

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 016/CENIPA/2016

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PT-WFX
MODEL:	AT-401B
DATE:	20JAN2016



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 taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document which 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 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 in the Brazilian legal system by virtue of the 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 to 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 20JAN2016 accident with the AT-401B aircraft, registration PT-WFX. The accident was classified as “[SCF-PP] System/Component Failure or Malfunction Powerplant”.

During an attempt to return to the runway after an engine failure, the aircraft collided against the ground and then against a vehicle traveling on state highway PR-545 and was, in that moment, in the extension of the SSOK threshold 28.

The aircraft and the vehicle were destroyed by the collision and fire.

The pilot and two occupants of the vehicle suffered serious injuries and six other occupants of the vehicle suffered fatal injuries.

An Accredited Representative of the National Transportation Safety Board (NTSB) – USA, (State holding the primary type design of aircraft manufacturing) was designated for participation in the investigation.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

3 rd BPM	Third Battalion of the Military Police
AFM	Aircraft Flight Manual
AMR	DCTA's Materials Division
ANAC	Brazil's National Civil Aviation Agency
APA-E	IAE Engineering Subdivision
BT	Technical Bulletin
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CI	Investigation Team
CMA	Aeronautical Medical Certificate
DCTA	Department of Science and Airspace Technology
EPI	Individual Protection Equipment
IAE	Aeronautic and Space Institute
Lat	Latitude
Long	Longitude
MCA	Aeronautics Command Manual
MNTE	Airplane Single Engine Land Rating
NTSB	National Transportation Safety Board (USA)
PAGA	Agricultural Pilot Rating
PCM	Commercial Pilot License – Airplane
PPR	Private Pilot License – Airplane
RBAC	Brazilian Civil Aviation Regulation
RS	Safety Recommendation
SAE-AG	Aircraft Registration Category of Specialized Air Service - Agricultural
SERIPA V	Fifth Regional Aeronautical Accident Investigation and Prevention Service
SIATE	Integrated System of Attendance to Trauma and Emergency
SICN	ICAO Locator Designator – Vista Bonita Farm Aerodrome, Sandovalina - SP
SIPAER	Aeronautical Accident Investigation and Prevention System
SSOK	ICAO Locator Designator – 14 Bis Aerodrome, Londrina - PR
TBO	Time Between Overhaul
UTC	Universal Time Coordinated
VRF	Visual Flight Rules
VMC	Visual Meteorological Conditions

1. FACTUAL INFORMATION.

Aircraft	Model: AT-401B	Operator: <i>Viagro Vidotti Agro Aérea Ltd.</i>
	Registration: PT-WFX	
	Manufacturer: Air Tractor	
Occurrence	Date/time: 20JAN2016 – 1910 UTC	Type(s): “[SCF-PP] System/Component Failure/ Malfunction Powerplant”
	Location: 14 Bis Aerodrome (SSOK)	
	Lat. 23°12'51”S Long. 051°11'09”W”	Subtype(s): Engine Failure In-Flight
	Municipality – State: Londrina - PR	

1.1 History of the flight.

The aircraft took off from the 14 Bis Aerodrome (SSOK), in the municipality of Londrina - PR, to the runway of Vista Bonita Farm (SICN), in the municipality of Sandovalina - SP, at about 1910 (UTC), for a transfer flight, with a pilot on board.

During the take-off procedure, the aircraft presented loss of power and the pilot tried to return to the runway, in a reversal curve at low altitude. In the final short, the aircraft crashed into the ground and then collided against a vehicle that was traveling on the state highway PR-545 and was passing near the threshold 28 of SSOK.

The aircraft was destroyed. The pilot and two passengers of the vehicle suffered serious injuries and six occupants of the vehicle had fatal injuries.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	6
Serious	1	-	2
Minor	-	-	-
None	-	-	-

1.3 Damage to the aircraft.

After the collision with the vehicle, the aircraft caught fire, resulting in the total burning of the fairing, engine mount, hopper, cockpit and front fuselage. There were major damage in the propeller, engine, landing gear and wings.

1.4 Other damage.

Impacts on the Km 04 pavement on state highway PR-545 and transverse collision with vehicle that was traveling at that moment, causing it to leave the runway and kneading the front and left side of the bodywork.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	1.200:00
Total in the last 30 days	30:00
Total in the last 24 hours	00:35
In this type of aircraft	30:00
In this type in the last 30 days	30:00
In this type in the last 24 hours	00:35

N.B.: The Data related to the flown hours were provided by the pilot.

