

**COMANDO DA AERONÁUTICA**  
**CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE**  
**ACIDENTES AERONÁUTICOS**



**FINAL REPORT**  
**A-096/CENIPA/2016**

<b>OCCURRENCE:</b>	<b>ACCIDENT</b>
<b>AIRCRAFT:</b>	<b>PT-DJH</b>
<b>MODEL:</b>	<b>182E</b>
<b>DATE:</b>	<b>02JUL2016</b>



## 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 02JUL2016 accident with the 182E aircraft, registration PT-DJH. It was classified as “In-Flight Breakup”.

During a parachutists launching flight, the aircraft disappeared from the radar screen, about two minutes after leveling on FL085. In the sequence, it was sighted falling without the wings in the Brazilian Agricultural Research Company’s area (EMBRAPA).

The aircraft was destroyed.

The pilot and three remaining parachutists died at the accident site.

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



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## GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	National Civil Aviation Agency
APP-BE	Approach Control - Belém
BKN	Broken (5-7 oktas)
CA	Airworthiness Certificate
CB	Cumulonimbus
CENIPA	Aeronautical Accident Investigation and Prevention Center
CENSIPAM	Management and Operational Center of the Amazon Protection System
	Center of Gravity
CG	Technical Qualification Certificate
CHT	Fourth Integrated Center for Air Defense and Air Traffic Control
CINDACTA IV	Pilot's Flight Logbook
CIV	
CMA	Aeronautical Medical Certificate
CST	Supplemental Type Certification
DCTA	Aeronautics' Science and Technology Department
EMBRAPA	Brazilian Agricultural Research Company
EO	Operational Specification
FAA	Federal Aviation Administration
FL	Flight Level
GPS	Global Positioning System
GS	Ground Speed
IFRA	Instrument Flight Rating - Airplane
IML	Legal medical Institute
LPQD	Parachutist Launcher Pilot Rating
LV	Checklist
METAR	Meteorological Aerodrome Report
MNTE	Qualification Type – Airplane Single Engine Land
NTSB	National Transportation Safety Board
PLA	Airline Pilot Rating - Airplane
PPR	Private Pilot Rating – Airplane
RAB	Brazilian Aeronautical Registry
RBAC	Brazilian Civil Aviation Regulation
RCA	Airworthiness Condition Report
RS	Safety Recommendation
SBBE	ICAO location designator – Belém Aerodrome - BE
SBJC	ICAO location designator – Brig. Protásio de Oliveira Aerodrome - PA
SCT	Scattered (3 and 4 oktas)
SERIPA I	First Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accidents Investigation and Prevention System
SN	Serial Number
TCU	Towering cumulus
TPP	Registration Category of Private Aircraft Service
TWR-JC	Brig. Protásio de Oliveira Aerodrome Tower Control - PA

UTC	Universal Time Coordinated
VA	Maximum Maneuvering Speed
VI	Indicated Airspeed
VNO	Maximum Structural Cruise Speed



## 1. FACTUAL INFORMATION.

<b>Aircraft</b>	<b>Model:</b> 182E <b>Registration:</b> PT-DJH <b>Manufacturer:</b> Cessna Aircraft	<b>Operator:</b> Aerotur Air Taxi Ltd.- EPP
<b>Occurrence</b>	<b>Date/time:</b> 02JUL2016 - 1625 UTC <b>Location:</b> Embrapa Area <b>Lat.</b> 01°26'43"S <b>Long.</b> 048°26'45"W <b>Municipality – State:</b> Belém - PA	<b>Type(s):</b> “In-Flight Breakup” <b>Subtype(s):</b>

### 1.1 History of the flight.

The aircraft took off from the Brigadeiro Protásio de Oliveira Aerodrome - PA (SBJC) at 1550 (UTC), with a pilot and four passengers on board, in order to perform a local parachutists launching flight.

After the launch of a parachutist on FL045, the aircraft disappeared from the radar screen, about two minutes after climbing and leveling on FL085.t.

At about 1625 (UTC), residents of a residential neighborhood saw the aircraft falling, without wings, in the Brazilian Agricultural Research Company's area (EMBRAPA).

The aircraft was destroyed.

The pilot and the three remaining parachutists died at the accident site.

### 1.2 Injuries to persons.

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

### 1.3 Damage to the aircraft.

The aircraft was destroyed.

### 1.4 Other damage.

Nil.

### 1.5 Personnel information.

#### 1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	7.118,20
Total in the last 30 days	unknown
Total in the last 24 hours	01:23
In this type of aircraft	22:35
In this type in the last 30 days	unknown
In this type in the last 24 hours	01:23

**N.B.:** The Data on flown hours were obtained from the Pilot's Flight Logbook and from

the declarations of Flight Hours issued by the companies where he was hired.

### **1.5.2 Personnel training.**

The pilot took the Private Pilot course - Airplane (PPR) at PARÁ's Aeroclube - PA, in 1995.

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

The pilot had the Airline Pilot Rating – Airplane (PLA) and had valid MNTÉ Technical Qualification and Instrument Flight Rating - Airplane (IFRA).

The pilot did not have the Parachutist Launcher Rating - Airplane (LPQD).

During the survey, it was verified that, in the flight plan of this occurrence, the ANAC code (CANAC) of another pilot, who was not on board, was used.

On the day of the occurrence, the pilot included in the flight plan was in another state of the federation. After becoming aware of the involvement of his name and his ANAC code in the incident, he made a police report bulletin, in which he informed the police authority about the fact.

### **1.5.4 Qualification and flight experience.**

The pilot was not qualified and did not have experience in that kind of flight.

### **1.5.5 Validity of medical certificate.**

The pilot had valid Aeronautical Medical Certificate (CMA).

### **1.6 Aircraft information.**

The aircraft, serial number 18254341, was manufactured by Cessna Aircraft, in 1962.

The Certificate of Airworthiness (CA) was valid and the aircraft was registered in the Category of Private Aircraft Service (TPP).

The airframe, engine and propeller logbooks records were updated.

The National Aircraft Maintenance Ltd., in Teresina - PI, performed the last inspection of the aircraft, the "100 hour-type" on 07MAR2016. Due to the lack of updated flight hours records, it was not possible to establish the number of hours flown after the inspection.

The National Aircraft Maintenance Shop Ltd., In Teresina - PI, carried out a Special Inspection on 07MAR2016 for revalidation of CA, and the Airworthiness Condition Report (RCA) was issued.

At that time, the Special Maintenance Items established in the Service Manual D138-1-13 Temporary Revision 07, and the Continued Airworthiness Program for the aircraft model of the occurrence were fulfilled.

This Special Inspection certified that the aircraft was in perfect conditions of airworthiness.

