COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-023/CENIPA/2015

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PT-KBV**
MODEL:	**182P**
DATE:	**19FEB2015**

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 19FEB2015 aeronautical accident with the 182P aircraft, registration PT-KBV. The accident was classified as "Spacial Disorientation".

With approximately one hour and ten minutes of flight, after takeoff, the aircraft was seen by observers in a downwards trajectory, losing parts in flight, until colliding with the ground, in the rural area of the city of Bueno Brandão, MG.

The aircraft was completely destroyed.

The pilot and three passengers died.

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

ACC	Area Control Center
AFIL	Flight Plan Filed in the Air
AIS	Aeronautical Information Service
ANAC	(Brazil's) National Civil Aviation Agency
APP-GW	Guaratinguetá Approach Control
BKN	Cloudy
CA	Airworthiness Certificate
CAVOK	Ceiling and Visibility OK
CMA	Aeronautical Medical Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CHT	Technical Qualification Certificate
CIV	Pilot's Flight Logbook
DCTA	Aeronautics' Science and Technology Department
FL	Flight Level
FT	Feet (unit of measurement)
H	Hours
ICA	Command of Aeronautics' Instruction
IAM	Annual Maintenance Inspection
IFR	Instrument Flight Rules
IAE	Aeronautics and Space Institute
IMC	Instrument Meteorological Conditions
KM	Kilometers
KT	Knots
M	Meters
METAR	Aerodrome Routine Weather Report
MHz	Megahertz
MIN	Minutes
MNTE	Qualification Type – Airplane Single-Engine Land
NM	Nautical Miles
PN	Part Number
PPR	Private Pilot – Airplane Category
RA	Rain
SBRP	ICAO location designator – Ribeirão Preto Aerodrome
SCT	Scattered Clouds
SDTK	ICAO location designator – Parati Aerodrome
SIGWX	Wind and Cloud Forecast Chart

SIPAER	Aeronautical Accident Investigation and Prevention System
TPP	Private Aircraft Service Registration Category
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions

1. FACTUAL INFORMATION.

Aircraft	**Model:** 182P **Registration:** PT-KBV **Manufacturer:** Cessna Aircraft	**Operator:** Private
Occurrence	**Date/time:** 19FEB2015 - 1340 UTC **Location:** Out of the Aerodrome **Lat.** 22º25'47"S **Long.** 046º17'37"W **Municipality – State:** Bueno Brandão - MG	**Type(s):** Loss of Control In-Flight **Subtype(s):** Nil.

1.1 History of the flight.

The aircraft took off from the Parati Aerodrome, RJ (SDTK), to the Ribeirão Preto Aerodrome, SP (SBRP), at 1230 UTC, in order to carry out a personnel transport flight with one pilot and three passengers on board.

With approximately one hour and ten minutes of flight, the aircraft was sighted by observers, in a downwards trajectory, losing parts in flight, until it hit the ground, in a region of medium-sized vegetation, in the rural area of the city of Bueno Brandão, MG.

The aircraft was completely destroyed.

The pilot and the three passengers of the aircraft perished at the accident site.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft was completely destroyed.

1.4 Other damage.

Nil.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	77:20
Total in the last 30 days	02:30
Total in the last 24 hours	01:10
In this type of aircraft	26:30
In this type in the last 30 days	02:30
In this type in the last 24 hours	01:10

N.B.: The data related to the hours flown were obtained through the records in the Pilot's Flight Logbook (CIV).

1.5.2 Personnel training.

The pilot took the Private Pilot - Airplane Category (PPR) course at the *Aeroclube de* Ribeirão Preto, in 2014.

1.5.3 Category of licenses and validity of certificates.

The pilot had the Private Pilot License - Airplane (PPR) and had valid technical certifications of single-engine aircraft (MNTE).

The pilot did not have the technical qualification for instrument flight (IFR)

1.5.4 Qualification and flight experience.

The pilot was qualified to perform this type of flight and had 26 hours and 30 minutes of flight in this kind of aircraft.

1.5.5 Validity of medical certificate.

The pilot had valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information.

The aircraft, serial number 18263144, was manufactured by Cessna Aircraft in 1974 and was registered in the category of Private Air Services (TPP).

The aircraft had valid Airworthiness Certificate (CA).

The airframe and engine logbooks records were outdated.

The Tangará Aero center shop performed the last inspection of the aircraft, the Annual Maintenance Inspection (IAM) type, on 30OCT2014. The aircraft flew 30 hours and 30 minutes after the inspection.

