. The situation may have been

further compounded by this type of engine's typical over-enrichment of the mixture in the FULL RICH position. The spark plugs would have begun to accumulate residue, as confirmed during the engine inspection, causing the engine to pull and vibrate.

When flying above 3000 ft, which corresponds to cruising altitude, it's vital to monitor the mixture required for correct engine operation. When above this altitude, a lean mixture is recommended, i.e. using a lesser quantity of fuel. This means proper flight protocol would have entailed a vigilant supervision of the mixture controller to ensure the correct fuel/air ratio as required, and this did not happen.

However, the power loss could have been recovered if the mixture controller had worked properly. The pilot reacted by switching on the auxiliary fuel pump and changing fuel tank by connecting the carburettor heater, according to the aircraft's in-flight power loss procedure.

His consideration was that, since he had fuel available and there were no other engine alerts on the instrument panel, the loss of power was probably due to the spark plugs having accumulated fuel residue as a result of flying with an enriched mixture.

He reduced the mixture ratio, and for a few seconds, the plane recovered some rpm. However, it failed again a few moments later. He switched off the carburettor heater but maintained the lean fuel ratio.

If you make the mixture leaner, the rpms improve a little but reduce again quickly afterwards. If you continue to run on a lean mixture, as in fact happened, the engine will start running erratically and lose power. As the situation didn't improve he returned to an enriched mixture. Until this moment in the flight, the pilot failed to adequately manage the mixture controller with sufficient understanding of its function and the need to monitor the mixture at this altitude and in this type of aircraft. This could have been because the pilot didn't have many flying hours in this type of aircraft.

However, when an enriched mixture was finally required, the mixture controller didn't work properly because the sleeve of the connecting cable between the controller and the carburettor had come loose, and the cable had been bent. This rendered the controller useless because it did not push the carburettor rod to inject more fuel. If this control had worked properly, the loss of engine power would probably have been recovered.

The pilot, aware that he was unable to recover the situation, rightly declared MAYDAY while looking for a field to make a forced landing. In choosing the field, the pilot selected the one he thought was the most extensive and believed it to be a tall grass meadow. However, it was actually a cornfield with a crop height of about 2 metres. Probably, when he got closer to the surface, he would have realised the plants were much taller than he'd estimated but, by then, he wouldn't have had time to change to another field so had to land in that one. He stopped the engine during the landing.

### 2.3. Analysis of the aircraft's maintenance

The aircraft had just left the maintenance workshop when the accident occurred.

The last maintenance check was a 50 h inspection of both the fuselage and the engine, carried out on the 16/07/2019, just three days before the accident.

Between this check and the time of the accident, the aircraft had flown for a total of 35 minutes on the previous day, and 2 hours 5 minutes on the day of the incident. The check included, among other things, changing the oil and the oil filter. This detail is not consistent with the engine oil found in the wreckage, which was very dark and dirty, or the condition of the oil filter, which was also deteriorated and contained metal particles.

Considering oil changes take place every 50 hours of flight, it's unlikely that recently changed oil could have deteriorated to such an extent in just 2 hours and 40 minutes flying time. As for the metal particles, it is not possible to specify how long they had been in the filter, but they indicate that an internal component of the engine was deteriorating as a result of a malfunction, probably due to a lack of lubrication.

However, the tests that could be performed during the engine inspection did not show compression failures or faulty operation. What it did show was a general lack of oil in the engine. Only 2 l was obtained from the sump. Although during the transfer of the aircraft and disassembly of the engine it was probably necessary to drain both oil and fuel, the amount of oil inside the engine was deemed insufficient for correct function.

Regardless, the engine would have provided power if the mixture controller had been connected and operated the fuel inlet on the carburettor. As it wasn't detected during the maintenance revision, the connecting cable probably became decrimped during the flight. It seems unlikely that the deterioration and eventual breakage of this cable could have occurred in such a short amount of flying time. However, it would have been impossible to foresee, even if preventive maintenance could have reduced the risk of it occurring.

### 2.4. Analysis of the organisation and management

Not applicable.

