# COMANDO DA AERONÁUTICA

## CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

# FINAL REPORT
# A - 002/CENIPA/2021

| | |
|---|---|
| **OCCURRENCE:** | **ACCIDENT** |
| **AIRCRAFT:** | **PR-TCE** |
| **MODEL:** | **PA-25-235** |
| **DATE:** | **05JAN2021** |

# NOTICE

*According to the Law nº 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination, and execution of the activities of investigation and prevention of aeronautical accidents.*

*The elaboration of this Final Report was conducted by taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document that reflects 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 Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).*

*This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated into the Brazilian legal system by Decree nº 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, the use of this report for any purpose other than that of 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 05JAN2021 accident with the PA-25-235 aircraft model, registration PR-TCE. The accident was classified as “[SCF-PP] Engine Failure or Malfunction – Engine Failure in Flight”.

The aircraft took off from a landing area for agricultural use at Floresta Farm, Guará - SP, to carry out a local flight to spray agricultural pesticides.

During the spraying, an engine failure occurred.

The engine failure was caused by an inadvertent grounding caused by the deterioration of the engine`s electrical wiring and the contact of the magnetos wiring with the exhaust.

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.

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## GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

| | |
|---|---|
| ANAC | Brazil's National Civil Aviation Agency |
| AEV | Special Flight Authorization |
| CA | Airworthiness Certificate |
| CENIPA | Aeronautical Accident Investigation and Prevention Center |
| CIV | Pilot`s Flight Logbook |
| CMA | Aeronautical Medical Certificate |
| CVA | Airworthiness Verification Certificate |
| IS | Supplementary Instruction |
| JIAAC | *Junta de Investigación de Accidentes de Aviación Civil* |
| MNTE | Airplane Single-Engine Land Rating |
| OM | Maintenance Organization |
| PAGA | Agricultural Pilot License - Airplane |
| PCM | Commercial Pilot License – Airplane |
| PIC | Pilot in Command |
| PPR | Private Pilot License – Airplane |
| S11 | Specialized Public Air Service Aircraft Registration Category – Aerial-agricultural (operating with ethanol) |
| SIPAER | Aeronautical Accident Investigation and Prevention System |
| UTC | Universal Time Coordinated |

## 1. FACTUAL INFORMATION.

| | | |
|---|---|---|
| **Aircraft** | **Model:** PA-25-235<br>**Registration:** PR-TCE<br>**Manufacturer:** Laviasa | **Operator:**<br>*Aeroagrícola Chapadão* Ltd. |
| **Occurrence** | **Date/time:** 05JAN2021 - 2030 UTC<br>**Location:** Rural area of the Guará municipality<br>**Lat.** 20°24'29"S **Long.** 042°46'25"W<br>**Municipality – State:** Guará – SP | **Type(s):**<br>"[SCF-PP] Engine Failure or Malfunction"<br>**Subtype(s):**<br>Engine Failure in Flight |

### 1.1 History of the flight.

The aircraft took off from a landing area for agricultural use at Floresta Farm, Guará - SP, to carry out a local flight to spray agricultural pesticides with a PIC on board.

During the application, the engine failed. An emergency landing was made on the crop.

The aircraft had substantial damage.

The pilot left unharmed.

### 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 propeller, engine, lower fuselage, both wings and the landing gear.

### 1.4 Other damage.

None.

### 1.5 Personnel information.

### 1.5.1 Crew's flight experience.

| Flight Hours | PIC |
|---|---|
| Total | 1536:00 |
| Total in the last 30 days | 30:00 |
| Total in the last 24 hours | 04:00 |
| In this type of aircraft | 530:00 |
| In this type in the last 30 days | 30:00 |
| In this type in the last 24 hours | 04:00 |

**N.B.:** The data relating to the flown hours were obtained through the records of the pilot`s CIV.

### 1.5.2 Personnel training.

The PIC took the PPR course at the Araraquara Aeroclub - SP, in 2012.

### 1.5.3 Category of licenses and validity of certificates.

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

### 1.5.4 Qualification and flight experience.

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

### 1.5.5 Validity of medical certificate.

The PIC had a valid CMA.

### 1.6 Aircraft information.

The aircraft, serial number 25-2711, was manufactured by Laviasa in 1965 and was registered in the S11 category.