The last revision of the aircraft, the 50h type, was held on 24JULY2014, by the Tangará Aero center shop, having flown 55 hours after the review.

1.7 Meteorological information.

On the planned day for the return to Ribeirão Preto, 18FEB2015, Wednesday, weather conditions (cloud ceiling and visibility) in Parati were not favorable to takeoff. For this reason, the pilot decided to delay the return to the next day.

On the day of takeoff, the weather conditions got better. The weather in Parati dawned on cloud base above 5,000ft and horizontal visibility over 10km (CAVOK). The pilot obtained information about the route and destination's weather conditions by means of contact with the Ribeirão Preto Airport's AIS room (SBRP), since the Parati Aerodrome was not provided with the Aeronautical Information Services (AIS).

The regular aeronautical meteorological reports (METAR) of the SBRP Aerodrome were as follows:

METAR SBRP 191300Z 02008KT 9999 SCT007 BKN100 24/21 Q1009

METAR SBRP 191400Z 03008KT 6000 -RA BKN040 BKN070 25/20 Q1015

At Parati's departure, weather conditions were favorable for the visual flight, but conditions at the chosen flight level were getting worse, as noted in the Wind and Cloud Forecast Chart (SIGWX) on the day of the occurrence.

The meteorology of the route indicated that there would be significant formation of clouds at the flight level chosen by the pilot, including the possibility of formation of clouds of great vertical development and thermal convection, from 2,000ft altitude. This information could also be observed in the SIGWX of the day and time of the occurrence (Figure 1).

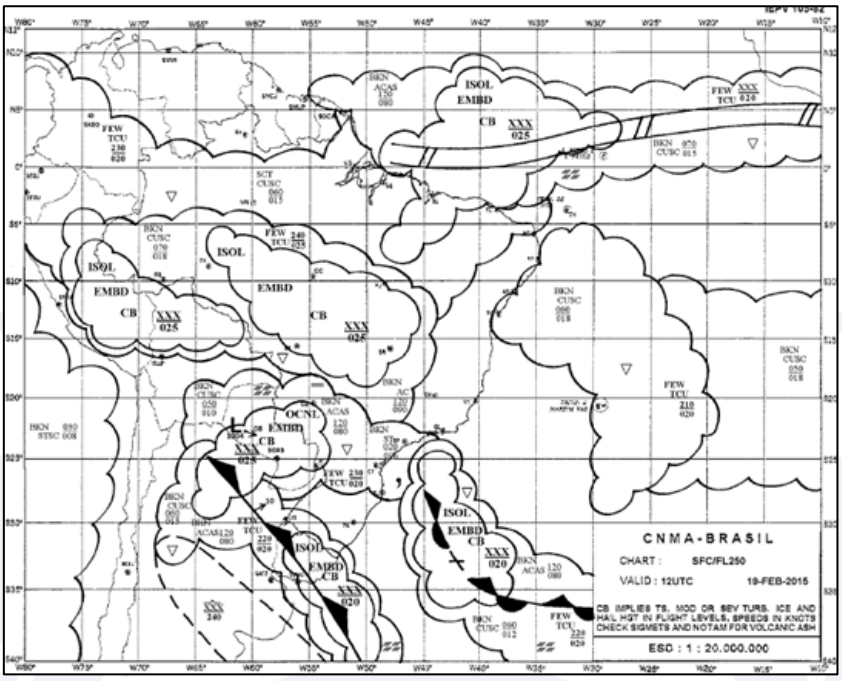

Figure 1 - SIGWX chart of the region on the day of the occurrence.
(The red arrow indicates the desired route).

1.8 Aids to navigation.

Nil.

1.9 Communications.

The pilot took off from *Parati* in visual conditions, and presented the Flight Plan for the Guaratinguetá Approach Control (APP-GW) when he was already flying (AFIL). He initially was in coordination with the APP-GW and was subsequently transferred to the Area Control Center - Brasília (ACC-BR).

The pilot also remained in bilateral contact with another aircraft, from the departure of Parati until the moments that preceded the accident, at the frequency 123.4MHz.

1.10 Aerodrome information.

The occurrence took place outside the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The aircraft was seen by observers in downwards and spiral trajectory, losing parts in flight, until colliding against the ground, in the rural area of the city of Bueno Brandão, MG.

From the spreading configuration of the wreckage and based on the marks observed in the vegetation, it was possible to conclude that the impact occurred with high speed and wide angle.

The main collision (core of the wreckage) against the ground occurred at the coordinates 22º25'47 "S / 046º17'37" W, at a distance of 6km from the city of Bueno Brandão - MG.