## 3. CONCLUSIONS

### 3.1. Findings

- The pilot had a valid private aeroplane pilot license, PPL(A), with MEP (land), SEP (land), IR (A) and NIGHT ratings.
- His class 1, 2 and LAPL medical certificate was valid and in force.
- He had a total of 161 hours and 43 minutes of flying time, of which 68 hours and 55 minutes were in the aircraft involved in the incident.
- There were no limiting meteorological conditions for visual flying.
- The incident occurred during a private recreational flight.
- The aircraft was owned by a pilot training school that rented out its aircraft for private flights.
- The aircraft was maintained by an AESA-authorised maintenance centre with a valid EASA Part-45 certificate.

- The aircraft had a valid airworthiness certificate.
- The aircraft was built in 1971 and had a cumulative flight time record of 8526 hours and 30 minutes.
- The aircraft involved in the accident had a carburettor heater control on the instrument panel and not an alternative air control as indicated by the pilot in his testimony.
- The last maintenance check was a 50 h check of both the fuselage and the engine, carried out on the 16/07/2019 (3 days before the accident) when both the aircraft and the engine had 8523:50 flight hours. The check included, among other things, changing the oil and the oil filter.
- The aircraft had only flown for 2 hours 40 minutes since the oil change during the maintenance inspection.
- The aircraft was removed from the accident site by the owner who fragmented the fuselage and wings of the aircraft, as well as disassembling the engine from its mounting structure. The remains of the aircraft were manipulated, altered and destroyed without CIAIAC's knowledge, and, therefore, it has not provided reliable evidence for the investigation.
- An analysis of the wreckage revealed that the mixture controller cable was not operative.
- The engine inspection revealed less than 2 l of poor quality oil in the sump. The oil tank was completely empty.
- The pilot and passenger sustained minor injuries. They exited the aircraft without assistance and were evacuated by the rescue services.

### 3.2. Causes/contributing factors

The investigation has determined that the cause of the accident was the performance of an emergency off-airfield landing in a cornfield, due to an in-flight engine power loss.

## 4. OPERATIONAL SAFETY RECOMMENDATIONS

No operational safety recommendations applicable to the incident are proposed.

# 5. ANNEXES

## 5.1. General aircraft information

The Piper PA-28-140 Cherokee is an all-metal, 4-seater, low-wing, tricycle-type fixed-landing gear and single-engine aircraft designed for VFR flight.

**Structure:**

- Wingspan: 10.66 m
- Length: 7.25 m
- Wing area: 15.1 $m^2$
- Maximum height: 2.22 m
- Empty weight: 637 kg
- Maximum take-off weight: 955 kg
- Fuel capacity: 189.27 l

**Performances:**

- Ascending speed: 3.4 m/s
- Never exceed speed ($V_{ne}$): 230 km/h
- Average cruising speed: 204 km/h
- Stall speed ($V_s$): 89 km/h

**Power plant:**

TEXTRON LYCOMING O-320-E2A 4-cylinder piston engine. s/n: RL-27827-27A.

Characteristics:

- Four-stroke, four horizontally opposite cylinders, and double ignition system (magnets)
- Air-cooled through the two front inlets
- Maximum power: 160 HP
- Rated speed: 2,700 rpm

**Propeller:**

- Forged aluminium 2025 Sensenich 74DM-6-0-58, s/n: k27952:
  - Two-blade, fixed pitch, tractor configuration
  - Power range: 125 to 165 HP
  - Diameter: 1.9 m

**Fuel:**

- Type of fuel authorised and used: AVGAS 100LL
- The aircraft had two tanks, one for each wing, with a total capacity of 25 US gal per tank (189.27 l).
- Unusable fuel is 1 US gal (3.78 l)
- Consumption is 8.3 US gal/h (31.41 l/ h)
- Before the accident, the aircraft was refuelled with 18 US gal (68.13 l) in each tank. There was approximately 10 US gal (37.85 l) per wing tank of fuel remaining after the event. The tanks were emptied by the owner before the aircraft inspection.

**Oil:**

- Type of oil authorised: MIL-L-6082
- The oil tank contains a maximum amount of 8 US quarts (7.57 l) with the minimum operating amount being 2 US quarts (1.89 l).
- Normal operating temperature between 75 and 245ºF, in the green area of the indicator.

