

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 041/CENIPA/2020

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PT-LZC
MODEL:	PA-25-260
DATE:	18MAR2020



NOTICE

According to Law n^o 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination, and execution of the investigation and prevention activities of aeronautical accidents.

The elaboration of this Final Report was conducted by taking into account the contributing factors and hypotheses raised. Therefore, the report is a technical document reflecting the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the different factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief, or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is under Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated into the Brazilian legal system by Decree n^o 21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of “non-self-incrimination” derived from the “right to remain silent” sheltered by the Federal Constitution.

Consequently, using this report for any purpose other than preventing future accidents may induce erroneous interpretations and conclusions.

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Taking into account the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This is the Final Report of the 18MAR2020 accident with the PA-25-260 aircraft model, registration PT-LZC. The accident was classified as “[SCF-PP] Engine Failure or Malfunction Powerplant – Engine Failure in Flight”.

During the last passage for fungicide application, the Pilot in Command (PIC) heard a loud noise, followed by a loss of power. Immediately, he tried to return to the landing area. However, when he was close to it, the pilot noticed the start of fire in the engine.

The pilot cut off the engine and made a forced landing on a crop.

The aircraft had substantial damage.

The pilot left unharmed.

An Accredited Representative of the *Junta de Seguridad en el Transporte* (JST) - Argentina, (State where the aircraft was manufactured) was designated for participation in the investigation.



CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS	5
1. FACTUAL INFORMATION.....	6
1.1 History of the flight.....	6
1.2 Injuries to persons.....	6
1.3 Damage to the aircraft.....	6
1.4 Other damage.....	6
1.5 Personnel information.....	7
1.5.1 Crew's flight experience.....	7
1.5.2 Personnel training.....	7
1.5.3 Category of licenses and validity of certificates.....	7
1.5.4 Qualification and flight experience.....	7
1.5.5 Validity of medical certificate.....	7
1.6 Aircraft information.....	7
1.7 Meteorological information.....	8
1.8 Aids to navigation.....	8
1.9 Communications.....	8
1.10 Aerodrome information.....	8
1.11 Flight recorders.....	8
1.12 Wreckage and impact information.....	8
1.13 Medical and pathological information.....	9
1.13.1 Medical aspects.....	9
1.13.2 Ergonomic information.....	9
1.13.3 Psychological aspects.....	9
1.14 Fire.....	9
1.15 Survival aspects.....	9
1.16 Tests and research.....	9
1.17 Organizational and management information.....	11
1.18 Operational information.....	11
1.19 Additional information.....	11
1.20 Useful or effective investigation techniques.....	11
2. ANALYSIS.....	11
3. CONCLUSIONS.....	12
3.1 Facts.....	12
3.2 Contributing factors.....	13
4. SAFETY RECOMMENDATION.....	13
5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.....	13

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
CVA	Airworthiness Verification Certificate
DCTA	Department of Science and Airspace Technology
INMET	National Institute of Meteorology
JIAAC	<i>Junta de Investigación de Accidentes de Aviación Civil</i>
MNTE	Airplane Single Engine Land Rating
NCSA	Aeronautics Command System Standard
OM	Maintenance Organization
PAGA	Agricultural Pilot Rating - Airplane
PCM	Commercial Pilot License – Airplane
PIC	Pilot in Command
PPR	Private Pilot License – Airplane
SAE-AG	Public Specialized Air Service Aircraft Registration Category - Aerial-Agricultural
SIPAER	Aeronautical Accident Investigation and Prevention System
SN	Serial Number
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	Model: PA-25-260	Operator: <i>Aero Agrícola Caiçara Ltd.</i>
	Registration: PT-LZC	
	Manufacturer: Piper Aircraft	
Occurrence	Date/Time: 18MAR2020 - 1400 UTC	Type(s): "[SCF-PP] Engine Failure or Malfunction Powerplant"
	Location: Caovi Road	
	Lat. 25°59'16"S Long. 048°49'54" W	Subtype(s): Engine Failure in Flight
	Municipality – State: Garuva - SC	

1.1 History of the flight.

The aircraft took off from a landing area for agricultural use in Garuva - SC, at around 1400 (UTC) to carry out a local spraying flight with a PIC on board.

During the last pass for the fungicide application, the PIC heard a loud noise, followed by a loss of power. Immediately, he headed for the landing area. However, when he was close to it, the pilot noticed the start of fire in the engine.

The pilot cut off the engine and made a forced landing on a crop.

The aircraft had substantial damage, and the pilot left unharmed.



