

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 089/CENIPA/2017

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PR-MFR
MODEL:	210M
DATE:	03JUL2017



NOTICE

According to the Law n° 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 n° 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.

SYNOPSIS

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.

The aircraft was destroyed.

The pilot and three passengers perished at the site of the accident. One passenger suffered serious injuries.

An Accredited Representative of the National Transportation Safety Board (NTSB) - USA, (State where the aircraft and the engine were designed) was designated for participation in the investigation.



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
APP	Approach Control
APP-BV	Boa Vista Approach Control
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CM	Registration Category
CMA	Aeronautical Medical Certificate
EO	Operating Specifications
IAM	Annual Maintenance Inspection
IAE	Aeronautics and Space Institute
METAR	Aviation Routine Weather Report
MGO	General Operations Manual
MNTE	Airplane Single Engine Land Rating
NTSB	National Transportation Safety Board (USA)
Pb	Lead
PLA	Airline Pilot License – Airplane
POH	Pilot's Operating Handbook
PPR	Private Pilot License – Airplane
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Aeronautical Certification Regulation
SN	Serial Number
SWAE	ICAO Location Designator – Uaicas Aerodrome, Alto Alegre - RR
SWPD	ICAO Location Designator - Pouso da Águia Aerodrome, Cantá - RR
TPX	Aircraft Registration Category of Non-Regular Public Air Transport
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	Model: 210M Registration: PR-MFR Manufacturer: Cessna Aircraft	Operator: Paramazônia Air Taxi Ltd.
Occurrence	Date/time: 03JUL2017 - 1510 UTC Location: Pouso da Águia Aerodrome (SWPD) Lat. 02°47'30"N Long. 060°35'24"W Municipality – State: Cantá – RR	Type(s): [SCF-PP] System/Component Failure or Malfunction Powerplant Subtype(s): Engine Failure in-Flight

1.1 History of the flight.

The aircraft took off from the Pouso da Águia Aerodrome (SWPD), Cantá - RR, to Uaicas Aerodrome (SWAE), Alto Alegre - RR, at about 1510 (UTC), in order to transport personnel, with a pilot and four passengers on board.

After takeoff, the aircraft showed a loss of power and was unable to maintain a positive climb ratio. It then collided its left elevator with a tree and fell down.

There was fire after the impact on the ground. Only one passenger was able to leave the aircraft.

The aircraft was destroyed.

One passenger suffered serious injuries.

The pilot and three passengers perished at the site.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	1	3	-
Serious	-	1	-
Minor	-	-	-
None	-	-	-

1.3 Damage to the aircraft.

The aircraft was destroyed.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	Pilot
Total	10.336:60
Total in the last 30 days	32:20
Total in the last 24 hours	00:00
In this type of aircraft	100:00
In this type in the last 30 days	12:55
In this type in the last 24 hours	00:00

N.B.: The data related to the flown hours were obtained from the aircraft's operator company.

1.5.2 Personnel training.

The pilot took the PPR course at the São Carlos Aeroclub - SP, in 1987.

1.5.3 Category of licenses and validity of certificates.

The pilot had valid PLA and valid MNTE Rating.

1.5.4 Qualification and flight experience.

The pilot was qualified and had experience in that kind of flight.

1.5.5 Validity of medical certificate.

The pilot had valid CMA.

1.6 Aircraft information.

The aircraft, serial number 21061795, was manufactured by Cessna Aircraft, in 1997 and it was registered in the TPX category.

The aircraft had valid Airworthiness Certificate (CA).

The airframe, engine and propeller logbooks records were updated.

The last inspection of the aircraft, the "200-hours" type, was performed on 28JUN2017, by the Paramazônia Air Taxi Maintenance Organization, in Cantá - RR, having flown 10 hours and 50min after the inspection.

The last overhaul of the aircraft, the "IAM" type, was performed on 28MAR2017, by the Paramazônia Air Taxi Maintenance Organization, in Cantá - RR, having flown 107 hours and 40min after the inspection.

1.7 Meteorological information.

The METAR of Boa Vista Aerodrome (SBBV), 7.2 nautical miles away from the scene of the accident, contained the following information:

METAR SBBV 031500Z 13005KT 9999 VCSH BKN020 FEW025TCU 30/24 Q1015 =

It was found that conditions were favorable for the visual flight with visibility over 10km, rain showers in the vicinity, 5 to 7 eighths of sky cover at 2,000ft and few clouds at 2,500ft with towering cumulus. The wind had intensity of 5kt.

1.8 Aids to navigation.

Nil.

1.9 Communications.

According to the transcripts of the communication audio between the PR-MFR and the Air Traffic control bodies, it was verified that the crew maintained radio contact with the APP-BV and that there was no technical abnormality of communication equipment.