As it was an aircraft that was modified in accordance with the IS 137.202 for use with ethanol, it did not have a CA but an AEV, which was valid.

The airframe, engine, and propeller logbooks were outdated. There were no entries in Part I of the logbooks. However, the other parts were complete.

The last inspections of the aircraft, the “500 hours” and “CVA” types, were carried out on 03DEC2020 by the Maintenance Organization (OM) Tangará Aero center Ltd., in Orlândia - SP, with 30 hours flown after the inspection.

The CVA was valid until 03DEC2021.

### 1.7 Meteorological information.

The weather conditions were favorable for the flight.

### 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.

The impact occurred on a sugarcane plantation near where the pesticide spraying was being carried out.

After touching the ground, the aircraft traveled around 10 meters, turning approximately 90 degrees to the right with the approach axis.


Figure 1 - Side view of the aircraft after impact.

## 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 no fire.

## 1.15 Survival aspects.

Nil.

## 1.16 Tests and research.

During the beginning of the analysis of the powerplant, soon after removing the seals, it was observed that the electrical wiring of the engine, where the cables of the starter engine and magnetos were located, was leaning against the exhaust pipe on the left side. It showed deterioration in its protection and internal components due to friction and heating, as shown in Figure 2.

Figure 2 - Damaged engine electrical wiring, leaning against the exhaust.

It was found that the electrical cabling would be attached to the engine cradle through a general-purpose plastic clamp without contact with the exhaust. The aforementioned plastic clamp was with the latch lock damaged and loose, yet still next to the engine cradle (Figure 3).


Figure 3 - Plastic clamp found on the engine cradle with the broken latch.

The operator presented a copy of the PA-25 Maintenance Manual, chapter 7 - Power Plant (engine), without publication date, which did not refer to the type of clamp that should have been used for fixing the electrical cabling and other engine parts.

In this condition, the electrical cabling started to touch the engine exhaust, the heat and friction generated by its operation caused the damage observed in the cabling and in the exhaust itself (Figure 4).

Figure 4 - Damage generated in electrical cabling and exhaust.

Digging deeper into the analysis, the wiring harness was opened, and the grounding wires of the magnetos were found to be damaged by heat-related melting (Figure 5).

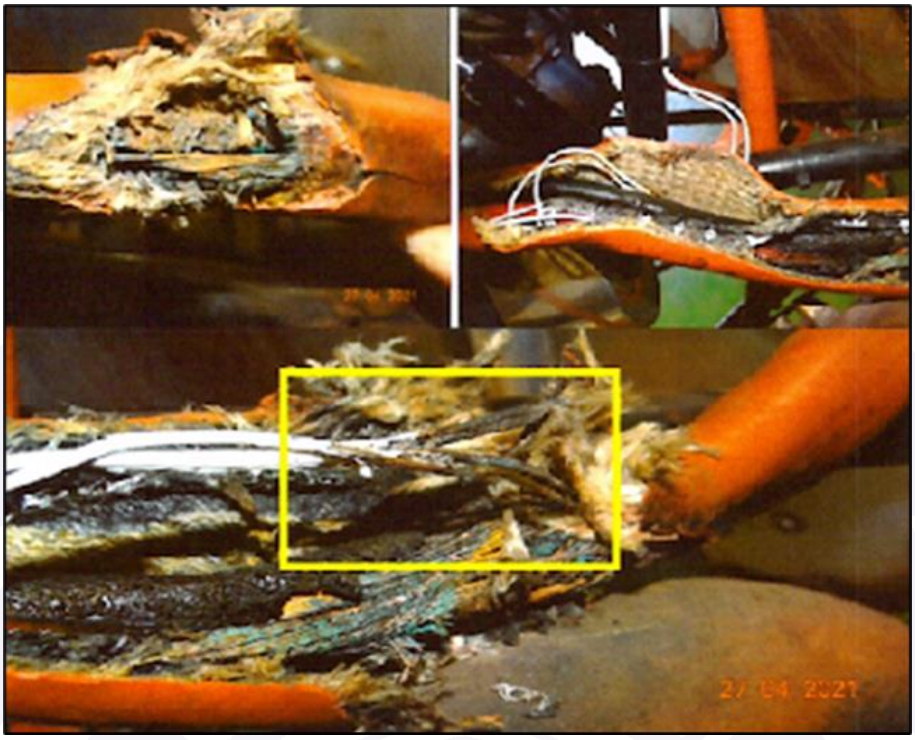

Figure 5 - View of the inside of the damaged electrical wiring exposing the magneto ground wires, damaged by melting.