The aircraft crashed directly into the ground, with no previous impacts. There was separation of some of its parts in flight, which were scattered in an area of approximately 190x70 meters. (Figure 2).

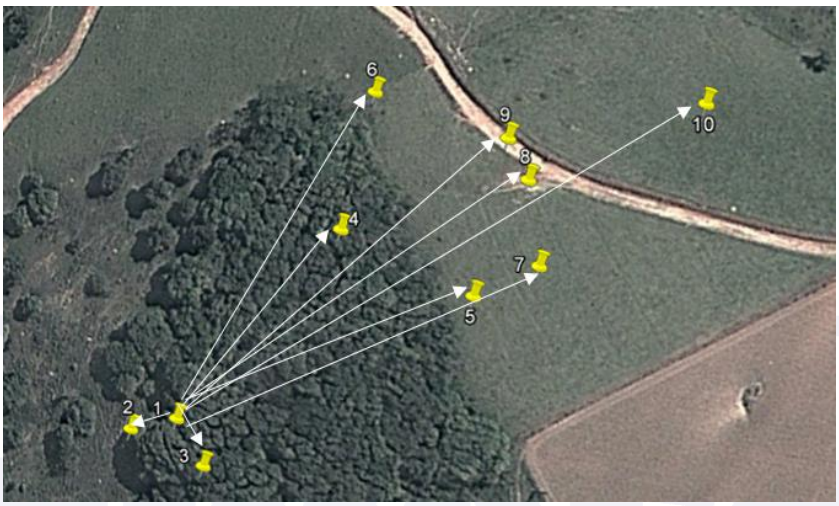

Figure 2 - Placement of the aircraft wreckage.

The distance of the parts separated in flight, in relation to the core of the wreckage, can be visualized in the diagram in table 1, below:

1- Core of the Wreckage	6- Bottom of the fuselage: 109m
2- Right Aileron: 15m	7- Right Wing Fragment: 111m
3- Landing Gear Wheel: 16m	8- Right Elevator: 120m
4- Windshield: 72m	9- Left Aileron: 123m
5- Right Wing: 92m	10- Right Wing Tip: 171m

Table 1- Distances relative to the core of the wreckage.

The fragmentation of the aircraft in flight and the large angle of impact against the ground caused a random but linear distribution of the wreckage. In this sense, it can be inferred that the basic course was approximately 290º.

At the core of the wreckage, there were the following items: flight and passenger cabin; left wing; wheels; seats; part of the fuselage; engine and propeller. The great energy of the impact of the aircraft against the ground caused enormous damages, deforming and fragmenting its components in several parts (Figures 3 and 4).

Figure 3 - Core of the wreckage.

Figure 4 - Core of the wreckage.

The marks left on the ground and the damage caused to the vegetation indicated that the aircraft and its components collided against the ground with reduced horizontal displacement, and it can be seen that the angle of impact was approximately 80º (Figure 5).

Figure 5 - Marks of the impact of the aircraft on vegetation.

The right wing was sectioned near the fuselage and divided into three main parts. Signs of collision could be observed at the end of the wing, which was 92 meters from the core of the wreckage (Figure 6).

Figure 6 – Bigger part of the right wing.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Nil.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Nil.

1.14 Fire.

There was no evidence of fire in flight or after impact.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

The Aeronautics and Space Institute (IAE), of the Aeronautics' Science and Technology Department (DCTA), conducted tests and research concerning the analysis of fault occurred with the following components of the aircraft: two propeller blades, the speedometer and parts of the fuselage (Figure 7).

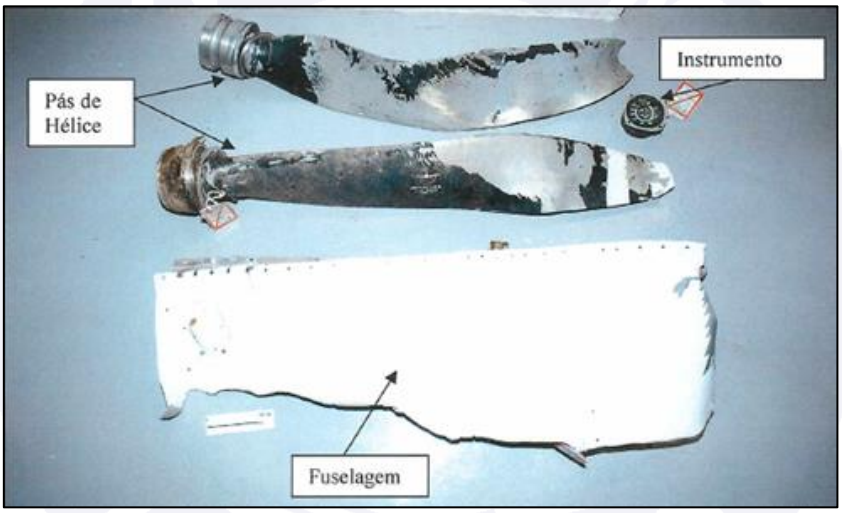

Figure 7 - Components submitted to DCTA failure analysis.