1.5.2 Personnel training.

The pilot took the PPR course, at the Londrina Aeroclube - PR, in 2008.

1.5.3 Category of licenses and validity of certificates.

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

1.5.4 Qualification and flight experience.

The pilot was qualified and had experience in that kind of flight. The pilot had more experience in the EMB-202 IPANEMA aircraft and had only 30 hours of flight time in the operation of the AT-401B Air Tractor.

1.5.5 Validity of medical certificate.

The pilot had valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information.

The aircraft, serial number 401B0981, was manufactured by Air Tractor, in 1995, and it was registered in the SAE-AG category.

The aircraft had valid Airworthiness Certificate (CA).

The airframe, engine and propeller logbook records were outdated. The airframe and engine ones had their last update inserted in May 2015 and the propeller was updated only until October 2010. Therefore, it was not possible to determine accurately the total hours of flight of the aircraft.

The engine had a total of 10.479 hours and 6 minutes, according to the last release in its book. The Time Between Overhaul (TBO) of this engine was of 1.200 hours. Covington Aircraft Engines Inc., Oklahoma - USA made its last overhaul on 19AUG2011, and its continued airworthiness was approved according to the certificate issued.

The most extensive revision record, the 1.000 hours type, as provided by the manufacturer, was not found in the aircraft folder. The last inspection of this type occurred when the aircraft was with 1.043 hours and 48 minutes on 06SEPT2004, as recorded on page 15/132 of the Airframe Book nº 04 / PT-WFX / 03.

According to only the records found, the aircraft would be with 2.391 hours and 18 minutes total and 1.348 hours and 18 minutes after its last inspection of 1.000 hours (that is, with 348 hours and 18 minutes after expiration).

The aircraft's logbook was inside the aircraft at the time of the accident, being totally burned.

The last inspection of the aircraft, the "50 hours" type, was carried out on 29JUN2015 by VIMAER Ltd., in Londrina - PR, with one hour flown after the inspection.

The last revision of the aircraft, the "100 hours" type, was performed on 09FEB2015 by the VIMAER Ltd. shop, in Londrina - PR, with 48 hours flown after the review.

1.7 Meteorological information.

At the time of take-off, the meteorological conditions were visual, with wind of 110° of direction and intensity of 10kt.

1.8 Aids to navigation.

Nil.

1.9 Communications.

The aircraft was not equipped with VHF radio communication equipment.

1.10 Aerodrome information.

The occurrence took place outside the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The impact of the aircraft occurred at a 45° wing tilt angle against a ravine that was 8 meters from the side of state highway PR-545. Then, there was the collision against the asphalt of this highway and a transverse collision against a car that was traveling over there at that moment.

The aircraft stop occurred 30 meters after the collision, in a soybean plantation located between the state highway PR-545 and the 14 Bis Airport runway, in Londrina - PR.

After the collision with the vehicle, the aircraft caught fire, resulting in the total burning of the fairing and the engine mount, hopper, cockpit and front fuselage.

There was the separation of the cylinder head #4 from its engine housing and the propeller blades were bent (bending stress) facing back.

The aircraft and the vehicle were moved by the firefighters and the military police of the Third Battalion of the Military Police (3rd BPM) from the State of Paraná - PR, and by first responders of the SIATE, for the removal and the assistance of the victims.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

The pilot suffered 2nd degree burns on 6% of the body surface (face, hands, forearms and lower limbs) and there were no associated fractures.

He had no chronic diseases or pathological conditions that might have interfered with his psychophysical aptitude.

There was no evidence of use of narcotic or psychotropic substances, nor of sudden discomfort or aerospace disorientation at the time of the accident.

The pilot did not wear gloves and had injuries caused by 2nd degree burns in both hands.

Finally, there was no evidence that physiological or disability considerations had affected the performance of the crewmember.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot began his aviation activities at the age of 18, in Londrina, where he took the Private Pilot course, in a flying club, and he took the Commercial Pilot course in the aviation school that belonged to the company group of the aircraft operator.