In order to support the analysis of the sequence of events that preceded the crash, the Investigation Team highlighted some transmissions that may help in understanding the dynamics of the accident. For the recording of the schedules described in this field, the UTC was used as reference.

At 15:05:33, the PR-MFR informed APP-BV that it had the engine running in SWPD, with five people on board, five hours of endurance, that would follow the radial 302 and go up to FL065.

Then, the APP-BV informed the transponder code that the aircraft should select and requested it to inform the control when it was off the ground, that is, after takeoff.

At 15:13:55, PR-NYA questioned the control if it had already called firefighters, as the PR-MFR aircraft had fallen after takeoff. It requested firefighters to be urgently sent to the Aerodrome.

The control reported that it would call the municipality's firefighters because it believed that the Cantá Aerodrome was out of the reach from the Boa Vista International Airport firefighters.

1.10 Aerodrome information.

The Aerodrome was private, administered by Paramazônia Air Taxi and operated under visual flight rules (VFR) in daytime.

The runway was made of asphalt, with thresholds 06/24, dimensions of 750m x 18m, with elevation of 86 feet.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The impact occurred at approximately 100m from SWPD threshold 24, opposite threshold from the takeoff one, with evidence of previous impact of the left horizontal stabilizer with a tree. The wreckage distribution was of the concentrated type.

The first impact occurred in a pitch up attitude, causing the left horizontal stabilizer to collide against the top of a tree (Figure 1), which resulted in the detachment of the left elevator (Figures 2 and 3).



Figure 1 - View of the first impact point.



Figure 2 - Left elevator found near the first impact site.



Figure 3 - Left horizontal stabilizer without elevator.

After the impacts on the vegetation, according to the evidence of the wreckage, the aircraft collided with the ground and had its total stop next to a tree.

The fire started after the full stop of the aircraft.

The landing gear, of the retractable type, and the flaps were retracted (Figure 4). The position of the elevators could not be determined.



Figure 4 - Aircraft destroyed by fire. Landing gear and flaps retracted.

The degree of destruction and carbonization of the aircraft prevented the verification of equipment and instruments.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Not investigated.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

According to information collected, the pilot was considered by the interviewees to be an experienced professional who had the habit of inspecting the aircraft with criteria and frequency.

On the day of the accident, he inspected the aircraft, as usual, prepared and summoned the passengers for boarding.

The relationship between the pilot, the ground staff, the administrative staff, and the technical support was very friendly and respectful. The relationship with the owners was based on trust and friendship.

The Organization had experienced two accidents within a month.

1.14 Fire.

The fire started shortly after the impact of the aircraft against the ground, due to the contact of hot parts and electric cables with the fuel of the wings. The fire consumed the entire cabin and part of the wings.

1.15 Survival aspects.

A company's employee visualized the fall of the aircraft and went to the site of the impact in the attempt to provide help, but he was prevented by the intensity of the heat radiated by the fire.

The survivor reported that after the impact on the ground, he heard the pilot command the immediate exit of the aircraft, but only he, who was in the last seat in the back of the cabin, was able to abandon it.

The exit was through the cargo door. The passenger was with his clothes on fire and was taken to the hospital by a vehicle that had arrived at the place.

The pilot and three other passengers were unable to leave the aircraft and perished at the site.

1.16 Tests and research.

During the disassembly of the IO-520-L-12B, Serial Number (SN) 1002430, it was observed that all cylinder exhaust valves were reddish in color (Figure 5).