The logbook of the aircraft was not turned over to the Investigation Committee. Both the owner and the operator reported not having copies of the flight records.

On the website of the aircraft manufacturer, a Temporary Revision 08, inserted in the Service Manual D138-1-13, on 18MAY2015, was not identified in the records of the aircraft.

### **1.7 Meteorological information.**

The CENSIPAM Weather Report, issued by the Belém Regional Center, reported that the weather conditions in the Belém metropolitan area indicated absence of obscuring

meteorological phenomena in the period between takeoff and the time of the accident, resulting in good horizontal and oblique visibility.

Surface warming and wind circulation would contribute to atmospheric instability in the region. However, a subsidence movement on the area did not favor the development of deep cloudiness, mainly Cumulonimbus (CB) or Cumulus type (TCU).

The satellite images did not identify smoke plumes from fires that could restrict horizontal or oblique visibility in the hour before the accident. The STARNET network did not record atmospheric discharges from CB-type clouds within a radius of up to 300km away from the accident site at any time between 1500 and 1600 UTC.

The Meteorological Aerodrome Report (METAR) of SBBE Aerodrome, between 1500 UTC and 1700, reported visual weather conditions with horizontal visibility equal to or greater than 10 km, with the presence of sparse clouds of good weather in the highest part of the period and ceiling of 3,000ft, as noted below:

- METAR SBBE 021500Z 16008KT 9999 SCT030 31/22 Q1014=
- METAR SBBE 021600Z 13009KT 9999 BKN030 32/21 Q1013=
- METAR SBBE 021700Z 13009KT 9999 BKN030 31/22 Q1012=

In the same way, at the SBJC airport, PT-DJH takeoff Aerodrome, METAR indicated visual meteorological conditions, with horizontal visibility equal to or greater than 10km, absence of ceiling and presence of scattered clouds of good weather at 3,000ft, as noted below:

- METAR SBJC 021500Z 16008KT 9999 SCT030 32/24 Q1014=
- METAR SBJC 021600Z 15010KT 9999 SCT030 33/23 Q1013=
- METAR SBJC 021700Z 15009KT 9999 SCT030 33/23 Q1012=

It was verified, through an amateur video, recorded by a resident near the crash site that, at the time of the accident, there were few clouds in the flight sector.

Thus, it can be asserted that the observed meteorological conditions did not indicate turbulence and were favorable for the visual flight.

### **1.8 Aids to navigation.**

Nil.

### **1.9 Communications.**

According to transcripts of the communication audios between the Belém Approach Control Center (APP-BE) and the Control Tower of the Brigadeiro Protásio de Oliveira Aerodrome (TWR-JC), the PT-DJH took off at 1550 (UTC) in order to perform a local parachutists launching flight, having on board 05 people, a pilot and four passengers (parachutists), with three hours of autonomy.

The first launch was on FL045 and the others would be on FL085.

The initial phases of the flight at the Brigadeiro Protásio de Oliveira (SBJC) Aerodrome: starting, taxiing and takeoff occurred in an apparent normality, and no interurrence was observed or reported.

After verifying that the aircraft had lost contact via radio, TWR-JC asked the patio supervisor to make contact with the personnel accompanying the launch, but there were no responses from the team.

An unidentified person informed the TWR-JC of the occurrence with the aircraft.

### **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.

According to observers of the moment of fall, the aircraft was developing a downward trajectory and, during this route, structural parts were detached, being possible to identify that there was a separation between the wings and the fuselage (Figure 1).



Figure 1 - Moment of the aircraft's fall with few clouds in the flight area. Highlight to the wings above and the fuselage below.

On the ground, the left and right wings were 276 meters from the fuselage and about 150 meters apart.

The pilot was located 125 meters from the fuselage. Observers reported that the pilot was in free fall outside the aircraft.

Figure 2 shows the distribution of the wreckage and the pilot's body. The three parachutists remained inside the aircraft.

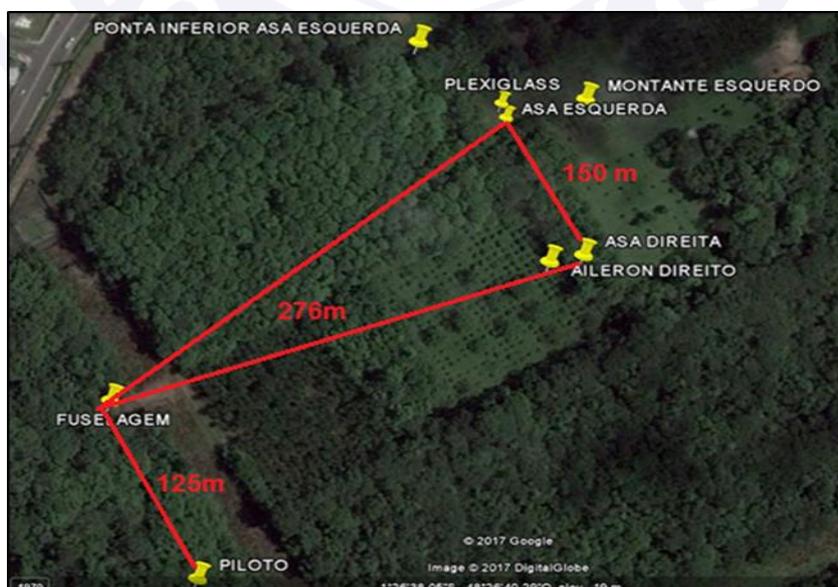


Figure 2 - Distribution of the aircraft wreckage at the crash site.

An amateur video corroborates the information provided by observers of the plane crash.

### **1.13 Medical and pathological information.**

#### **1.13.1 Medical aspects.**

According to a report by the Instituto Médico Legal (IML), the injuries found in all occupants are consistent with the history of the crash, and, given the circumstances, it was concluded that all patients died due to acute anemia caused by internal hemorrhage due to polytrauma.

No alcohol was detected in the blood of any of the people on board, as described in the IML cadaveric report. There was no evidence that physiological or disability weights affected the performance of the crewmember.

#### **1.13.2 Ergonomic information.**

Nil.

#### **1.13.3 Psychological aspects.**

The commander had been in aviation for more than 29 years, dedicating full time to this professional activity. He had been serving the company for about ten months. In addition, sporadically and by indications, the pilot acted as a flight instructor at the Aeroclub do Pará.

The professional background of the pilot indicated that in the period between 1999 and 2013 he maintained a formal employment relationship with nine air taxi companies and was also the commander of a private aircraft.

According to reports, the pilot had a harmonious family relationship. He was described as a person who stood out by his charisma, influencing all of his fellowship.

In the professional scope, he was considered skilled, being a reference among colleagues. According to the information obtained, he presented himself physically and emotionally well for the exercise of air activity and reacted well to adverse situations.