At the beginning of his professional life, he acted as a flight instructor and later as an agricultural aviation pilot in another state, where he performed flights with an Ipanema model aircraft (EMB-202), in which he had approximately 500 flight hours.

Upon returning to Londrina, he acted as an instructor to acquire flight hours. There was, by the pilot, a feeling of appreciation for the job opportunity given to him by the aircraft's operator company.

Upon being hired by this company to perform actions related to the agricultural aviation, the pilot made an adaptation of approximately five hours on the Air Tractor aircraft. At the time of the occurrence, the pilot had 30 hours of flight in the model involved in the accident, and approximately 1.200 total flight hours.

The pilot reported that, the day before the flight, he had rested and fed properly.

As reported by the pilot, the engine failure was not immediately identified, however, when he noticed problems in the attitude of the aircraft during take-off, the pilot tried to return to the runway to land.

The Investigation Team (CI) found that, when he was providing flight instruction, the pilot always trained with his students the emergency procedure at low altitude with landing ahead.

The pilot reported he had assessed that the ground at the front was rather irregular to provide a safe landing, and took into account the possible risk to himself and the possibility of considerable damage to the aircraft and loss of credibility with employers. Based on this evaluation, he decided to try to return to the runway.

1.14 Fire.

After the impact on the vehicle, an explosion occurred and the fire reached approximately 75% of the aircraft, resulting in the total burning of the fairing and engine mount, hopper, cockpit and front fuselage.

1.15 Survival aspects.

The rapid performance of the Fire Department and the SIATE teams from Londrina, avoided the death of the pilot and of other 2 occupants of the vehicle.

1.16 Tests and research.

Due to the evidence of a failure of the aircraft's engine operation, it was removed for the purpose of examination and technical analysis by specialists of the SERIPA V, of the DCTA and of the VIDOTTI Manutenção de Aeronaves Ltd. shop, in Londrina - PR.

The report issued after this analysis concluded that:

- a) it was not identified malfunction in the lubrication system, no presence of filings in the rotating or moving components of the engine;
- b) the magnetos were blinking normally and the alternator did not present difficulty in the rotating movement;
- c) no cracks, warping or other damage were found on the connecting rod assembly and the engine reduction box; and
- d) the cylinder head #4 was separated from its housing, demonstrating that this cylinder failed. To find out the reason for this cylinder head fracture, a more specific analysis was requested by the AMR of the IAE.

The AMR, in turn, issued a report stating that:

- a) after visual analysis and examination by electronic stereoscopy, the cylinder failure occurred due to the propagation of two cracks that became passers before the cylinder fracture; and
- b) the most probable mechanism of this fracture was the propagation by material fatigue.

It was concluded, therefore, that the failure of the engine that equipped the aircraft was caused by a fatigue of material that gave rise to two passing cracks, whose propagation reached the head of the cylinder N° 4, causing it to fail due to deficiency in the compression of the air-fuel mixture in the combustion chamber, even before the total fracture of this cylinder occurs.

However, it was not possible to determine, objectively, what was the factor that initiated this fatigue process.

1.17 Organizational and management information.

The company operating the aircraft had three operational bases, an agricultural aviation school and its own maintenance shop, and it was observed that it offered good working conditions to its pilots and technicians.

It was reported that only informal meetings were held with the pilots to deal with operational and flight safety issues, with no record of participation in these events.

Because there was no legal requirement on the part of the regulatory agency at the time of the occurrence, 5 hours of flight were made as an adaptation of the pilot to that aircraft model.

1.18 Operational information.

The aircraft was within the limits of weight and center of gravity (CG) specified by the manufacturer.

The weather conditions were favorable for the flight under visual conditions, with a wind of 110° with 10kt of intensity.

The Air Tractor Model AT-401B was a single-engine with conventional landing gear and a low wing, with a maximum of 13kt limitation of maximum crosswind at landing, as described in Section 1 LIMITATIONS of AFM AT-401B, of 09NOV1998, being inadvisable for it to land with tail wind.

The pilot had more experience on the EMB-202 IPANEMA aircraft and had 30 hours of flight in operation of the AT-401B Air Tractor.

From the date of the accident until the publication of this report, there was no legal provision in the ANAC regulation that contemplated the need for a specific instruction or even training of differences, or a similar one (endorsement), to the crashed aircraft model.

Thus, no record of a pilots' training program for the crashed aircraft model was found, and this training was not required by the relevant legislation.