The engine was analyzed in its general aspect for oil and fuel leaks, the freedom of the crankshaft to turn, the carburetor operation, the generation of sparks and adjustment of the magnetos.

During the inspection of the magnetos, it was found that one of them had its platinum damaged and inoperative. After replacing the item, both magnetos received a new adjustment and synchronization, aiming at the functional test to be performed.

The propeller, originally installed on the aircraft, had a slight bend in one of the blades during the event, so it was replaced by one of the same model for the functional test.

During the functional test, the engine was started and operated without major problems. The rotation was raised to 1,200 RPM and was maintained until it reached normal operating temperature remaining like this for eight minutes until it was turned off to check for possible leaks and other discrepancies. Nothing unusual was noticed.

In the next step, the grounding wires of the magnetos were intentionally placed in contact with the structure of the aircraft's exhaust, simulating the discrepancy found at the beginning of the analysis, which resulted in the engine shutting down. (Figure 6).

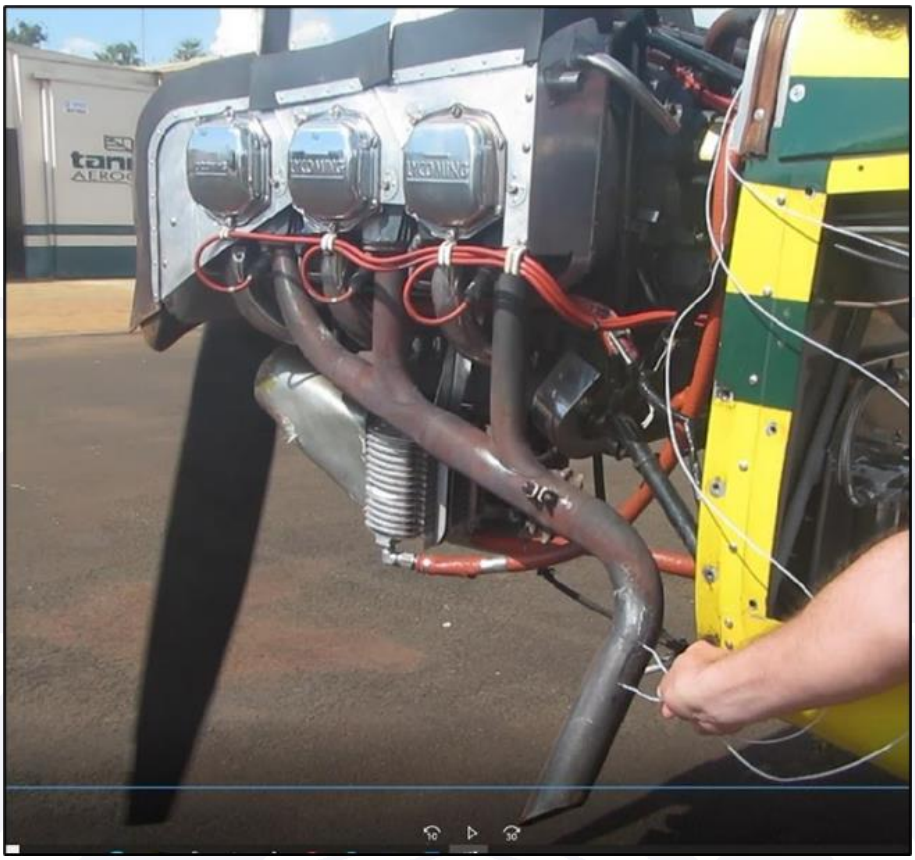

Figure 6 - Ground wires of the magnetos being pressed against the exhaust, causing the engine to shut down.

As no leaks or other discrepancies were found, the engine was restarted, and performance tests were carried out at higher speeds, observing the other engine parameters, such as oil pressure and temperature. The engine behaved within operating green bands as intended by the manufacturer.

**1.17 Organizational and management information.**

Nil.

**1.18 Operational information.**

According to the data provided by the crewmember and the operator, the aircraft took off with approximately 1,315 kg, and weighed 982 kg at the time of the occurrence. Therefore, within the weight and balance limits specified by the manufacturer.