### 5.2. Information on mixture control operation

According to the aircraft's operations manuals, its engine runs most efficiently with a fuel/air ratio of 1:15. In this aircraft, the FULL RICH configuration is designed to provide a slightly richer mixture than the most efficient, being set at a ratio of 1:12 to reduce the possibility of pre-ignition/detonation and help to prevent the cylinders from overheating.

If the altitude increases, the density of the air decreases, so above 3000 ft the fuel/air mixture becomes over-enriched, resulting in a patent loss of power, irregular operation and even total engine failure.

The mixture control lever allows pilots to select the required fuel/air ratio. Usually, when flying above 3000 ft, which corresponds to cruising altitude, it’s vital to monitor the mixture required for proper operation of the engine. When above this altitude, a lean mixture is recommended, i.e. using a lesser quantity of fuel.

When the mixture is leaner, the rpm instantly raise a little and then decrease again quickly afterwards. If it continues to run on a lean mixture, the engine will start operating irregularly and lose power.

Particular care should be taken with the use of lean mixture in a generalized way since, although it may seem to be cheaper due to lower fuel consumption, sooner or later it can cause serious engine damage.

In particular in full-power operations the enriched mixture will also ensure engine cooling and protection against the appearance of the detonation phenomenon inside the cylinders. It’s also recommended to fly with rich mixture if the outside temperature is high to prevent overheating of the engine.

In any case, the operational procedures of the aircraft state that before changing the power configuration to increase it, it's essential to have the mixture control in the FULL RICH position.

Furthermore, when descending from a high altitude, the mixture gradually becomes poorer. Therefore, if it is not enriched, the cylinders may overheat, with the consequent loss of power and eventually engine failure.

Generally, the mixture control should be in the FULL RICH position during landing unless operating at a high elevation aerodrome.

The ICO (idle cut-off) mixture control position corresponds to the lean-mixture position used as the standard method for shutting down the engine.

### 5.3. In-flight emergency procedures in the event of engine power loss

#### 5.3.1. Loss of engine power in flight

An in-flight loss of engine power is usually caused by an interrupted fuel supply, so once the fuel is restored, the power also recovers quickly.

If the power loss occurs at low altitude, then the appropriate emergency procedure should be applied, and preparations made for an emergency landing according to the POWER OFF LANDING check-list. Speed should be maintained at least at 80 KIAS, and if the altitude allows it, the following steps should be taken:

1. Fuel selector: switch to a fuel tank containing fuel
2. Electrical fuel pump in ON position
3. Mixture control in RICH position
4. Carburettor heater in ON position
5. Engine indicators on the instrument panel: check for any indication of the cause of the power loss
6. Fuel primer: check that it is not blocked
7. If low fuel pressure is indicated, check the position of the tank selector to make sure the selected tank contains fuel.

If the power returns:

8. Carburettor heater in OFF position
9. Electrical fuel pump in OFF position

If the power does not return, prepare for an emergency landing, and if there is enough time:

a) Activate the Magnet Switch, first to the L position, then to the R position, then return to the BOTH position
b) Gas and mixture control lever: change setting
c) Select another fuel tank

If the power loss was due to a lack of fuel in a given tank, the power will not be recovered until the empty fuel lines are filled, which will take more than 10 seconds.

If the power does not return, proceed with the POWER OFF LANDING procedure.

### 5.3.2. POWER OFF LANDING

If the loss of engine power occurs at sufficient altitude, the aircraft should be adjusted to achieve the best gliding angle at 80 KIAS, and the most appropriate field for landing should be identified.

When a suitable field has been located, the aircraft should fly around it in a spiral pattern. Attempts should be made to fly at 1000 ft over the field, in a tailwind position to make a standard approach. Runway contact should be made at the lowest possible speed and with flaps fully extended.

During the landing:

1. Ignition in OFF position
2. Master switch in OFF position
3. Fuel selector in OFF position
4. Mixture control in ICO (idle cut off) position
5. Ensure safety belts are properly fastened