According to reports from former employers, he always maintained good relationships with co-workers, was friendly and easy-going. He expressed concern for safety, seeking, whenever possible, to follow up the revisions of the aircraft he would fly.

These characteristics were also present in his relation with Aerotur Air Taxi Ltd. According to the information obtained, he had a good interpersonal relationship and a good humor that inspired everyone.

He excelled at teaching his workmates, especially the beginners, whom he supported in the achievement of the first flights. Crewmen who have flown with him have reported that, in situations of abnormality, he took a cautious and at the same time assertive stance.

Despite these mentioned characteristics, situations were reported in which the pilot presented some attitudes marked by indiscipline and noncompliance with rules. To corroborate with this aspect, it was observed that the pilot did not have the qualification to carry out the flight on screen and used CANAC of another pilot to make the flight plan

### **1.14 Fire.**

There was no fire.

### **1.15 Survival aspects.**

According to standardized procedures, in case of crash and emergency on board during launch, the attitude of the parachutists should be the abandonment of the aircraft, since it was flying above 5,000ft. However, this did not occur, given the permanence of the passengers on board.

The condition of remaining on the aircraft in the event of an emergency landing would be recommended only if the crash occurred below 1,500 ft.

Due to the high impact energy of the aircraft against the ground, there were no survivors among those who remained on board.

The pilot was found 125m away from the fuselage of the aircraft. Observers reported that he was in free fall outside the aircraft.

The only survivor of the crash was the first parachutist who jumped on FL045, with no abnormalities reported during the jump.

### 1.16 Tests and research.

During the initial action, structural components of the aircraft, the engine, navigational aids and equipment used to record the parachute launches were collected.

At the place of occurrence, the empennage, fuselage, propeller and engine of the aircraft were grouped. The wings were still unleashed in flight and were found at a distance of 276 meters from the fuselage.

The aircraft was of the high wing type, with those being fixed in the upper part of the fuselage in two points of each side. The wings were joined by two U-shaped rear and front spars (Figure 3), which showed fractures (Figure 4).

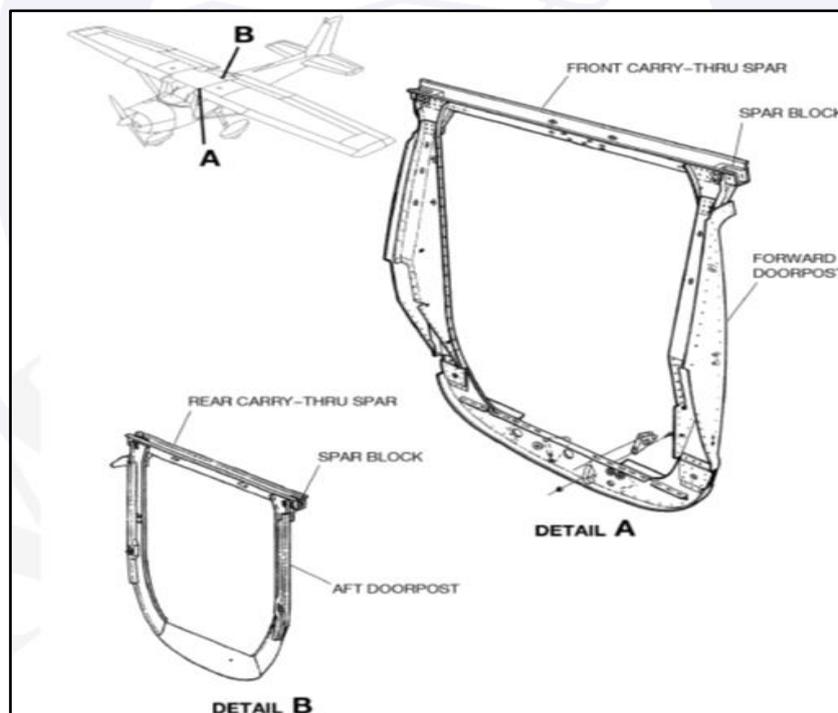


Figure 3 - Front Spar in Detail A and Rear Spar in Detail B.



Figure 4 - Fractured spar.

A third wing attachment point was fixed in a wing strut in the central region of each wing near the leading edge (Figure 5).

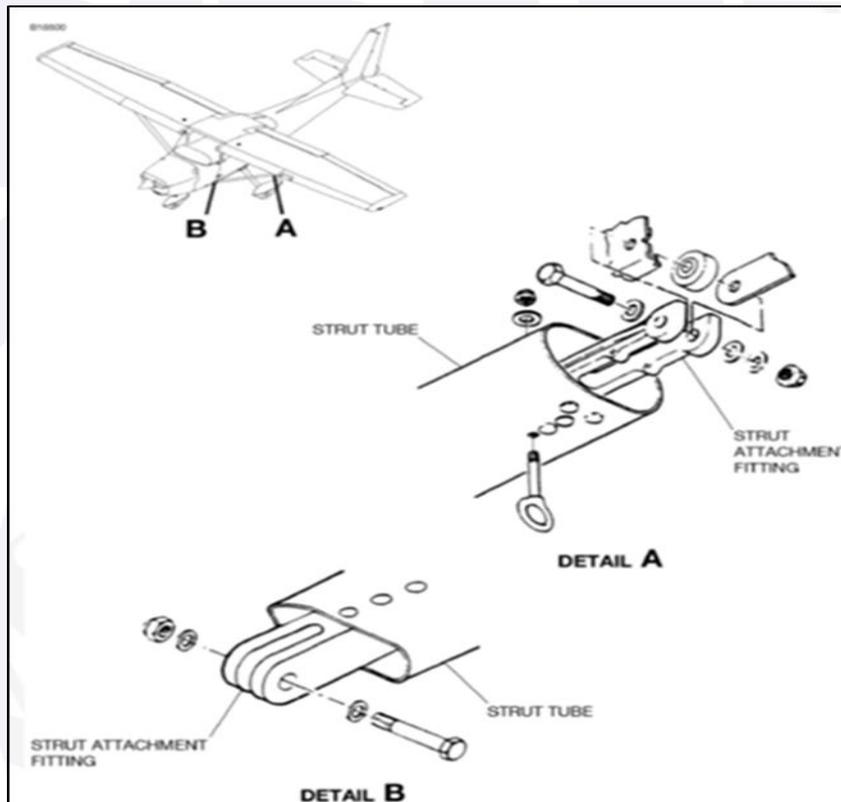


Figure 5 - Fixation points of the wing struts.

The left wing strut was found near the tip of the left wing with fractured fixation points (Figure 6).



Figure 6 - Left wing strut with fractured fixation points.

The right wing strut was not found, however the fixation points were identified, which presented fractures (Figure 7).