The PIC reported that, during the flight, there was a loss of engine power.

Before landing, the agricultural pesticide was jettisoned.

Except for the powertrain system, no evidence of failure of any other system, that could have contributed to the occurrence was found.

Nor was found any other operational procedure that could contribute to the occurrence.

**1.19 Additional information.**

Nil.

**1.20 Useful or effective investigation techniques.**

Nil.

## 2. ANALYSIS.

It was a flight for spraying agricultural pesticides in a sugarcane plantation.

During the flight, the aircraft had an engine failure and made an emergency landing.

According to the survey carried out, the pilot was qualified for the flight. He had valid licenses and ratings. There were no indications of operational failure in the event.

The meteorological conditions were favorable for the intended flight, and there was no influence of this factor on the occurrence.

The aircraft was within weight and balance limits.

The airframe, engine and propeller logbook records were outdated, as there were no hours registered in their Part I.

According to the analysis presented, the damage observed in the electrical wiring of the engine deteriorated by friction and heating, and the contact of the magnetos wiring with the exhaust, caused the magnetos to be grounded inadvertently and, consequently, the engine shutdown during flight.

The plastic clamps that fixed the electric cabling to the engine cradle were considered inadequate, since they are fragile and get loose over time due to the vibration of the powertrain, leading to the possibility of this type of occurrence.

In the aircraft maintenance manual, in the chapter referring to the engine there was no specification regarding the clamp that should be used for fixing the electrical cabling.

However, good aeronautical maintenance practices recommend that the fastening of electrical cables in the engine area, on the structure or cradle of the engine, should be done with metal clamps, fixed with screws and self-braking nuts, or that can be braided with stainless steel braiding wire.

The application of this material (plastic) was considered the first link in the chain of events that led to the outcome of the occurrence and evidenced that there was participation in the maintenance of the aircraft due to inadequacy of services performed.

This situation also evidenced the contribution of the managerial supervision of the operating company regarding the non-observation of the use of inappropriate material in the engine maintenance services.

No other evidence of failure in any other aircraft system was found.

## 3. CONCLUSIONS.

### 3.1 Facts.

a) the PIC had a valid CMA;

b) the PIC had valid MNTE and PAGA Ratings;

c) the PIC was qualified and had experience in the type of flight;

d) the aircraft had a valid AEV;

e) the aircraft was within the weight and balance limits;

f) the Part I records of the airframe, engine, and propeller logbooks were outdated;

g) the weather conditions were favorable for the flight;

h) the electrical wiring of the engine was found deteriorated by friction and heating;

i) the electrical wiring of the magnetos was in contact with the exhaust;

j) there was an inadvertent grounding of the magnetos, causing the engine to shut down;

k) the aircraft made a forced landing on the sugarcane plantation;

l) the aircraft had substantial damage; and

m) the PIC left unharmed.

**3.2 Contributing factors.**

- **Aircraft maintenance – a contributor.**

The use of plastic clamps to secure the electric cables to the magnetos and starter engine, which are susceptible to early deterioration from friction and heating, allowed them to come into contact with the exhaust ducts, causing inadvertent grounding of the magnetos and engine failure.

- **Managerial oversight – a contributor.**

The management supervision of the operating company contributed to the occurrence, with regard to the non-observance of the use of adequate material in the engine maintenance services.

## 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 the Brazil's National Civil Aviation Agency (ANAC):**

**A-002/CENIPA/2021 - 01 Issued on 03/23/2023**

Disseminate the lessons learned from this investigation to the Aircraft Maintenance Organizations in order to warn about the risks caused by the use of plastic clamps on the engine's electrical wiring due to their risk of deterioration, breakage and consequent friction and heating with the hot parts of the engine, which can cause grounding and failures in the powerplant, as observed in this occurrence.

**A-002/CENIPA/2021 - 02 Issued on 03/23/2023**

Assess the relevance of acting with the primary certifier, to require the aircraft manufacturer or current certificate holder to issue technical instructions that guide the proper attachment of electrical cables in the engines` region of the PA-25-235 aircraft.

## 5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

The OM Tangará Aero center Ltd. performed maintenance on the other aircraft of the same model, operated by Aeroagrícola Chapadão Ltd., in order to improve the attachment of the cables to the engine cradle with the use of metal clamps.

On March 23th, 2023.