Figure 1 - Aircraft position after a forced landing.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	1	-	-

1.3 Damage to the aircraft.

The aircraft had substantial damage to the powerplant, landing gear, wings, and control surfaces.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	PIC
Total	12.000:00
Total in the last 30 days	34:35
Total in the last 24 hours	01:05
In this type of aircraft	1.500:00
In this type in the last 30 days	34:35
In this type in the last 24 hours	01:05

N.B.: The data relating to the flown hours were provided by the pilot.

1.5.2 Personnel training.

The PIC took the PPR course at the Rio Grande do Sul Aeroclub - RS, in 1976.

1.5.3 Category of licenses and validity of certificates.

The PIC had the PCM License and valid MNTE and PAGA Ratings.

1.5.4 Qualification and flight experience.

The PIC was qualified and had experience in this kind of flight.

1.5.5 Validity of medical certificate.

The pilot had a valid CMA.

1.6 Aircraft information.

The aircraft, serial number 2556009, was manufactured by Piper Aircraft in 1991 and was registered under the SAE-AG Category.

The aircraft's CVA was valid.

The airframe, engine, and propeller logbook records were updated. However, it was found that from 10OCT2019 to 18MAR2020, the total hours' computation in the Logbook was not consistent with the flight time records made, causing inaccuracy in the hours' record after the last inspections.

The aircraft's last inspection, the "1,000 hours" type, was performed on 13FEB2017 by the OM Tangará Aero Center Ltd., and the aircraft flew 702 hours and 55 minutes after the inspection.

The last inspection, the "100 hours" type, was performed by the OM Aero Agrícola Caiçara Ltd. on 13FEB2020, having flown about 49 hours and 10 minutes after the inspection.

The engine installed in the aircraft, model O-540-G1A5, Serial Number (SN) L-24367-40A, was manufactured by Textron Lycoming. The last engine inspection, of the 100-hour type, was performed in conjunction with the airframe inspection by the same OM. At that time, according to the record in the logbook, the engine was with 1.218 total hours and 5 minutes and, at the time of the accident, at approximately 1.268 hours.

On 13NOV2014, when the engine was with 318 hours, it was opened for internal checking, after a long period of storage, according to the record in the engine logbook. In this service, performed by Tangará Aero Center Ltd., the cylinders were disassembled, and some items were replaced.

Following that, the engine was installed in the aircraft PT-WDF. Soon after, on 13FEB2017, the same engine was installed in the aircraft PT-LZC being, at that time, with 588 hours and 5 minutes total.

1.7 Meteorological information.

According to the pilot, the weather conditions were favorable for the visual flight, with a wind of approximately 060° with 3 continuous kt, with no significant cloud cover or visibility restrictions.

The conventional station of the INMET in Paranaguá - PR, about 30 NM away from the place of occurrence, recorded, at 1200 (UTC), a temperature of 26°C, humidity of 86%, and pressure of 1.013,5 hPa.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place out of the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

During the flight, cylinder nº 4 came off the engine block, which was found next to the aircraft, as shown in Figure 2.



Figure 2 - Cylinder nº 4 next to the aircraft.

The pilot tried to return to the landing area but decided to make an emergency landing on a crop.

The aircraft crashed into a banana plantation. The powerplant, landing gear, wings, and respective flight controls had substantial damage.

There was no in-flight detachment from other parts of the aircraft and the wreckage was concentrated.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Nil.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Nil.

1.14 Fire.

There was a start of fire and smoke production, after the detachment of cylinder nº 4, but both stopped spontaneously after landing.

1.15 Survival aspects.

There were no difficulties reported by the pilot to abandon the aircraft.

1.16 Tests and research.

After the occurrence, the Textron Lycoming engine, model O-540-G1A5, SN L-24367-40A, was subjected to the DCTA experts' analysis, which reported that the engine failure was related to the release of cylinder nº4.



Figure 3 - View of the engine without the cylinder nº 4.

The sequence of failures could not be established, because some bolts were torn out of their respective housings and could not be found for analysis.

The segments of the bolts that were stuck in the block suffered several dents, and it prevented the failure analysis.