Figure 7 - Attachment points of the fractured right wing strut.

The left elevator was found fractured (Figure 8). The flange riveted to the torque tube had three tie-down eyelets that were fractured. There were no indications of failure of the elevators.

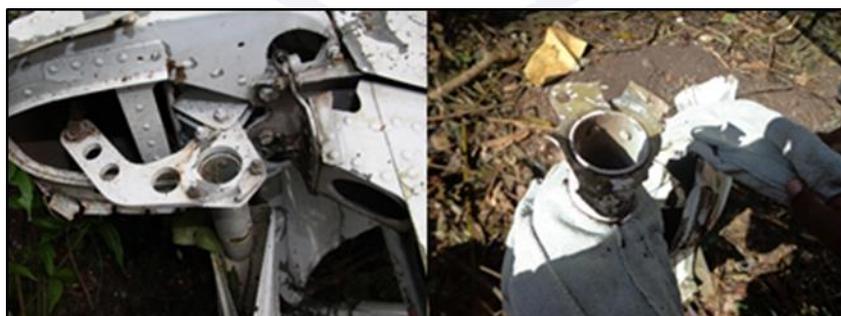


Figure 8 - Left elevator fractured.

At first, the DCTA's Institute of Aeronautics and Space (IAE) analyzed the fuselage fragments (Spar Assy Rear); (Fitting Bulkhead LH and RH) and Tube Assy Elev (LH) (Figure 9).

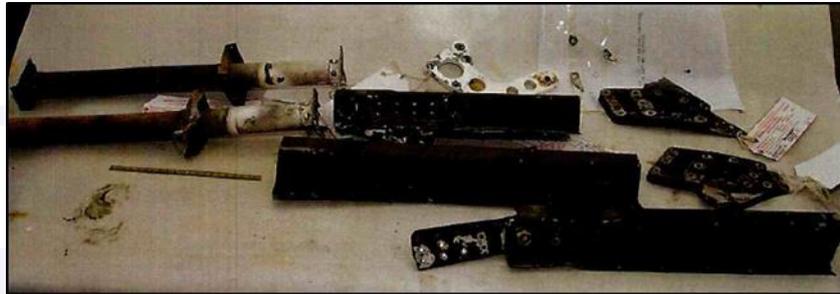


Figure 9 - Parts of the aircraft analyzed in the Technical Report.

The analyzed parts were submitted to visual and stereoscopic analysis. The conclusion of this report reported that all surface fractures were caused by overload applied to the material.

Then, the left wing strut, the central part of the front spar and the fragmented part of the right front spar were also analyzed by the IAE (Figure 10).

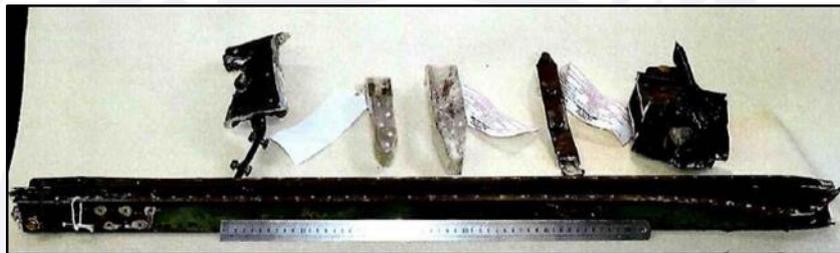


Figure 10 - Central part of the front spar and fuselage fragments.

Still in the First Regional Aeronautical Accident Investigation and Prevention Service (SERIPA I), the control cables, surfaces and fractures of the wings, tail cone, engine fixation and the general structure of the crashed aircraft were analyzed (Figure 11).



Figure 11 - Wreckage analyzed at SERIPA I facilities.

Likewise, the visual analysis and by stereoscopy revealed that all analyzed material had fractures caused by overload applied to the material, and there were no signs of corrosion or fatigue in all the material analyzed.

The engine was visually inspected for its parts and components, except for magnets, which were stolen from the place of the occurrence.

In this inspection, the items were all intact externally. The engine was installed in a support and the rotation was made in the crankshaft, not being found difficulties during this turn, being discarded internal abnormalities in the engine.

The Garmin 296 Global Positioning System (GPS), SN 10C008881, boarded on the aircraft, was inspected in a Maintenance Organization certified by the National Civil Aviation Agency (ANAC), and there were no recorded flight data of the occurrence. The last release of information was dated 01JUL2016.

In the analysis of the wreckage, there was no evidence of possible collision against fauna during the flight.

#### **1.17 Organizational and management information.**

The aircraft involved in the incident was privately owned, but there was an operating lease agreement in favor of Aerotur Air Taxi Ltd., located at Brigadeiro Protásio de Oliveira Aerodrome, in Belém - PA. In compliance with the operating lease agreement, the air taxi company was responsible for the processes related to the operation and maintenance of the aircraft.

In relation to the staff, the company had the owner, the administrator and three pilots. According to information obtained, the pilot involved in the incident provided service to the airline company for approximately ten months, with the expectation of imminent hiring. Until the date of the occurrence, the pilot had carried out less than 10 hours of flight in the company, altogether.

According to reports, the pilot did not complain about dissatisfaction in the work environment or about the use of flying equipment / aircraft (adequacy, quality, maintenance, etc.). His workload was considered adequate, even while performing random flights.

The flight that resulted in the crash occurred after the air taxi company offered the aircraft to provide the service. The negotiation between the pilot and the parachutists was performed informally. At the time, the pilot informed the instructor (Launch Coordinator) that he had the qualification to carry out the parachutists launch.

Although the aircraft owner showed interest, the aircraft used to launch the parachutists was not listed in the company's Operational Specification (E.O). This condition did not materialize, since the Regulatory Agency, in the process of inclusion of the aircraft in the E.O, noted nonconformities, which were passed on to the company, without it having provided the necessary corrections for the conclusion of the process.

Thus, the fact that there was no operating lease agreement between the owner and the operator did not cause the aircraft to be included in the company's E.O.

#### **1.18 Operational information.**

On the flight in question, the aircraft took off with five people on board, which exceeded the maximum allowable capacity of four people for the aircraft model.

In the same way, the maximum quantity specified in the Airworthiness Certificate (CA) of the aircraft was three passengers.

During the investigation, no Supplemental Type Certification (CST) or equivalent document was issued which would allow flights with passenger capacity to be exceeded by the manufacturer or even allow operation without passenger seats.

In the case of a parachutists launching flight, this occurred with the aircraft in an unapproved configuration, that is, without the passenger seats, remaining on board only the pilot's seat with the seatbelt. It should be noted that the aircraft did not have this configuration approved by the manufacturer.