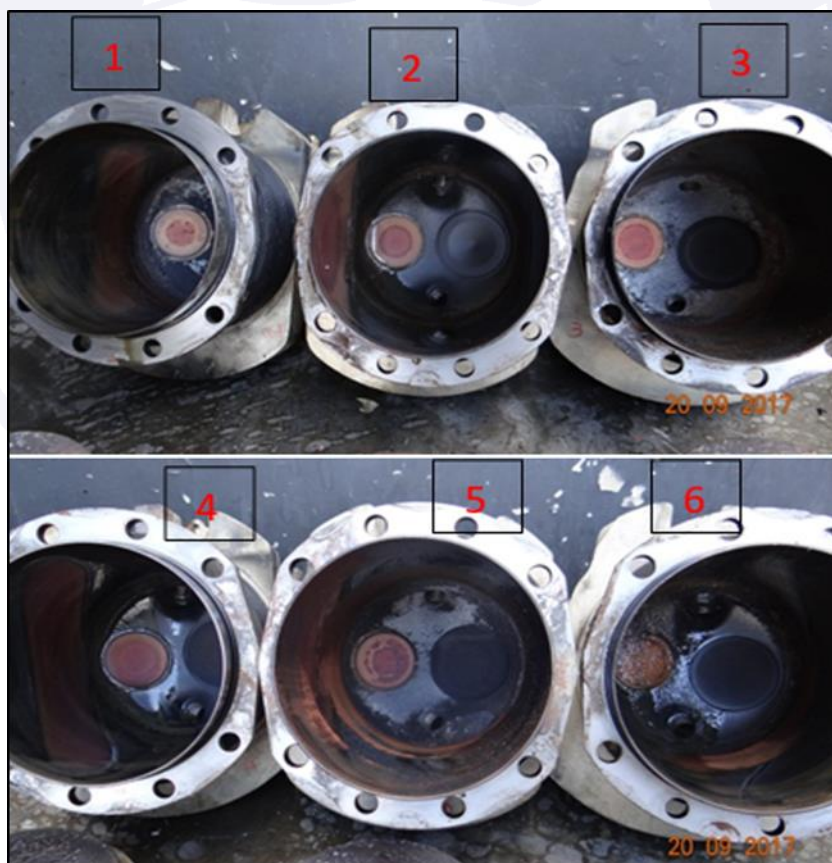


Figure 5 - Interior of the cylinders. Exhaust valves with reddish coloration.

Such a condition is a consequence of poor fuel mix engine operation, that is, adjusting the mix lever to a fuel and air ratio with less fuel. This procedure allows the airplane to have greater endurance.

The fuel decrease beyond the recommended in manual (very poor mix), when used routinely, causes increased engine wear.

The valve seats of cylinders 1, 3, and 6 were dark in color resulting from poor seating (Figure 6).



Figure 6 - Valve seat with dark coloration.

Valve guides of cylinders 1 and 4 showed discrepancies when checked according to the Overhaul Manual (X30039), whose result indicates whether the component is able (GO) or not (NO GO) to be used (Figure 7).

Cilindros	Sede da válvula	Guia da válvula
1	Vazamento	Válvula presa
2	Normal	Ok
3	Oxidação	Ok
4	Vazamento	Folga excessiva
5	Vazamento e Oxidação	Ok
6	Vazamento	Ok

Figure 7 - Analysis of the cylinders.

The looseness in the valve guide is characteristic of hot engine operation, caused by the use of poor mixed fuel.

The valve control drive assembly showed wear on one cam of the valve control drive shaft (Figure 8) and three tappets (Figure 9).

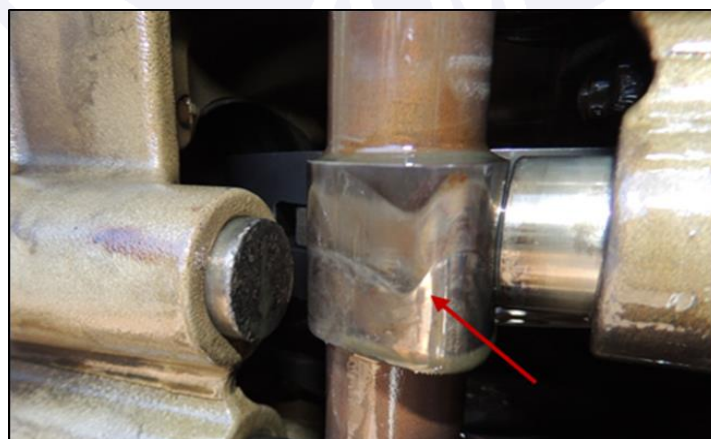


Figure 8 – Wear in the Valve control camshaft.

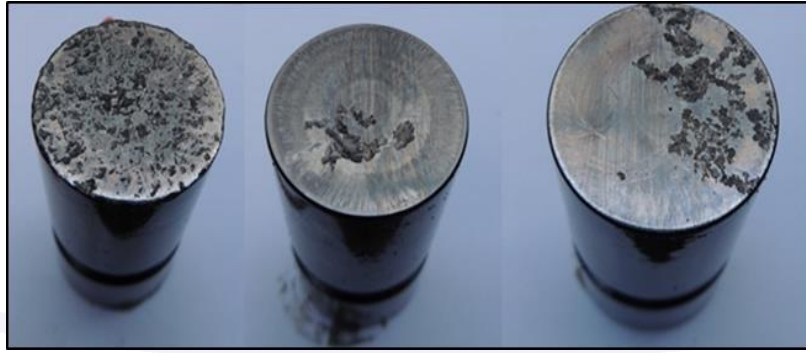


Figure 9 – Worn tappets.

The wear observed on the hydraulic tappets could generate micro particles and these would not be retained by the main and primary oil filters.

Marks compatible with such micro particles were observed. They followed the normal lubrication flow of the engine, causing scratches on the camshaft bearings (Figure 10), the crankshaft rear bearing (Figure 11), and the inside of the oil pump body. Fine filings were also observed in the residual oil in the crankcase.



Figure 10 - Supporting bearings of the valve control shaft.