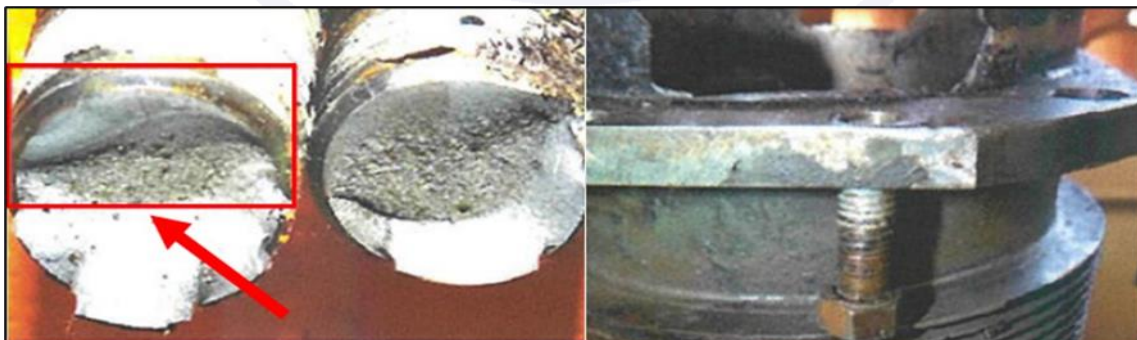


Figure 4 - The image on the left shows the fatigue that was observed in the passing stud. The image on the right shows the only stud remaining at the cylinder's base.

In this way, hypotheses were raised that the damage observed may have been caused by:

- failure of a bolt due to fatigue or detachment from the block;
- failure of the cylinder fixing nuts due to cracking or loss of torque; and
- failure in the engine block structure that may have allowed the stud bolt to come loose.

The initial failure overloaded the other bolts, causing the cylinder to come off the engine block.

Thus, at the moment when the cylinder was released, its misalignment occurred in relation to the block so that the piston, also misaligned, when moving to the bottom dead center, due to the rotation movement of the crankshaft, collided against the base of the engine block, resulting in the fractures observed in the pin housing and also in the piston skirt, in addition to the connecting rod head, as shown in Figure 5.

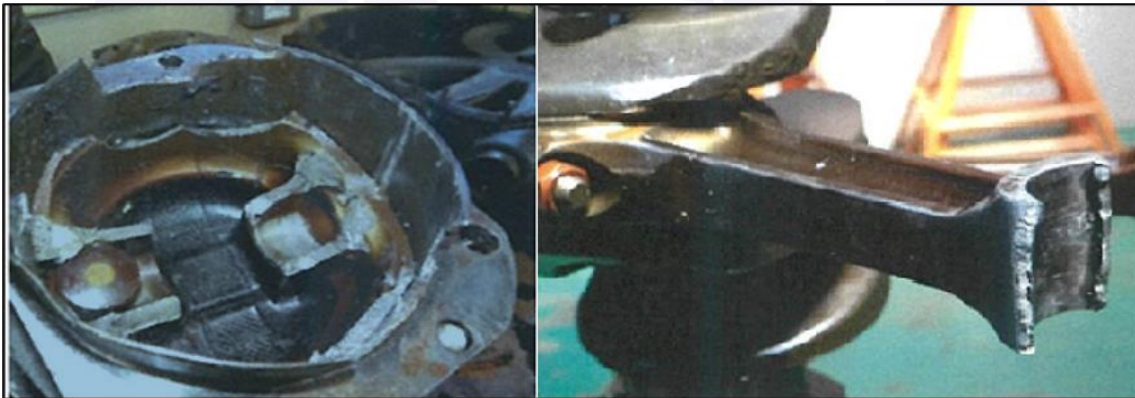


Figure 5 - The image on the left shows the destruction of both the skirt and the piston pin housing of cylinder nº 4. The image on the right shows the fracture in the connecting rod foot of cylinder nº 4.

Figure 6 also shows that the left side of cylinder nº 4 was the first part that worked on the base of the block, due to the dark color, and the right side was the last part, due to the glow on the surface.



Figure 6 - Close-up view of the base of cylinder number 4, showing dents and fractures.

After the initial failure, the remaining bolts could not withstand the cylinder's efforts and failed due to overload, causing the entire assembly to come off.

It is noteworthy that only one service was identified, on 13NOV2014, in which the cylinder was dismantled, and the aircraft flew almost 1,000 hours after it was performed.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

It was a flight to apply agricultural fungicide in a banana crop, and the aircraft took off from a location about 0.5 NM away from the application area.

The pilot reported that he had flown four times before the accident and that, on the fifth flight, he made two passes over the area before starting the application. At the end of the second pass, he heard a noise coming from the engine and noticed a loss of power and smoke.

The pilot said that, at that moment, he started to return to the landing area and, when he was near the threshold, he noticed a fire in the powerplant. A preventive engine shutdown was performed, followed by a forced landing.