According to the report of the first parachutist that jumped, the pilot in command did not meet some procedures that should generally be performed during the preparation for launch.

Also, according to the report, the pilot did not adopt all aspects related to the safety of that flight, including procedures such as the aircraft abandonment briefing by the parachutists or the attitudes to be adopted in an emergency.

The service provider performed the supply of a total of 50 liters of aviation gasoline, according to the proof of supply.

Although operated by an air taxi company, the aircraft did not have the manifesto of charge for determining the center of gravity (CG). However, it is possible to state that the aircraft was flying within the weight and balance parameters established by the manufacturer.

When reproducing the trajectory described by the aircraft in the moments that preceded the accident, it was verified that the PT-DJH was not in the final for launch, since it would still proceed to a final frame on the Senador Lemos Av. with a street intersection and launch near the Aeronautics Officers' Club (Figure 12).



Figure 12 - Routes and launch zones.

The launch area, called positive zone, was propitious to parachuting because the prevailing wind on the spot tended to facilitate the parachutist's navigation.

Based on information provided by the Fourth Air Defense and Air Traffic Control Integrated Center (CINDACTA IV), after the launch of a parachutist on FL045, the aircraft reached FL085 for the launch of three more parachutists.

Figure 13 shows a chart with flight level and velocity data, as seen in the radar, in the 2 minutes and 40 seconds preceding the disappearance of the aircraft from the radar.

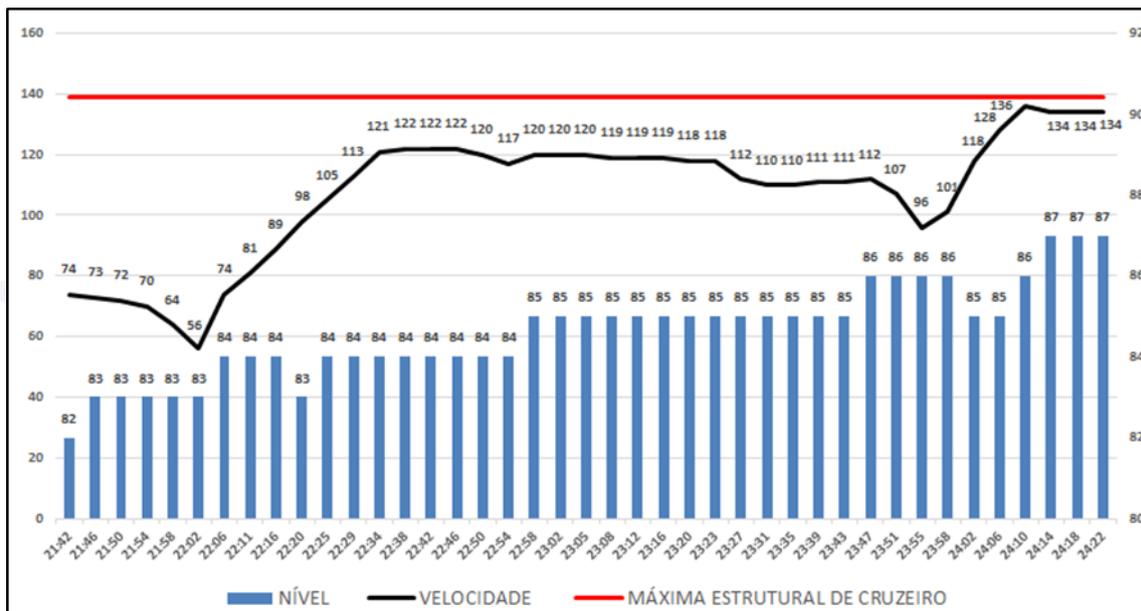


Figure 13 - Flight level and speed data, according to radar visualization, in the 2 minutes and 40 seconds before the traffic control loses the aircraft location.

The velocities and altitudes disclosed by the radar display provide the speed of the aircraft in relation to the ground (GS), but it has a difference in relation to the real speed, since the position and the attitude of the aircraft in relation to the position of the radar influence in the obtained speed.

It should be noted that the time interval between the radar positions varied from 4 to 6 seconds. In this way, it is possible that higher or lower speeds have been reached between the radar capture windows. That is, it is possible that, by data interpolation, the speed displayed in 23 minutes and 55 seconds, was less than 96kt about 2 to 3 seconds before or after.

However, it can be understood that this interpolation of data close to the 96 kt GS moment would not be sufficient to create a stall-favorable condition, since the stall speed was close to 55 kt of indicated speed (VI).

The main issue facing this interpolation of speed data is directed to the moment 24 minutes and 10 seconds, in which the speed presented by the surveillance system was 136kt GS. In this sense, it is possible that the aircraft may have exceeded, according to the Cessna 182 Training Manual, the maximum structural cruise speed (VNO) of 140kt.

Another aspect observed during the flight was the Maximum Maneuvering Speed (VA), whose maximum value was 111kt. From the moment of 24 minutes and 00 seconds, the aircraft began to describe a curve trajectory at a velocity in relation to the ground above 118kt, which assumes that it maneuvered with speeds greater than 111kt.

This velocity was presented as a structural limitation, since the total deflection of any flight control surface at speeds close to or faster than VA should not be attempted because of the risk of aircraft damage.

It can be observed that there was a wide variation of velocities in the minutes that preceded the loss of radar contact.

The limit load factor with the flaps collected for the Cessna 182 was + 3.8g. If this value were exceeded, the aircraft could be subject to irreversible structural damage.

The load factor, the variable represented by the acceleration of gravity, is the relationship between the lift produced and the weight of the airplane, representing the load to which the structure of the aircraft is subjected.

High load factors can be caused mainly by: curved flights; maneuvers made by the pilot; wind gusts; and recovery of dives.

Above the maneuver speed, the aircraft can fly, with smaller angles of attack, so that the limit load factor is not exceeded.

The Federal Aviation Administration (FAA) considers an aircraft in an abnormal attitude when certain parameters are exceeded unintentionally. Among the indicated parameters, the inappropriate speed for flight conditions is included.

### **1.19 Additional information.**

According to the report of the skydiving instructor's father, who was aboard and would make the double jump, the parachutist was professionally distinguished in Brazil and abroad, being responsible for the graduation of more than 30 parachutists.

By the influence of his father, also a parachutist, he was in a life phase marked by the transition of professional activities, with a distancing from his acting as a lawyer and an increased dedication to parachuting.

He was recognized for the high standard of competence and technique, and also responsible for planning the jumps, including the financial aspects. The pair of professional parachutists, father and son, had made other jumps with the air taxi company operating the aircraft involved in the accident.

During interview, the surviving parachutist reported that he had started in this activity by influence of the deceased friend in the occurrence (instructor). He also reported on the dedication of this professional with the sport and reinforced the perfectionism with which he guided the members of the flight and his professionalism with the jumps, having a profession in the practice of parachuting.