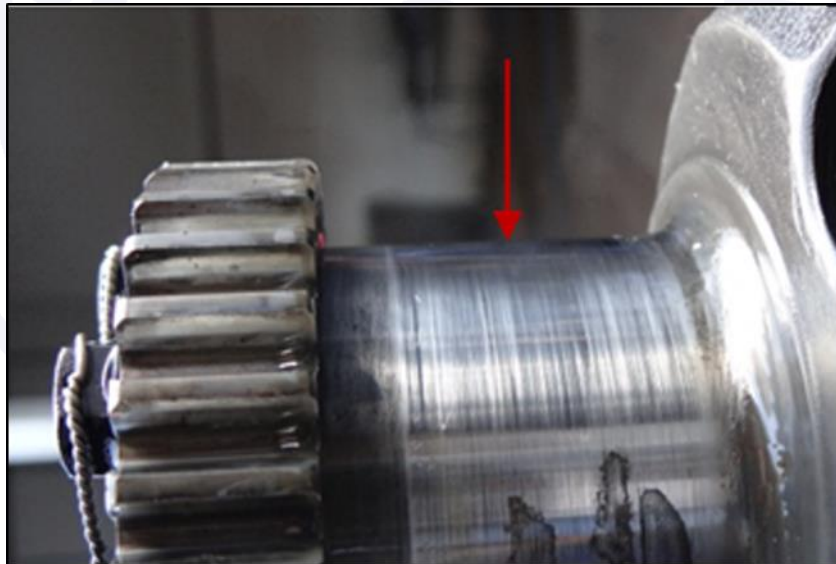


Figure 11 - Rear crankshaft bearing.

A white powder was found on the filter screen of the fuel distributor and at the bottom of the distributor diaphragm (Figure 12). After laboratory analysis, it was found that the presence of the residue was partially blocking the screen of the fuel filter.

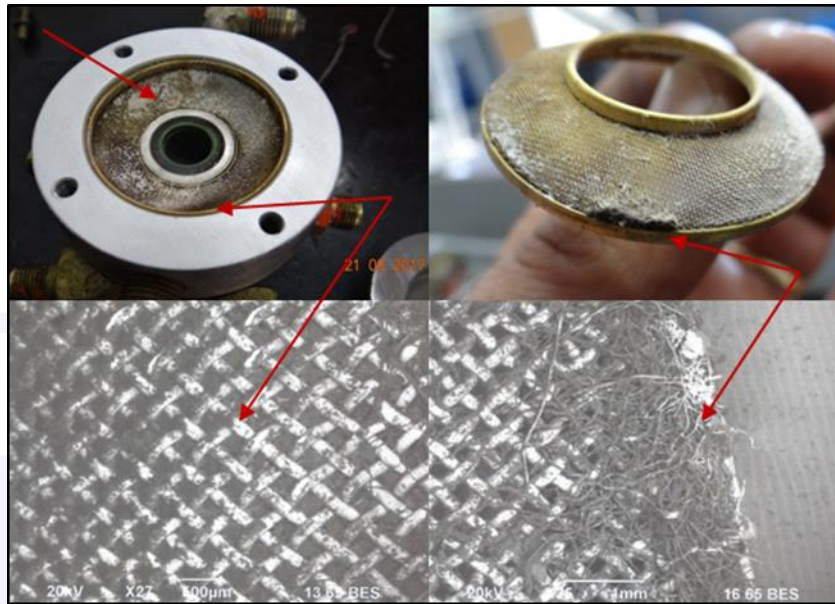


Figure 12 - Filter of the fuel distributor with lead powder.

It was still possible to confirm the presence of lead (Pb), resulting from the degradation of the fuel. This occurs when the fuel is stored or transported in a clear container, allowing contact with sunlight. This contact promotes the precipitation, in powder form, of tetraethyl lead from the fuel.

At the last inspection performed (200 hours), there was a task of checking the fuel distributor for leaks only. There was no provision for inspection of the distributor screen.

Although it was not prevised in the cited inspection, in case the engine was running with difficulty, the Trouble Shooting of the Service Manual produced by the manufacturer of the aircraft dedicated to troubleshooting the IO-520-L-12B engine considered that one of the probable causes of the problem could be a constraint on the fuel injection system. In this case, it was recommended that the fuel system be cleaned and that all defective units be replaced.

The main filter of the fuel system, in which aviation gasoline passes before reaching the distributor, was not found in the wreckage, as it was probably consumed by fire.

The propeller assembly had its blades kneaded back and with transverse scratches at its ends (Figure 13). This showed that at the moment of impact against the ground, the engine developed little power, but in the field investigation, it was observed that the metering valve was in the position of maximum power.



Figure 13 - Scratches and kneading of propeller blades.