The fractures examined in the fuselage section indicated rupture by overload, presented tearing aspects of the aluminum plate and fracture with angles of approximately 45º in the reinforcement profile (Figures 8 and 9).

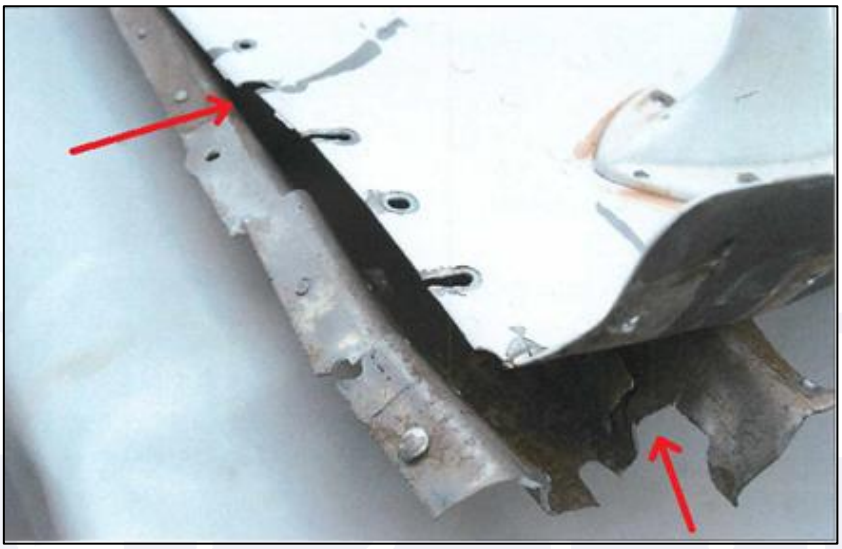

Figure 8 - Tearing aspects of the aluminum plate of the fuselage.

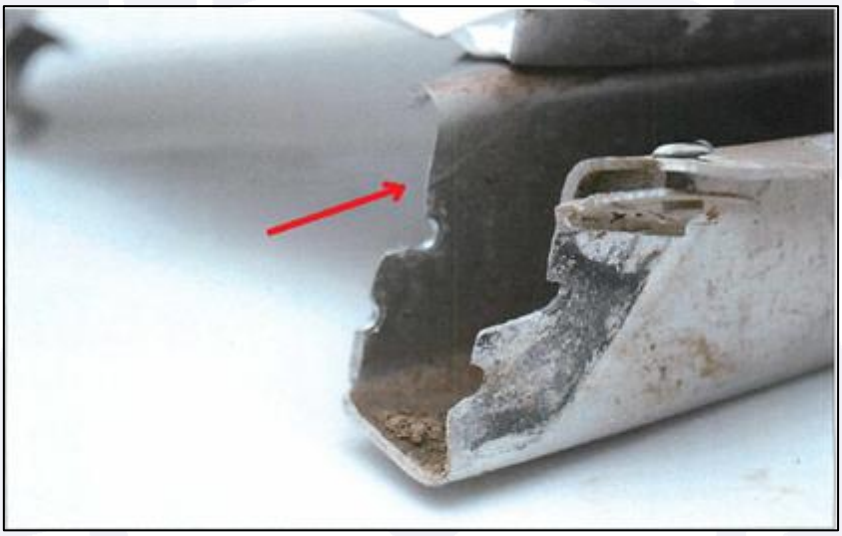

Figure 9 - Fracture in the fuselage reinforcement profile.

Analyzes concluded that the kneading and deformation of the propeller blade Part Number (PN) 98.3BT.24/K and that the fracture at the tip of the propeller blade PN 98.85T.19/B presented evidence of having occurred due to the impact of the aircraft against the ground.

The tests performed on the speedometer using ultraviolet light were not conclusive due to the high degree of destruction of the device.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

The pilot, who was also one of the owners of the aircraft, had 77 hours and 20 minutes of flight, with 26 hours and 30 minutes of flight in that kind of aircraft.