During take-off, after the aircraft had run 3/4 of the runway and was still very low, with an estimated speed between 65kt and 70kt, a power failure occurred. The pilot did not immediately identify the breakdown.

The pilot, when he realized the low performance of the engine, opted to make a return maneuver to the runway, in order to land in the direction of threshold 28.

According to his report, such decision was made after evaluating that the landing ahead conditions were not propitious, due to the relief of the terrain, which could lead to serious physical injury and greater damage to the aircraft.

It also contributed to his decision that the engine did not stop completely, but rather showed signs that it was losing power.

Thus, the pilot commanded a slight left turn and lowered the flaps to the 1st position. Soon after, he made a reversal curve of great slope (60°) from the right, lowering the flaps to the 2nd and 3rd positions (all lowered), trying to align with the axis of threshold 28.

At this moment, still in a curve of great inclination, the pilot realized that the aircraft was sinking too much and that it would not arrive at the runway again. He tried unsuccessfully to level his wings to land.

There was loss of effectiveness of ailerons control and, consequently, loss of the aircraft control, resulting in the collision at a 45° wing tilt angle against the ground, 188 meters from threshold 28.

Regarding the FORCED LANDING procedure motivated by engine failure, the Airplane Flight Manual (AFM) of the Air Tractor Model AT-401B, Section 3 - EMERGENCY PROCEDURE, determined that the speed should be maintained from 78kt to 87kt, an adequate area of landing was to be searched and that the flaps remained retracted.

The same AFM, in its Section 4 PERFORMANCE, table p. 17, reported that the stall velocity of the AT-401B with flaps lowered was of 75kt when in a 60° slope curve.

Aircraft flight manuals with physical and aerodynamic characteristics similar to those of the AT-401B, such as the EMB-202 "IPANEMA", advised that in the event of an engine failure at take-off, the pilot should land ahead without making turns, maintain 85mph (74kt) glide and flaps retracted (according to the Operation Manual MO 202/007 "IPANEMA" EMB 202, Rev. 29, 05/04/2012, of NEIVA Ind. Aeronáutica Ltd., Section 3 "EMERGENCY PROCEDURES, "items 3-9 ENGINE FAILURE DURING TAKE- OFF, and 3-16-2 FORCED LANDING WITH ENGINE FAILURE).

Some aspects observed by the investigators of SERIPA V in the analysis of the wreckage, besides a video recorded by a security camera positioned in patio 1 of the 14 Bis Airport, were in agreement with the information given by the pilot that there was an engine failure during the take-off.

1.19 Additional information.

The 2004 Aeronautics Command Manual (MCA) 58-3 the "Private Pilot Course Manual - Aircraft" 2004, Phase I (Pre-Solo) and Phase II (Improvement) predicted that low-level simulated engine failures would be thoroughly trained in the pilot formation, with the objective of ensuring an emergency landing, safely, in the occurrence of an actual emergency situation.

In this same sense, the "Commercial Pilot Course Manual - Airplane" 1990, recommended that Phases I (Adaptation) and III (Maneuvers) of the 1st Stage and Phase II (Adaptation) of the 2nd Stage, be trained simulated engine failures at low altitude and simulated engine failures after take-off again, so that the pilot was able to fly and solve an emergency engine failure immediately after take-off.

In addition, the "AIRPLANE FLYING HANDBOOK" of the Federal Aviation Administration (FAA), 2nd edition, revised in 2007, stated in the topic "ENGINE FAILURE AFTER TAKE-OFF" (SINGLE ENGINE) that the available height was in many cases the control factor in the successful completion of an emergency landing, and it would be safer to immediately establish the appropriate gliding attitude and select a field directly ahead or slightly alongside the take-off path.

The Investigation Team noted that there was a requirement in the Brazilian Civil Aviation Regulation 137 (RBAC 137), section 137.209, for the use of flight safety equipment for the agricultural operation, such as helmet, gas mask, etc. However, the wear of flight gloves and anti-flame flying suits was not covered in this item, although several pilots were already using these Individual Protection Equipment (EPI) on their own.