Regarding the environment between the occupants of the aircraft in the moments that preceded the occurrence, the survivor stated that all safety procedures were fulfilled by the parachutists, including checking the equipment for the jump.

A father and his daughter were also present on the flight. The father was an athlete and began his journey in parachuting. The daughter, who was in the passenger condition, made her first double jump with the professional parachutist and showed a natural nervousness.

According to interviews with other pilots, in relation to the passenger, the first-jump condition may have contributed to an increase in the stress levels in the flight environment, which may affect the flight safety perspective.

On the day of the incident, a local television station was reporting on parachute launching. The report was performed in the morning and, at the time, the pilot, the coordinator of the launches in ground, a parachutist and one of the passengers that were launched in double jump were interviewed (*tandem*).

To record the launches, there were high-definition, GoPro type portable cameras that were on the parachutists' wrists and on the right wing of the aircraft. These cameras, with their respective data generated in the launches, were rescued during the first action, and that of the wing, despite having been released from its support, was found in the forest with its entire contents.

We analyzed the images acquired with the cameras; however, it was verified that none of them had recorded the moment of the accident.

The hand-operated wrist cameras provided images on board the cabin moments before the event, in which the pilot verified the parachute layout and position of equipment in addition to the position and use of the belt.

Thus, it can be affirmed that, near the moment of the jump, the pilot was using the seat belt, but it was loose in the middle third of his thigh. The isolated parachute was near the cabin's right door (the aircraft flew without that door); the instructor was leaning with his back on the back of the pilot's chair; and the passenger was connected to the instructor by the karabiners.

The camera attached to the inboard of the right wing was remote-controlled, usually with the aircraft in the final for launch. However, according to the report of the parachutist who jumped on FL045, this camera was with low battery, so its last recording was on the previous flight.

The researchers obtained information that there was a digital altimeter with one of the parachutists. This type of equipment could contain information on variations in altitude, acceleration and velocity that are important for research. However, without the knowledge of the team that conducted the First Action at the scene, relatives collected this equipment and, without authorization, sent it for analysis outside the country.

After questioning by the investigators, they received the information that the equipment had not registered any information.

Another relevant aspect of the investigation was the finding that the aircraft was involved in an aeronautical accident on 22DEC2012, in the locality of Gurupá - PA. On that occasion, some facts and violations were observed, as follows:

- a) the occurrence was informed by third parties and was not informed by the operator or the pilot;
- b) the aircraft was moved from the place of occurrence, covering up possible evidence;
- c) there was no first action;
- d) the pilot had his Technical Qualification Certificate (CHT) suspended; and
- e) the pilot used ANAC code from another pilot.

The images of the aircraft attest that it had damage at the leading edge of the left wing, the right wing and the right wing strut (Figures 14 and 15).



Figure 14 - Damage to the leading edge of the left wing (22DEC2012).



Figure 15 - Damage to the leading edge of the right wing and the strut of the right wing (22DEC2012).

In the Failure Report, issued by the National Aircraft Maintenance Ltd., which carried out the recovery of the aircraft, there are no repairs on the leading edges of the left wing, as well as on the edge of the wing and on the right wing strut. According to this organization, the aircraft was already received with these components repaired. No other document was submitted that would prove the repair of the parties affected by the occurrence in 2012 in Maintenance Organization.

#### **1.20 Useful or effective investigation techniques.**

Nil.

#### **2. ANALYSIS.**

This was a parachutist launching flight with a pilot and four passengers on board, which was contrary to the maximum number of three passengers specified in the aircraft's Airworthiness Certificate (CA).

No Supplemental Type Certification (CST) or equivalent document was submitted, which would allow flights with a passenger capacity above the one permitted.

The aircraft was not approved to operate with the pilot seat and without the passengers' seats installed. Therefore, the flight could not have been accomplished in this configuration.

The aircraft was operated by an air taxi company, without being included in the Operational Specification (E.O). An operating lease agreement between the operator and the company had been forwarded to the RAB. However, during the process for including the aircraft in E.O. of the company, nonconformities were pointed out. These procedural issues were not solved by the company.

In view of this, the aircraft, despite being operated by an air taxi company, was registered in the Private Air Services category (TPP). According to Resolution No. 293 of 19NOV2013, aircraft used in the TPP category must comply with item VI of Art. 60, as follows:

VI - Private Air Services (TPP): aircraft employed in services performed without remuneration for the benefit of owners or operators, including recreational or sporting activities, transportation reserved to the owner or operator, of specialized air services performed for the sole benefit of owner or operator, and cannot perform any paid air services.

This scenario indicated that the aircraft could have been used for commercial purposes, even though it was registered in the category of Private Air Services (TPP).

There was no cargo manifest for the determination of the center of gravity (CG). However, it is possible to state that the aircraft was flying within the weight and balance parameters established by the manufacturer.

Before taking off, the pilot informed the Launch Coordinator that he had documentation enabling him to perform launching. However, he was not required to submit such documentation.

Similarly, the pilot admitted, on the morning of the accident, during an interview for a local station that had the necessary qualification for the flight. He also said he had great experience in the launch.

However, it was verified that the pilot, despite having experience in aviation, did not have the Parachutist Launcher Pilot Rating - Airplane (LPQD), that is, he was not qualified to perform this type of flight. Therefore, to make the operation feasible, the aircraft commander used the CANAC of another pilot, who had the Parachutist Launcher Pilot Rating - Airplane (LPQD).

The accomplishment of this flight with a non-homologated aircraft for this type of operation and with a pilot without the necessary qualification to perform it indicated that the air taxi company did not have effective organizational processes that allowed the adequate management of the air activities.

The lack of training and experience of the pilot in this type of mission was evidenced when the first launch of a parachutist in the FL045 was performed.

According to the coordinator's report, some basic procedures for launching were not implemented, such as reducing the speed of the aircraft.

Compliance with regulations, notably the attainment of LPQD rating, could have acted as a barrier to avoiding the accident, as the pilot would be properly familiarized and checked to perform this type of air activity.

Thus, in accepting to perform a flight for which he was not enabled, the pilot assumed a complacent attitude, which favored an imprecise and inadequate evaluation of the risks involved in this type of operation.

It should be emphasized that the fact the pilot had expectations of establishing a formal bond with the organization, through hiring, may have motivated him to make the flight, despite his lack of preparation in this type of operation.

Even though this condition was evident, it was not possible to establish a direct connection with the accident, since it occurred at a point far from the launch area (positive zone). However, it is possible to consider that in the face of a critical situation in flight, the lack of experience and the necessary qualification may have increased the level of anxiety of the pilot, as well as reduced situational awareness in the management of the flight.