Two samples containing 1,000ml of aviation gasoline were collected from the fuel tank at the company's owner base on 04JUL2017. They were sent to the IAE for physicochemical tests, in order to verify compliance with the specifications of the ANP and/or presence of contaminating agents.

The results presented concluded that the samples were in accordance with their specifications and showed no signs of contamination.

1.17 Organizational and management information.

The company Paramazônia Air Taxi operated according to the RBAC 135. Its base was in Cantá - RR, where it operated from its own runway. It had an inventory of eighteen aircraft, being two of them helicopters.

There were approximately 25 pilots there. Flight safety was a responsibility of the Safety Manager. The company had two accidents in a month, which, according to interviewees, generated a climate of fragility.

According to the interviewed professionals, the company ensured flight safety and sought to meet the demands made by regulatory agencies.

There were reports that the crashed aircraft had already presented a problem on previous flights and that the maintenance sector was aware.

The General Operations Manual (MGO) of 20JUN2013, in its section 4.6.7, Responsibilities and Obligations of the Flight Coordinator, prevised:

"1 - Plan, organize and control the flights, scheduling departure and arrival times, passengers' list with identity and telephone number of a relative and file it for a minimum period of 120 days."

Yet item 6.4.1, Criteria for Flight Planning, sub item "f", prevised:

"Check if the passengers' list includes the name, ID and the telephone number of a relative of the passengers."

The company did not provide the passengers' list.

Item 6.9.4.2, Authorized Inspections and Maintenance, established:

"Paramazônia Air Taxi, according to item III of the operating specifications, is authorized to perform the inspection and maintenance services, listed below, in its own aircraft's fleet" (Figure 14)

EQUIPAMENTO		LIMITAÇÕES	BASE
FBRICANTE	MODELO/PN		
CESNNA	U206D	Inspeções de até 100 horas e IAM, cumprir AD/DA de complexidade equivalente e MANUTENÇÕES PREVENTIVAS, citadas no APÊNDICE "A" parte C do RBHA 43.	SWPD
CESSNA	U206E U206F	Inspeções de até 100 horas e IAM, cumprir AD/DA (somente inspeção visual) de complexidade equivalente e MANUTENÇÕES PREVENTIVAS, citadas no APÊNDICE "A" parte C do RBHA 43 e Manutenção de Linha conforme IAC 119-1001B (somente tarefas descritas no MGM)	SWPD
CESSNA	C201L	Inspeções de até 100 horas e IAM, cumprir AD/DA de complexidade equivalente e MANUTENÇÕES PREVENTIVAS, citadas no APÊNDICE "A" parte C do RBHA 43 e Manutenção de Linha conforme IAC 119-1001B (somente tarefas descritas no MGM)	SWPD
NEIVA	EMB720D	Inspeções de até 100 horas e IAM, cumprir AD/DA de complexidade equivalente e MANUTENÇÕES PREVENTIVAS, citadas no APÊNDICE "A" parte C do RBHA 43 e Manutenção de Linha conforme IAC 119-1001B (somente tarefas descritas no MGM)	SWPD

Figure 14 - Aircraft table and inspections.

Model 210M was not included in the table, but inspections of 50, 100, 200 hours and IAM were performed by Paramazônia.

Item 8.2.3 of the MGO established the procedure for weighing passengers, cargo and baggage:

"For the purpose of weighing calculation, Paramazônia Táxi Aéreo establishes that all passengers, cargo and baggage, including hand luggage, shall be weighted before boarding the Company's aircraft."

The survivor reported that he and the other passengers were not weighted.

1.18 Operational information.

The five hours of endurance, informed by the pilot to the air traffic control at the beginning of the taxi, would need 400lb of fuel.

The estimated weight of each passenger was informed by the survivor. The basic weight of the aircraft was taken from the aircraft's weight and balance sheet, dated 17MAR2017.

With this data, it was possible to estimate that the aircraft had the maximum takeoff weight of 1,723 kg, as provided in the Pilot's Operating Handbook (POH), therefore, the aircraft was considered within the weight and balance limits specified by the manufacturer.

Item 6.9.3 of the MGO, Report and Registry of Operating Irregularities, established:

"Paramazônia Air Taxi establishes that the pilots in command of the Company shall record in the Flight Logbook all discrepancies found before, during and after the flight related to irregularities in the operation of the aircraft. He should make the report succinctly, but clearly and objectively, and still clarify the reports directly to the mechanics."

During the interviews, some pilots reported that the aircraft had a "weak" engine, that the race on the ground was larger than normal and that it was difficult to climb, but no records of engine malfunction were found. It was also noticed that some pilots were dissatisfied with the maintenance and did not trust the services performed.