Figure 7 - Sketch of the probable flight trajectory before the accident.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a flight to apply agricultural fungicide on a banana crop, and the aircraft took off from a location about 0.5 NM away from the application area.

The pilot's Ratings were updated and experienced in the type of flight, and the weather conditions were considered favorable for the visual flight, so it was considered that these factors did not contribute to this occurrence.

After hearing a loud noise from the engine and noticing that it was losing power, the pilot decided to return to the landing area but was surprised by the smoke and fire that followed.

The pilot's report and the conditions found at the site of the occurrence led the Investigation Team to conclude that the forced landing was the most conservative option since there was no guarantee that the aircraft would be able to reach the landing area.

Although the logbook hours were not consistent with the flight time records, resulting in inaccurate hours after the last inspections, it was considered that this fact did not

contribute to the occurrence, although it revealed latent flaws regarding the management supervision of the aircraft's time control.

The engine from the crashed aircraft was initially installed in the PT-WDF aircraft. Soon after, on 13FEB2017, the same engine was installed in the aircraft PT-LZC being, at that time, with 588 total hours and 5 minutes.

Analysis of the Textron Lycoming engine, model O-540-G1A5, SN L-24367-40A, revealed that the engine failure was related to the detachment of cylinder n° 4.

The sequence of failure could not be established, because some stud bolts were pulled out of their respective housings and were not found for analysis. The segments of the stud bolts that remained in the block had various dents, and that prevented the failure analysis.

Considering the information gathered, it is possible to conclude that the most likely hypothesis for the detachment of cylinder n° 4 was the embrittlement of at least one of the stud bolts by fatigue process, leading to its rupture, which caused the rupture of other stud bolts by overload, causing the detachment of the cylinder from the engine block, the beginning of fire and smoke, and the consequent loss of power.

Three possibilities were considered to explain the brittleness of the bolts:

- failure of a stud bolt by fatigue or by detaching from the block;
- failure of the cylinder fixing nuts due to cracking or loss of torque; and
- failure of the engine block structure that may have allowed the stud bolt to loosen.

It is noteworthy that only one service was identified, on 13NOV2014, in which cylinder disassembly took place, and the aircraft flew almost 1.000 hours after it was performed. It could not be ruled out that, on this occasion, the cylinder was assembled with an inadequate application of torque, which would have allowed the beginning of the fatigue process due to the failure of the nuts' fixation.

In this situation, the fatigue crack would have slowly progressed due to the increased stress load to which the stud bolts would be subjected during the operation of the aircraft.

Thus, the improper assembly of the cylinders, during the engine overhaul, or even during some unrecorded maintenance service, would have caused the fragility of the bolts and their consequent rupture, which could indicate the participation of the maintenance process as a contributing factor to the occurrence.

3. CONCLUSIONS.

3.1 Facts.

- a) the pilot had a valid CMA;
- b) the pilot had valid MNTE and PAGA Ratings;
- c) the pilot was qualified and experienced in the type of flight;
- d) the aircraft had a valid CVA;
- e) the aircraft was within weight and balance limits;
- f) the airframe, engine, and propeller logbook records were updated;
- g) the total hours' computation in the logbooks was not consistent with the flight time records made;
- h) the weather conditions were favorable for the flight;
- i) during the second pass of the fifth take-off of the day, there was a loud noise coming from the engine, followed by power loss;

- j) the pilot cut off the engine and made a forced landing over a crop;
- k) the engine failure was related to the detachment of cylinder n^o 4 during the flight and associated with the breakage of the stud bolts for this cylinder;
- l) the stud bolt that remained attached to the base of the cylinder showed signs of fatigue;
- m) the aircraft had substantial damage; and
- n) the pilot left unharmed.

3.2 Contributing factors.

- Aircraft maintenance – undetermined.

There is the possibility that during the opening of the engine for overhaul or even some unrecorded maintenance, the cylinders were assembled with improper torque application on one or more bolts, which would have led to the loosening of the other bolts and the loss of engine power in flight.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation made intending to prevent accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

In consonance with Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 “Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State”.

Recommendations issued at the publication of this report:

To Brazil’s National Civil Aviation Agency (ANAC):

A-041/CENIPA/2020 - 01

Issued on 12/05/2022

Disclose the lessons learned in this investigation to the Tangará Aero Center Ltd., so that this OM uses these lessons in the promotion of operational safety within that organization, disclosing the consequences arising from the lack of effective quality control in engine maintenance services during preventive and corrective procedures.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On December 5th, 2022.