This may have been exacerbated by the failure to conduct a briefing, which would cover all aspects of the safety of that flight, including aircraft abandonment procedures or attitudes to be taken in emergencies.

According to the information obtained during the investigation process, during the flight, the passenger who would perform her first jump showed behaviors marked by anxiety.

This context, added to the lack of a relevant safety briefing, could create conditions of high stress level among the other occupants of the aircraft, damaging the management of the situation. This possibility would justify the fact that, with the exception of the pilot, the remaining occupants of the aircraft remained inside, even carrying a parachute.

In the organizational context, flaws related to organizational processes, such as pilot training or air operation supervision, resulted in informal practices and the absence or non-compliance with established criteria for the proper management of air activities.

As a result of this informality, the level of flight safety was compromised, since the air taxi company allowed the aircraft to be employed in its operations, without, however, being part of its Operational Specification. In addition, it allowed the flight to be performed by a non-qualified pilot to perform that type of operation.

The absence of employment relationship between the pilot and the operating company may have favored the flaws in the verification of the necessary qualifications for the operation of the aircraft and the professional accompaniment of the pilot. This may have led to a possible compromise of the ideal conditions for maintaining technical proficiency.

In this condition, the pilot may have compromised the safety of operations, for lack of fundamental technical data, such as operating limits.

In the accident in question, it can be inferred that these aspects were present, since the little flight experience in that aircraft and the type of mission reinforced the presence of failure in the management supervision.

These aspects were indicative of weaknesses in flight safety due to the lack of compliance with norms and procedures, as well as due to the informality that characterized the management of the air activity.

As a consequence, it was evident that the organization did not have an adequate safety culture in order to allow the barriers to act in order to avoid the accident. In this way, the latent conditions in the organization contributed to an inadequate assessment of the scenario, which contained a number of elements that placed the operation at risk.

These facts are similar to the traits of the group culture identified in the region, punctuated by noncompliance with formal rules and procedures, far from values and safety culture of flight.

The CA of the aircraft was valid and had been revalidated during maintenance services performed on 07MAR2016.

During the maintenance services, in addition to the "100 hour" inspection, the Airworthiness Condition Report (RCA) was prepared for the revalidation of the Airworthiness Certificate. The Special Maintenance Items established in the Service Manual D138-1-13 Temporary Revision 07, and the Continued Airworthiness Program for the aircraft model were met.

However, on the aircraft manufacturer's website, a Temporary Revision 08, inserted in Service Manual D138-1-13, on 18MAY2015, was not identified in the aircraft records. Therefore, it was verified that the aircraft was released for return to service with outdated technical data.

At the place of occurrence, it was verified that the empennage, fuselage, propeller and engine were grouped. The wings were unleashed still in flight and were found at a distance of 276 meters from the fuselage of the aircraft.

All components, fuselage fragments, wing fixation hardware and the elevator were forwarded for analysis by the Aeronautics and Space Institute (IAE) of the DCTA.

The analyzed parts were submitted to visual and stereoscopic analysis. The report issued by IAE concluded that all surface fractures were caused by overloading applied to the material. There were no indications of failure of the elevators.

The control cables, surfaces and fractures of the wings, tail cone, engine fixation and the general structure of the crashed aircraft were also analyzed in the premises of the First Regional Aeronautical Accident Investigation and Prevention Service (SERIPA I).

Likewise, the visual and stereoscopic analysis revealed that all analyzed items presented fractures caused by overload applied to the material, and there were no signs of corrosion or fatigue in all the components verified.

Motor analysis revealed no abnormalities in its operation. Thus, it was evidenced the non-contribution of this component to the occurrence.

The aircraft was involved in an aircraft accident that took place on 22DEC2012, in the locality of Gurupá - PA. In the photographic records in Figures 14 and 15, damage was identified on the leading edge of the left and right wing, and on the right wing attachment strut.

In the Failure Report issued by the company that recovered the aircraft after the accident in 2012, there are no records of repairs to these components, thus suggesting that these services may have been performed by not qualified personnel and without the pertinent verification of the conformity required for structural repair.

According to information from CINDACTA IV, following the launch of a parachutist on FL045, the aircraft went up to FL085 to launch three more parachutists. In this report, are also included the images of the surveillance radar, which presented the estimated positions and velocities of the aircraft.

Based on the final two minutes of the flight, it is possible to verify that the aircraft decelerated in turn on the left, then immediately descended 100ft and accelerated abruptly about 32kt. In the sequence, still maintaining an acceleration vector, a rise of 200ft was verified. In this interval, the airplane reached a velocity relative to the ground (GS) of 136kt (Figure 13).

From this perspective, it cannot be ruled out that the indicated speed of the aircraft has exceeded the Maximum Structural Cruising Speed (VNO), which was 139kt. This speed should not be exceeded, except in a gentle way and only with caution.

In the same way, it can be stated that the aircraft performed maneuvers with speeds above the Maximum Maneuvering Speed (VA), which was 111kt. According to the Cessna 182 Training Manual, VA is the maximum speed at which commands can be used at their maximum amplitude or abruptly.

Therefore, and based on the results of the examinations, tests and research, which indicated an overload applied to the fractured material, it is fair to infer that there has been a structural failure, caused by the extrapolation of the load factor and by the use of the commands in their maximum amplitude or abruptly at speeds exceeding the Maximum Maneuvering Speed (VA).

In this sense, it is possible to deduce that the aircraft, when surpassing its operational limits, had a structural failure, characterized by the separation of the wings and the fuselage. Such evidence was proven by filming, in which wings were observed falling apart from the fuselage of the aircraft, being located 276 meters apart.

After separating the wings and the fuselage, the pilot was extracted from his seat. This condition is also supported by the fact that the aircraft has only abdominal belt and the pilot uses it loose in the middle third of his thigh.

In view of the above-mentioned facts, the most probable hypothesis for the structural failure occurred with the PT-DJH aircraft is the combination of a series of factors, among which the following ones stand out:

- structural repair service performed by not qualified personnel and without verification of conformity; and
- excess load factor and use of speed above the limits set by the manufacturer, in a curve and with the use of the commands at maximum amplitude or abruptly.

The wide variation in speed, attitude and altitude observed in the minutes prior to the separation of the wing and fuselage suggest that the pilot has entered into an abnormal attitude, so that the recovery attempt has not been performed effectively, making the load factor limit be exceeded, causing the structural failure that led to the accident.

It was also verified the hypothesis of a movement of the parachutists inside the aircraft, but this condition does not corroborate with the position in which they were found in the wreckage. Thus, the action of the paratroopers in the flight commands was considered unlikely.