A survey carried out in the reports issued by the CENIPA since 2005 showed that, on at least three occasions, the lack of such equipment contributed to aggravate the injuries caused to the occupants of the aircraft, due to fire.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

This was a transfer flight from Londrina to Vista Bonita Farm (SICN), in the municipality of Sandovalina, where during the take-off procedure, the aircraft presented a loss of power and the pilot attempted to return to the runway in a reversal curve at low altitude.

In the final short, the aircraft crashed into the ground and then collided with a vehicle that was traveling on state highway PR-545 and was passing near the 28th SSOK threshold.

At the moment the aircraft entered a very steep curve, with flaps completely extended and at low speed, it was out of the envelope of operation, losing effectiveness in flight commands.

In addition, the tailwind at the end of SSOK runway 28 influenced the aircraft's performance in the return procedure, helping the plane sink and crash against the ground about 188 meters before the threshold.

The Air Tractor Model AT-401B aircraft had the maximum limit of 13kt of crosswind at landing, as it was stated in the AFM, and it is not advisable to perform it with tailwind.

The doctrine recommended in the air instruction manuals seeks the correct application of the piloting techniques, the correctness in the initiatives taken and the clearance in the conduct of the actions directed to solve the emergency, such as: adequate choice of the landing place, correct execution of the approach, maintenance of the standard speed for landing, judgment, point of touch on the runway, etc.

Particularly in the engine failure after take-off on single-engine aircraft, it is advised to always land (choose a landing area on a sector of 20° from the heading of the aircraft) or, in the case the breakdown occurs at a sufficient height, to make a short traffic circuit, with the final higher than normal and an approach aiming at landing on the first third of the runway.

The configuration with lowered flaps and landing gear should only be made when landing is already fully guaranteed.

The decision to attempt a return to the runway may have been influenced by the fact that the engine did not stop altogether, but began to show an intermittent fault, due to the problem in cylinder #4.

Thus, it is reasonable to assume that the pilot, in the face of this failure, may have believed that the remaining power would be sufficient to sustain a flight during emergency traffic.

In addition to this assumption, the pilot's decision also made him afraid that his employer could hold him responsible for the damages to the aircraft, if he decided to land on uneven ground.

The decision-making process is one in which the individual collects and analyzes the information relevant to the given situation and chooses the most acceptable alternative of action over a given period of time. People often use subjective criteria to make decisions and thus reduce the cognitive load involved in the process, which although not always result in bad decisions, can increase the probability of errors.

In the accident in question, despite the knowledge about the proper procedure to be adopted in this emergency, the decision to return to the runway was influenced by the

pilot's fear that the consequences of landing on uneven ground would cause damages not only to him, but also to the aircraft and to his credibility with employers.

It is possible that the motivation of the pilot to continue working for the company in which he had just entered after a period of distance from the agricultural operation influenced the adoption of subjective criteria for decision making, to the detriment of observance of the predicted procedures. It follows, therefore, that the pilot did not follow the operational procedures, recommended in basic piloting instruction manuals and common to aircraft similar to the AT-401B. The return procedure to the runway should only be done at a safe height.

In the course of the investigative process, it was verified that: the airframe, engine and propeller logbooks were outdated, preventing the accurate calculation of the aircraft's total flight hours; no record of the most extensive review of 1000 hours was found; and according to records found, the aircraft would be with 348 hours flown more than expected by its last 1.000-hour inspection.

Such discrepancies indicated a lack of monitoring, traceability of services and lack of maintenance supervision, aspects that could be related to the non-perception of the appearance of cracks in the cylinder head and consequent engine failure.

It was concluded, therefore, that the cause of the engine failure immediately after take-off, originated from the cracks in the cylinder head #4 caused by material fatigue, however, it was not possible to determine objectively what the factor that started this process was. It also contributed to aggravate the injuries to the pilot, the non-wear of flight gloves and anti-flame flying suits. The use of protective equipment, provided for in RBAC 137, did not contemplate the use of these EPI; although many pilots already did so considering that they provided greater safety to this type of operation.

It should be noted that, in addition to fire protection, the use of such equipment might also increase protection, due to exposure to the chemicals present in this type of operation.