The pilot was not qualified for flights under the Instrument Flight Rules (IFR).

The aircraft had sufficient autonomy to fulfill the intended route, including alternate aerodrome. The aircraft was within the weight and balance parameters specified by the manufacturer.

The aircraft traveled to the city of Parati, from Ribeirão Preto, with three passengers. Its purpose was to stay in that city for 5 days and at the end of that period, it would return to Ribeirão Preto on 18FEB15.

According to information from observers, on the day planned for takeoff, the weather conditions in the locality were not favorable for the visual flight. It rained a lot, making the takeoff unviable. With this, the pilot decided to remain in the locality for another day, waiting for the improvement of the meteorological conditions.

One of the observers was a pilot from another aircraft, who was also in Parati awaiting the improvement of the weather conditions to take off for Ribeirão Preto. This pilot followed all PT-KBV procedures from take-off, the moment when the weather conditions began to get bad, until moments before the accident.

This observer reported that the day after the one planned for take-off, that is, on Thursday, the day dawned with clear sky in Parati. He also said that the pilot of the PT-KBV had checked the meteorological bulletins from the Ribeirão Preto Airport, through contact with the AIS room of that same Airport, which indicated that the meteorological conditions in that Aerodrome allowed the visual operation.

Under the circumstances, PT-KBV's pilot-in-command, in coordination with the pilot of the other aircraft, decided to take off and maintained bilateral contact in flight, combining the 123.4 MHz frequency. According to verified data, the pilot presented an AFIL plan with APP-GW, requesting the FL085, and indicating the Ouro Fino Aerodrome as an alternative.

According to the observer, the PT-KBV took off 5 minutes before him, but was exceeded in flight, due to the difference in performance of the aircraft. According to the reports, the meteorological conditions at the exit and at Vale do Paraíba were excellent. It remained like that until approximately 60NM after takeoff. The observer reported that he found some turbulence in the city of Campos do Jordão and realized that the weather began to degrade on the border with the State of Minas Gerais. Both aircraft maintained FL085.

After the vertical of Campos do Jordão, the observer concluded that it could not continue at that level, due to the progressive degradation of visibility conditions, and decided to ascend to FL105. He then informed PT-KBV about these conditions and recommended that he should also ascend levels. Upon reaching FL105, the pilot of the other aircraft realized that there was already a dense layer of clouds below that level.

The pilot of the aircraft ahead continued in contact with the PT-KBV pilot on the radio, informing that the conditions were deteriorating rapidly and reinforcing that he should ascend to another level. The PT-KBV pilot reported that he was noticing that the visibility conditions were getting critical in FL085 and felt that these conditions should be better down. After a few moments, the pilot informed that he still kept the FL085 and that he was "guarded", which in the pilots' slang meant to be inside the cloud, without visual references.

Following the events, the pilot would have informed his intention of lower his level to try to regain visual conditions. At that moment, the pilot of the other aircraft would have recommended that he should keep an eye on the horizon and advised him that if he were to descend, he should only do so after the border with the State of São Paulo. This would be a way to ensure a safe separation of the ground, due to the relief of the region.

The Command of Aeronautics' Instruction (ICA) 100-12, which regulates the airspace rules under Brazilian jurisdiction, established that flights under Visual Flight Rules (VFR) should observe certain ceiling and visibility limits, as described in its Item 5.1.2, below:

> 5.1.2 Notwithstanding at previous 5.1.1, VFR flights shall only be performed when they are simultaneously and continuously able to meet the following conditions:
>
> A) Keep reference to ground or water, so that meteorological formations below the flight level do not obstruct more than half the pilot's area of vision;
> B) Fly below FL 150.

The last contact between the two aircraft occurred when the aircraft ahead was approximately over the city of São João da Boa Vista. From this point, the observer reported that he made some calls on the combined frequency, but that he did not get an answer.

The PT-KBV pilot did not report any abnormality with any of the aircraft's systems during the time he was in contact with the other aircraft, since takeoff, during the en-route flight, until the moment he reported that he was beginning to face unfavorable conditions to keep the visual flight.

The aircraft was seen by observers on the ground in downwards trajectory, in spiraling motion and losing parts in flight, until the collision against the ground.

1.19 Additional information.

The occurrence of structural separation in flight is usually related to material fatigue or corrosion, fabrication or maintenance, design error or aerodynamic overload. Generally, a sequence of failures occurs: initial failure, subsequent failures, and damage from ground impact.