The MGO in its item 6.10.3, Verbal Instructions to Passengers, prevised:

"Using seat belts: give instructions on how to put, adjust and remove them;"

"Seat upright restraints: instruct on placing seat back rests in upright position before each takeoff and landing;"

"Entry doors and emergency exits: instruct on location and way to open."

"Survival equipment: instruct on location on aircraft;"

"Landing in the water: instruct on procedures to be followed in case of landing in the water."

"Fire extinguishers: give instructions on the location and operation of fire extinguishers; and

"Portable electronic equipment: instruct on the restrictions of use on board the aircraft and on the route between boarding and disembarkation."

"Before each take-off the Commander shall ensure, or instruct, the procedures for persons requiring assistance from others to move, if an emergency occurs, and for that person's assistant, if any, in case of an evacuation of emergency."

"Bags located behind passenger seats contain Passenger Information Cards with guidance on on-board procedures. The Commander shall inform passengers of their location and reading. "

The survivor reported that emergency procedures were not explained.

Item 6.10.14 of the MGO, Boarding and disembarkation of passengers with the engine(s) in operation, established:

The Paramazônia Air Taxi will not allow the operations of boarding and disembarkation of passengers with the engine of the aircraft in operation.

The MGO itself referred to the RBHA 91.102:

"(e) No pilot in command of an aircraft may allow passengers to board or disembark from its aircraft with its engine (s) in operation, unless:

(1) for an airplane, the geometry of the airplane allows passengers to use a normal boarding and disembarking door without passing in front of or behind a running engine(s);

(3) the pilot in command shall assume responsibility for the operation and take appropriate measures to ensure the safety of the operation."

Boarding was made with the engine running.

The flight scheduling, standby, maximum flight time and planned rest were regulated by the MGO. The pilot had flown in the model 12 hours in the last 30 days, being the last flight on the aircraft on 24JUN2017. There was no flight record within the last 48 hours prior to the accident.

The survivor reported that he noticed the aircraft in pitch up attitude moments before the first impact.

1.19 Additional information.

The Operating Specifications (EO) approved by the ANAC, from 05APR2016, contained conflicting information.

Figure II.6 - Cargo Transport (Figure 15) did not include the PR-MFR registration, but in the table shown in Figure 16, the aircraft was authorized to carry cargo.

II.6 – Transporte de Carga
 Autorizadas somente as aeronaves PT-DNT, PT-FBO, PT-KKN, PT-KLT, PT-KVW, PT-KAG, PT-KGC e PR-GPG, PT-IXS, PT-OJD e PR-GPI que possuem configuração cargueira aprovada.

Figure 15 - EO statement.

TABELA 1 – AERONAVES AUTORIZADAS

I T E M	MARCAS	FABRICANTE	MODELO	N° SÉRIE	Operações Autorizadas														PAX		
					F S G	C R G	A R P	A E N	L A R	L A S	E T O P S	B R N A V	N A T M N P S	R V S N	C 2	C 3	C 4				
1.	PR-NYA	CESSNA	C210L	21060165	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
2.	PT-DNT	CESSNA	U206E	U20601565	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
3.	PT-FBO	CESSNA	U206F	U20602579	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
4.	PT-KKN	CESSNA	U206F	U20602515	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
5.	PT-KLT	CESSNA	U206F	U20602493	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
6.	PT-KVW	CESSNA	U206F	U20603019	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
7.	PT-RXS	NEIVA	EMB-720	720183	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	6 (seis)
8.	PT-KAG	CESSNA	U206F	U20602420	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
9.	PT-KGC	CESSNA	U206F	U20602494	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
10.	PR-MFR	CESSNA	C210M	21061795	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
11.	PR-GPG	CESSNA	C210L	21061183	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
12.	PP-ICS	CESSNA	C210L	21060984	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
13.	PT-VKS	NEIVA	EMB720D	720255	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	6 (seis)
14.	PT-EBZ	NEIVA	EMB720C	720021	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
15.	PT-HRM	BELL	206B	4127	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	4 (quatro)
16.	PT-IXS	CESSNA	U206F	U20602130	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
17.	PR-GPI	CESSNA	U206F	U20603150	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	4 (quatro)
18.	PT-OJD	CESSNA	U206F	U20602884	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	5 (cinco)
19.	PT-YDG	BELL	206B	4457	S	S	S	N	N	N	N	N	N	N	N	N	N	N	N	N	4 (quatro)

Figure 16 - Table of operations authorized by the EO.

The cargo manifest and the passengers' list were not presented, failing to comply with MGO and RBAC 135, subpart 135.63, item "c" and "d" (Figure 17).