### **3. CONCLUSIONS.**

#### **3.1 Facts.**

- a) the pilot had valid Aeronautical Medical Certificate (CMA);
- b) the pilot had valid MNTE Technical Qualification and IFRA;
- c) the pilot did not have Parachutist Launcher Pilot Rating (LPQD);
- d) the pilot used the ANAC (CANAC) code of another professional that had the LPQD Rating;
- e) the pilot was not qualified and did not have experience in that kind of flight;
- f) the weather conditions were favorable for the visual flight;
- g) the aircraft had valid Airworthiness Certificate (CA);

- h) the aircraft was within the weight and balance parameters specified by the manufacturer.
- i) the aircraft was not included in the Operational Specification (E.O.) of the operating company;
- j) the aircraft was registered in the Private Air Services category (TPP);
- k) the aircraft has taken off with the number of passengers above the allowable capacity in the CA;
- l) The flight occurred with the aircraft in an unapproved configuration, that is, without the passenger seats;
- m) the airframe, engine and propeller logbook records were outdated;
- n) the aircraft was released for return to service with outdated technical data;
- o) the repairs carried out on the leading edge of the left and right wing and the strut of right wing attachment resulting from a previous accident were not registered;
- p) the examinations, tests and research indicated that the fractures were caused by overload applied to the material;
- q) there was no evidence of corrosion or fatigue in all analyzed material;
- r) the pilot did not adopt all procedures related to flight safety, such as an aircraft abandonment briefing by the parachutists or the attitudes to be adopted in an emergency;
- s) the parachutist who jumped on FL045 survived;
- t) the aircraft maneuvered with speeds greater than 111kt - Maximum Maneuvering Speed (VA);
- u) there were abrupt variations in attitude and speed in the final moments of the flight;
- v) there was separation between the wings and the fuselage;
- w) the pilot was removed from the aircraft after the wings were detached;
- x) the three remaining passengers stayed on board;
- y) there was no fire;
- z) the aircraft was destroyed; and
- aa) the pilot and three passengers suffered fatal injuries.

### **3.2 Contributing factors.**

- **Handling of aircraft flight controls - undetermined.**

The aircraft exceeded the Maximum Maneuvering Speed (VA) and was likely to have extrapolated the Maximum Structural Cruise Speed (VNO) as well. The structural failure may be associated with a deformation caused by the extrapolation of the load factor and the operation of the aircraft at speeds higher than VA with the use of the commands at maximum amplitude or abruptly.

- **Attitude - a contributor.**

Performing the flight without being qualified to do so, as well as not conducting a briefing and guiding passengers regarding the security procedures provided, denoted a complacent attitude that contributed to the accident.

- **Other - Cabin Coordination - undetermined.**

Although the pilot did solo flight, there is evidence of inefficiency in the use of the human resources available in the operation, due to the inadequate management of the tasks assigned to each parachutist during the emergency. The pilot did not address aspects related to safety, including procedures such as the aircraft's abandonment briefing by the parachutists or the attitudes to be adopted in cases of emergency.

- **Organizational culture - a contributor.**

The management processes adopted by the organization were based on informally adopted practices that compromised the maintenance of safe levels of operation. This fact was evidenced by the permissiveness of employing aircraft that was not found in the company's Operational Specifications, as well as of a pilot who did not have the necessary qualification for the type of flight. These conditions were contrary to the requirements demanded to maintain flight safety.

- **Emotional state - undetermined.**

The conditions in which the flight was performed involved the presence of a passenger anxious to be on her first jump. This, together with the lack of a briefing, may have raised the level of stress among passengers and affected the management of the situation.

- **Training - undetermined.**

The fact that the pilot did not have the LPQD rating evidences that he was not provided with adequate qualification or training to carry out the parachutists launch. In this condition, ignorance of key technical data, such as operational limits, may have compromised the pilot proficiency and flight safety.

- **Flight indiscipline - a contributor.**

The pilot violated operating rules and regulations for having used another pilot's ANAC code to conduct the parachutists launch flight without being able to do so.

- **Piloting judgment - undetermined.**

The use of the aircraft at speeds close to and above the limits established by the manufacturer presupposes an inadequate evaluation by the pilot of aspects related to the operation of the aircraft.

- **Aircraft maintenance - undetermined.**

The repairs carried out in the recovery of the aircraft were not recorded during the accident in 2012. This fact indicates that these services may have been carried out by personnel not qualified and without the pertinent verification of the conformity required for a structural repair.

- **Motivation - undetermined.**

The pilot had personal interests to carry out the flight, because he wanted to be hired. This expectation may have motivated him to make the flight, although he did not have the required qualification for this type of operation.

- **Perception - undetermined.**

The overload to which the aircraft was subjected may have been caused by an abnormal attitude of the aircraft. It is possible that at some stage of the flight there has been a reduction in the situational awareness of the pilot, impairing his ability to properly manage the flight.

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

The fact that the pilot performed the launch of parachutists without having the necessary qualification may have contributed to the occurrence, since he did not have specific knowledge for the type of operation.

**- Organizational processes - undetermined.**

The air taxi company did not have effective organizational processes to identify and correct failures that could adversely affect the safety of air operations. The lack of effective control of aircraft conditions or pilot proficiency level may have created a favorable scenario for the accident.

**- Managerial oversight - a contributor.**

There was inadequate oversight by the operator's management regarding the allocation of a pilot that was not qualified for the type of flight.

#### **4. SAFETY RECOMMENDATION.**

*A measure of preventative/corrective nature issued by a SIPAER Investigation Authority or by a SIPAER-Link within respective area of jurisdiction, aimed at eliminating or mitigating the risk brought about by either a latent condition or an active failure. It results from the investigation of an aeronautical occurrence or from a preventative action, and shall never be used for purposes of blame presumption or apportion of civil, criminal, or administrative liability.*

*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-096/CENIPA/2016 - 01**

**Issued on 10/05/2018**

Disseminate the lessons learned from the present investigation in order to alert pilots and operators to the risks arising from the use of aircraft that do not comply with Brazilian civil aviation regulations, especially when practicing parachutists launching.

**A-096/CENIPA/2016 - 02**

**Issued on 10/05/2018**

Acting with the Aerotur Air Taxi Ltd. company - EPP, in order to verify the conformity of the organizational processes and the management supervision mechanisms adopted by this operator, aiming at increasing the levels of competence and operational safety required for the performance of the activities for which such organization is certified.

**To the Air Traffic Control Department (DECEA):**

**A-096/CENIPA/2016 - 03**

**Issued on 10/05/2018**

Carry out a study on the possibility of implementing security mechanisms in the flight plan transmission system that have the capacity to inhibit the misuse of ANAC Codes.

#### **5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.**

Nil.

On May 10<sup>th</sup>, 2018.