In this case, there were no signs related to design error or material fatigue, but strong evidence was found that the structural separation was consummated due to aerodynamic overload.

Aerodynamic overload occurs because of two main types: that resulting from turbulence and that imposed by the execution of maneuvers. Such overloading may also occur simultaneously, as a result of attempts to maintain flight parameters, under conditions of severe turbulence.

An in-flight separation is the result between applied down force and the capability of the structure to withstand such loads. This may occur when the aircraft's load factors are exceeded. Two important load factors are established in the design: the limit load factor and the final load factor. The first is defined as the one from which permanent deformations in the structure must occur; and the second is the factor beyond which the structure must break.

If a pilot loses control when in flight under instrument conditions and the aircraft enters a downward spiral, the traction will exceed the drag, regardless of engine speed, as it will depend on the assumed pitch down attitude. This will be true until the aircraft reaches the final speed for that attitude.

The term final velocity means the maximum velocity achieved in a determined flight attitude in descending trajectory. This factor is not established as a design requirement, since its value is usually so high that it exceeds the structural limits.

Once these limits are exceeded, the structure of the aircraft may break. The fuselage could break at any point; however, it is not common for that to happen with small- and medium-sized aircraft.

In small aircraft, the places where the break usually occurs are in the wings and in the horizontal stabilizers. The wing, when subjected to a high "G" positive load, deflects upward, generating tension stress on the lower surface and compression on the upper one. The wing, when detached due to an excessive positive load "G", causes a rolling movement of the aircraft towards its side, while it will do the same over the fuselage (Figure 10).

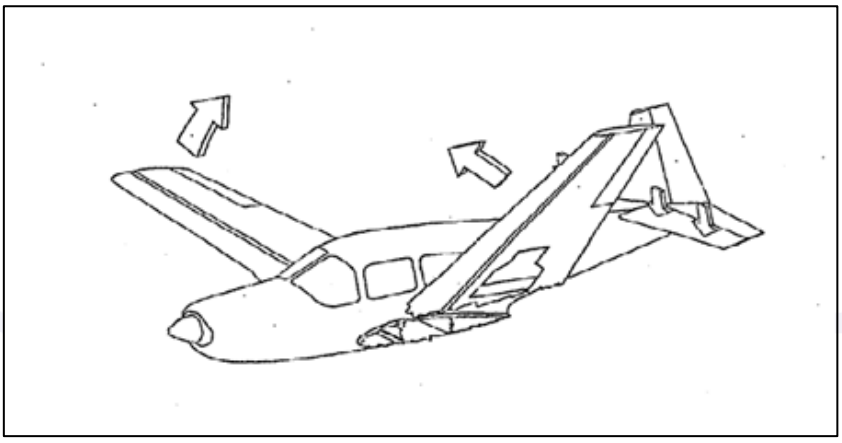

Figure 10 - Illustration of wing break caused by positive "g" excess load.

This situation may result in the collision of the wing against the tail of the aircraft, horizontal or vertical stabilizer, characterizing the occurrence of a primary and a secondary fault, as shown in Figure 11.

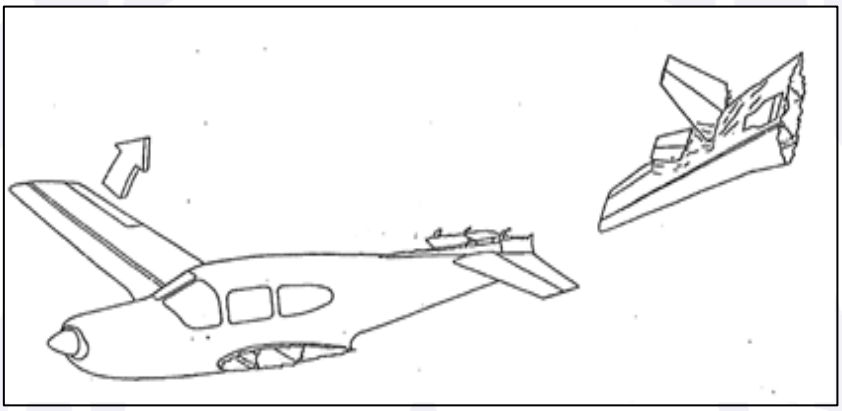

Figure 11 - Secondary stabilizer break illustration.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

The pilot was waiting for the weather conditions at the *Parati* Airport to improve, to return to the city of Ribeirão Preto, since he had already spent the days he had planned to stay with friends in that city. On the expected day for the return, the weather conditions were not favorable, and for that reason, he decided to wait another day.