(c) Cada detentor de certificado é responsável pela preparação e precisão de um manifesto de carga em duplicata contendo informações concernentes ao carregamento da aeronave. O manifesto deve ser preparado antes de cada decolagem e deve incluir:

- (1) o número de passageiros;
- (2) o peso total da aeronave carregada;
- (3) o peso máximo de decolagem permitido para o voo;
- (4) os limites do centro de gravidade;

(5) o centro de gravidade da aeronave carregada, exceto que o centro de gravidade real não precisa ser calculado se a aeronave for carregada de acordo com um planejamento de carregamento ou outro método aprovado que garanta que o centro de gravidade da aeronave carregada está dentro dos limites aprovados. Nesses casos deve ser feita uma anotação no manifesto indicando que o centro de gravidade está dentro dos limites conforme um planejamento de carregamento ou outro método aprovado;

- (6) a matrícula de registro da aeronave ou o número do voo;
- (7) a origem e o destino; e
- (8) identificação dos tripulantes e as suas designações.

(d) O piloto em comando de uma aeronave deve ter consigo, até o destino do voo, uma cópia desse manifesto. O operador deve conservar uma cópia do mesmo, em sua sede operacional, por, pelo menos, 90 dias após a realização do voo.

Figure 17 - RBAC 135 statement.

Item 8.5 of the MGO, Calculation of the CG Position, Elaboration and distribution of the Report of Weight and Centering (Cargo Manifest), established:

"Paramazônia Air Taxi establishes that the Company's pilots in command are responsible for the preparation and precision of a cargo manifest in duplicate containing information concerning the loading of the aircraft ..."

"... Paramazônia Air Taxi establishes that the Company's pilots in command, after the preparation of the cargo manifest, in two ways, shall:

1 - Leave a copy of the manifest at the origin of the flight.

2 - Keep with you until the destination of the flight, the other copy of the manifest ..."

"... Paramazônia Air Taxi shall keep a copy of it, in the Operations sector, for a minimum of 90 days after the flight.

The Standard Practice for Spark Ignited Engines, Publication M-0, Change 1, Continental Motors maintenance manual, from May 2016, related to the aircraft engine, described, in Chapter 6, Engine Inspection and Service, pages 6-8, an oil analysis procedure through a sample collected, according to the instructions in Section 6-4.8.4 (Oil Sample Collection) and Section 6-4.8.5 (Monitoring of Tendencies and Spectral Analysis of Oil):

"6-4.3. 50-Hour Engine Inspection, Procedure, item 3, "Establish an oil analysis profile by collecting an oil sample according to the instructions in Section 6-4.8.4, "Oil Sample Collection" and Section 6-4.8.5, "Oil Trend Monitoring and Spectrographic Oil Analysis."

This procedure was also prevised for the 100h engine inspections in 6-4.4. 100-Hour (Annual) Engine Inspection, Procedure, item 3.

Although it was stated in the aircraft logbooks that the 50-hour inspection was performed, no trend monitoring records spectral analysis of engine oil were found.

The last overhaul of the engine and fuel distributor was performed on 23JUN2016.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a passenger transport flight between the municipalities of Cantá - RR and Alto Alegre - RR.

According to information, the relationship between the company's employees was good. The organizational climate, however, was fragile due to two accidents that occurred within a month. However, there were no indications that this fact influenced the accident in question.

The aircraft had its inspections of 50, 100, 200 hours and IAM made by the maintenance organization owned by the operator. Some pilots reported that they were not satisfied with the maintenance and did not trust the service. However, all the documentation was up to date.

Before the airplane started the 200-hour inspection, there were at least two verbal reports that the aircraft engine was "weak" and had little traction for takeoff.

Pilots reported that the race on the ground was longer than normal and the aircraft had difficulties to climb. Maintenance was notified, verbally, however, no record in the aircraft logbook was found.

The mechanics confirmed that they received the verbal information and checked the compression rate of the engine, fuel system and oil filter. The results, according to them, were within the manufacturer's manual. However, no formal record of such interventions / maintenance checks was found.

Reviewing the Service Manual table produced by the manufacturer of the aircraft, dedicated to solve problems in the engine IO-520-L-12B, which is called Trouble Shooting, it was observed that if the engine was running with difficulty (roughly) one of the likely causes of the problem could be a restriction on the fuel injection system.

In this case, it was recommended the system to be cleaned and that all defective units to be replaced. In view of the condition in which the screen of the fuel distributor was found, it could be inferred that the recommended cleaning was not carried out properly.

The mechanics did not report how the checks were performed and no records of low power engine checks were found in the aircraft logbook. It was also verified that some important items prevised in the MGO were not being fulfilled.

Thus, it was possible to observe the existence of informal practices in the organization, both in the scope of operation and maintenance, which weakened flight safety, whose reflexes could be observed in this occurrence.

The survivor reported that he noticed the aircraft in a pitch up attitude, signaling a possible attempt by the pilot to roll over the trees, but the horizontal stabilizer collided against a treetop and detached itself from the aircraft, causing the partial loss of pitch control. This resulted in loss of control of the aircraft that fell down in the sequence.