3. CONCLUSIONS.

3.1 Facts.

- a) the pilot had valid Aeronautical Medical Certificate (CMA);
- b) the pilot had valid PAGA and MNTE Ratings;
- c) the pilot was qualified, he had 1.200 total flight hours and 30 hours in the aircraft model;
- d) the aircraft had valid Airworthiness Certificate (CA);
- e) the aircraft was within the limits of weight and balance;
- f) the airframe, engine and propeller logbook records were outdated and the maintenance services could not be fully tracked;
- g) at the time of take-off the meteorological conditions were visual with wind direction of 110° and intensity of 10kt;
- h) during take-off, after running 3/4 of the runway, being at a low height and estimated speed between 65kt and 70kt, an engine failure occurred;
- i) the pilot commanded a left turn and lowered the flaps to the 1st position;
- j) soon after, the pilot made a reversal curve of great slope (60°) from the right, lowering the flaps to the 2nd and 3rd positions (all extended), trying to align with the axis of runway 28;

- k) during the base curve, the pilot realized that the aircraft was sinking too much and that it would not reach the runway again;
- l) the pilot tried to level the wings to land ahead, but could no longer command the level off;
- m) the aircraft collided against the ground at a 45° wing tilt angle;
- n) the crash occurred on highway PR-545 highway, 188 meters before the SSOK threshold 28;
- o) thereafter, there was the collision of the aircraft against a car, with the stop of both of them in a soybean plantation;
- p) during the research it was found that the cylinder head #4 was separated from its housing in the engine;
- q) the aircraft engine report concluded that cylinder #4 failed, due to the propagation of cracks resulting from material fatigue;
- r) analysis of damage to the propeller blades indicated that at the time of collision the engine did not develop power;
- s) the aircraft caught fire and was destroyed; and
- t) the pilot and two occupants of the vehicle suffered serious injuries and six other occupants of the vehicle suffered fatal injuries.

3.2 Contributing factors.

- **Control skills – a contributor.**

The performance of a return curve to the runway outside the flight envelope contributed to the loss of control of the aircraft.

- **Piloting judgment – a contributor.**

Despite being out of the envelope to perform a return to the runway, the pilot thought that he could carry out such a procedure, thus contributing to the loss of effectiveness of flying commands.

- **Aircraft maintenance – undetermined.**

The technical analysis found that the engine failure that equipped the AT-401B PT-WFX aircraft was caused by a fatigue of material that caused two passing cracks, which propagated to the head of cylinder #4, causing it to fail due to deficiency in compressing the air-fuel mixture in the combustion chamber.

However, it was not possible to determine, objectively, if there was any deficiency in the engine revision services and in the identification of this fatigue, leaving the contribution of this factor indeterminate.

- **Motivation – undetermined.**

It is possible that the adoption of subjective criteria in the decision-making process during the emergency, to the detriment of compliance with the prevised procedures, has been influenced by the motivation of the pilot to be stabilized in the company.

- **Insufficient pilot's experience – undetermined.**

The pilot was more experienced at another type of equipment and only had 30 hours of flight time on the crashed aircraft model, which may have influenced his ability to evaluate the performance of the AT-401B, especially in an in-flight engine failure condition.

- **Decision-making process – a contributor.**

The decision to return to the runway for landing was based on an inadequate assessment of the operational conditions present at the time of the emergency and the fear generated by the possibility of personal injury risk, considerable damage to the aircraft and loss of credibility with employers. The adoption of these subjective criteria led to an unfavorable decision to the context of the emergency and contributed to the occurrence.

- Managerial oversight – undetermined.

Although it was not possible to point out the maintenance of the aircraft as a contributing factor in this accident, it was verified that there were company failures in the monitoring and supervising of these services, since the airframe, engine and propeller logbooks were outdated, as well as there was no record of the last 1.000 hour revision of the aircraft. Such failures of supervision may have allowed the fatigue process on cylinder #4 to pass unnoticed.

- Other – a contributor.

The fact of not wearing flight gloves resulted in burning injury to the hands, which could have been avoided or minimized with the use of this Individual Protection Equipment (EPI).

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing 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 the 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-016/CENIPA/2016 - 01

Issued on 29/01/2019

Act together with VIAGRO Vidotti Agro Aérea Ltd., in order to guarantee compliance with the maintenance interventions in their aircraft’s fleet, as well as their respective records in accordance with the legislation in force.

A-016/CENIPA/2016 - 02

Issued on 29/01/2019

Analyze the pertinence of including the wear of flight gloves and anti-flame flying suits as Individual Protection Equipment, in item 209 of RBAC 137.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On January 29th, 2019.