The next day, the weather improved in the locality, the pilot consulted the meteorological bulletins of the destination aerodrome, seeing that it was possible to proceed, since both aerodromes operated VFR. However, it is plausible to assume that the pilot did not consult or did not adequately assess the conditions of the intended route, especially the possibilities of variation of meteorology, which could be observed in the SIGWX diagnostic chart of that day. This letter indicated the formation of significant nebulosity from 2,000ft of altitude.

This information suggested that, at any time, the flight conditions on the route could be modified and switched to Instrument Meteorological Conditions (IMC). This situation would oblige the pilot to change the level of flight, proceed to another aerodrome or return to the departure aerodrome, since the pilot was not qualified for that type of flight.

Based on the available meteorological information and the report of a pilot who accompanied the PT-KBV flight, it can be stated that the conditions of the route, from

60NM away from Parati, were not favorable for flying under visual conditions. This information also indicated the possibility of the formation of clouds of great vertical development and thermal convection, from 2,000ft of altitude.

The pilot of the other aircraft reported that the conditions had deteriorated to such an extent that it remained unfeasible to stay at that level of flight, and reported that as he climbed to FL105, he noticed that the cloud layer had closed below. Faced with this situation, he said that he suggested to the PT-KBV pilot that he should also do so, but that he did not comply, supposedly because he thought he would find better conditions at lower levels.

Therefore, it is reasonable to say that the decision to remain on that route and at the same level was due to a misjudgment of flight conditions, since there was enough information to alert him to the deterioration of the weather conditions on the route, mainly the information passed by the pilot of the other aircraft.

The pilot's hesitation regarding the decision-making led him to conditions of noncompliance of precepts set in ICA 100-12, which established that under VFR rules, meteorological conditions below the flight level could not obstruct more than half of the area of the pilot with the ground or water.

The experience of the pilot in the air activity was of 77 hours and 20 minutes total flight and of 26 hours and 30 minutes in that aircraft model. These could have been some of the factors that may have influenced the decision of the pilot to stay on FL085 (even when weather conditions were already degraded). Along with the fact that he was not qualified for IFR flights. In the same way, the pilot did not consider which actions he would take if the conditions of visibility deteriorated to the point where he could not continue the flight under visual conditions.

The communication established with the pilot of the other aircraft left no doubt that the pilot in command of the PT-KVB was in marginal meteorological conditions for the visual flight, which would have deteriorated progressively until the complete loss of visual references. This fact can be deduced from the pilot's information that he was "guarded", which in aeronautical jargon meant that at that moment he was flying in the cloud and without visual references to the ground.

Such a flight condition, without external references, in particular for a non-qualified pilot instrument flight, may have caused a change in the human body's balance system, contributing to a probable spatial disorientation.

In this situation, the pilot may have lost all sense of space, tending to believe that he was flying under certain conditions (level, inclined, with accelerations, etc.) when in reality the aircraft was in totally different conditions from those perceived by him.

In this sense, it was possible to construct the hypothesis that the pilot lost control of the aircraft for having suffered a spatial disorientation. What favors this hypothesis is the fact that the pilot was not qualified for IFR flights and he had to face conditions of flight without visibility, for which he was not properly prepared.

After entering IMC conditions, it is probable that the pilot, when trying to keep the parameters of straight and levelled flight and also going against the tendencies of the aircraft due to the possible accelerations caused by the adverse meteorological conditions, has suffered a spatial disorientation. He may also have acted on the commands of flight in a way that led the aircraft to assume attitudes that favored the values of velocity surpass and aerodynamic loads, higher than the structural limits of the project.

One of the possibilities that can be considered to explain the failure process of the aircraft structure, according to the evidences found, is that this process started from the application of positive loads that exceeded the final load factor of the aircraft. Therefore,

provoking the right wing breakage near the fuselage (primary fault) and possibly, the collision of the wing against the tail (secondary fault) of the aircraft, triggering the entire observed fragmentation sequence.

What strengthens the hypothesis raised is the fact that the aircraft has been sighted by observers in descending and spiraling trajectory, losing parts in flight. It also corroborates the fact that the right wing was found divided in three parts, with signs of collision at its end, in a prominent position of the core of the wreckage, which suggests that it was the first part to be detached.

The fractures observed in the examined pieces corroborated the hypothesis of aerodynamic overload and the other damages were produced by the impact against the ground. In the exams and signs collected, it was not possible to indicate another type of failure.