The lack of engine power may be related to leakage in the valves of the cylinders 1, 4, 5 and 6, allowing the air / fuel mixture to escape during the compression time and causing low burning efficiency within the combustion chamber. Cylinders 1 and 4 did not pass the GO / NO GO test.

The lead found in the screen of the fuel distribution filter partially obstructed the passage of fuel to the nozzles, reducing the supply of gasoline to the cylinders.

The 200-hour inspection provided in the aircraft manual prevised the fuel distributor check only when there was a leak, that is, if there was clogging, with no leakage, there would not be on-site inspection on the screen.

With this, it was verified that engine problems had influence in the accident. The engine had characteristic wear of hot operation, related to the use of poor fuel mixture, that is, more air and less fuel.

The takeoff is a phase that requires the maximum engine power for the plane to reach the speed to exit the ground and then speed up to the cruise level.

With the aircraft at its maximum takeoff weight and with the related discrepancies above, the engine failed to reach the required power and as a consequence did not reach the climb speed, losing height, leading to the collision against the vegetation and then against the ground .

After the occurrence, there was a change in the name of the company that operated the aircraft. According to *Portaria* nº 2.408/SAS, from 03AUG2018, the name Paramazônia Air Taxi Ltd. was modified to Voare Air Taxi Ltd. New managers took over the Company Direction and replaced the Operation Manager, the Maintenance Manager and the Safety Manager. The maintenance organization also had its name changed to Voare, according to the Maintenance Organization Certificate (COM) nº 1506-61/ANAC, from 19OCT2018.

3. CONCLUSIONS.

3.1 Facts.

- a) the pilot had valid Aeronautical Medical Certificate (CMA);
- b) the pilot had valid MNTE Rating;
- c) the pilot was qualified and had experience in that kind of flight;
- 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 logbooks records were updated;
- g) the maintenance services were considered periodic, but not adequate;
- h) the meteorological conditions were favorable for the flight;
- i) the reporting of aircraft discrepancies was done verbally;
- j) the passengers were boarded with the engine running;
- k) passengers were not instructed in emergency procedures;
- l) the aircraft collided its left stabilizer against a tree;
- m) there was detachment of the left elevator;
- n) the propeller blades were kneaded back;
- o) the filter screen of the fuel distributor was partially blocked by lead dust;
- p) the aircraft took off to transport personnel;
- q) the exhaust valves of cylinders 1, 4, 5 and 6 were leaking;
- r) three hydraulic tappets presented excessive wear;
- s) there was no cargo manifest and passengers' list;
- t) the aircraft was destroyed;
- u) one passenger suffered serious injuries; and
- v) the pilot and three passengers suffered fatal injuries.

3.2 Contributing factors.

- **Organizational culture – a contributor.**

The informal practices adopted in the organization, regarding both operation and maintenance, demonstrated weaknesses in the organizational culture, which favored the reduction of safety levels of the operation.

- **Aircraft maintenance – a contributor.**

The verification on verbal reports were made based on trust since there was no written record in the Aircraft Flight Logbook. In addition, the engine showed excessive wear of parts, compromising its operation.

- **Organizational processes – a contributor.**

The absence of an adequate management of the organizational processes, related to the operation and maintenance of aircraft, allowed the adoption of unsafe conduct and informal actions, which compromised the accomplishment of the flight safely.

- **Managerial oversight – a contributor.**

There was inadequate oversight of procedures, such as the lack of trend tracking and of oil spectral analysis, verbal reports to mechanics, rather than launching logbook discrepancies.

The lack of adequate oversight allowed the failures in the aircraft maintenance to pass unnoticed.

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-089/CENIPA/2017 - 01

Issued on 08/06/2019

Disseminate the lessons learned in this investigation, in order to alert operators and maintenance organizations about the importance of checking, during corrective maintenance procedures, the fuel system conditions of the IO-520-L-12B engines, not only for leaks, but also about the possibility of this system being contaminated by foreign material.

A-089/CENIPA/2017 - 02

Issued on 08/06/2019

Act in conjunction with VOARE Air Taxi Ltd., for that organization to demonstrate that it possesses and applies all the necessary resources for the adequate provision of maintenance services on CESSNA, model 210M aircraft and Continental IO-520-L- 12B engines, in accordance with the legislation in force, the respective technical manuals and the Company’s Capabilities List.

Act in conjunction with VOARE Air Taxi Ltd., in order to make that operator to improve its administrative and operational mechanisms for reports of abnormality in its aircraft, performed by crewmembers to the maintenance professionals, and bookkeeping of the services performed, as a way to prevent aeronautical occurrences.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

The ANAC conducted two audits in the company, one in July 2017 and another in October 2017.

On August 6th, 2019.