It was not found any evidence that could indicate failure of any of the aircraft's systems during flight, suggesting that they functioned normally during the entire stage. It is reasonable to conclude that if this was not the case, the pilot of the PT-KBV would have reported to the pilot of the other aircraft any abnormality, since they kept bilateral contact by radio until the beginning of the most critical moment of the flight.

3. CONCLUSIONS.

3.1 Facts.

a) The pilot had valid Aeronautical Medical Certificate (CMA);

b) the pilot had valid Technical Qualification Certificate (CHT);

c) the pilot was qualified for the flight;

d) the aircraft had valid Airworthiness Certificate (CA);

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

f) the airframe and engine logbooks records were not up-to-date.

g) the pilot had 26 hours and 30 minutes on that aircraft model and 77 hours and 20 minutes total flight.

h) the pilot did not have the technical qualification for instrument flight (IFR);

i) there was a delay of one day in relation to what was planned for take-off, due to the weather conditions, which were not favorable at the *Parati* Aerodrome on the planned day;

j) the aircraft took off from the Parati Aerodrome (SDTK) with four people on board, the pilot and three passengers;

k) the proposed route presented conditions of atmospheric instability, with the possibility of significant formations along the same route.

l) the pilot presented an AFIL plan for the APP-GW, bound for the Aerodrome of Ribeirão Preto (SBRB), under visual flight rules and proposed FL085 and the Ouro Fino Aerodrome as an alternative;

m) A pilot from another aircraft took off from the Parati Aerodrome, following the same route, with a five-minute delay from the PT-KBV take-off.

n) the pilots kept bilateral contact on the radio at the 123.4 MHz frequency, from takeoff till near the moment of the accident;

o) the pilot of the other aircraft reported that he also kept FL085, but was forced to climb to FL105 because of the en route weather degradation and suggested to the PT-KBV pilot to do the same.

p) PT-KBV kept FL085 and, at a given time, reported that the weather conditions were deteriorating and that he intended to lower his level;

q) the PT-KBV pilot reported that he was "guarded";

r) the aircraft was seen by observers on a downward path, spiraling and losing parts in flight, in the rural area of the city of Bueno Brandão-MG;

s) there was the separation of parts of the structure in flight;

t) the detached parts were scattered in an area of approximately 190mx70m;

u) the angle of impact was approximately of 80° and the distribution of the wreckage occurred in a predominantly linear way;

v) damage to propellers occurred due to the impact on the ground;

w) the fractures in the fuselage section presented indications of breakage by overload.

x) the aircraft was completely destroyed; and

y) the 4 occupants of the aircraft perished at the accident site.

3.2 Contributing factors.

- **Handling of aircraft flight controls – a contributor.**

The circumstances under which this occurrence happened indicate that the pilot did not apply the commands effectively in order to keep the flight parameters or to correct the attitudes faced by the aircraft, due to the probable disorientation, allowing the loss of control of the aircraft in the cruise phase.

- **Adverse meteorological conditions – a contributor.**

The available meteorological information indicated that there was the possibility of formation of significant meteorological phenomena, such as clouds of great vertical development, CB and TCU types, from 2,000ft altitude. The entry of the aircraft into areas of great instability and thermal convection enhanced the difficulties in which the pilot already was in order to keep control of the aircraft.

- **Disorientation – undetermined.**

A flight condition, without external references, in particular for a pilot who is not qualified to fly under instrument meteorological conditions (IMC), may lead to a change in the vestibular references (human body balance system), contributing to a probable spatial disorientation.

- **Flight indiscipline – a contributor.**

The failure to comply with the operational rule and the infraction of air traffic regulations was observed, since the pilot continued flying in FL085, even when the weather worsened in this level. It allowed him to fly under marginal conditions of visibility, until the point to make the flight unviable under visual conditions, intentionally exceeding the minimum limits recommended for VFR operation established in ICA 100-12.

- **Piloting judgement – a contributor.**

The pilot did not assess the risks arising from flying under marginal meteorological conditions for the maintenance of the VMC flight adequately. Nor the risk of degradation of the meteorological conditions at that level by deciding to remain on FL085 to the point

where the conditions became impeditive for VFR flight, forcing him to fly under IMC conditions, for which he was not qualified.

- **Flight planning – undetermined.**

There is a possibility that the en route meteorological conditions have not been adequately analyzed or that they have not been considered in planning, leading to a low situational awareness of the pilot.

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

It is plausible to say that improper decisions taken by the pilot, such as to keep flying in marginal conditions of visibility and to have failed to take action to avoid unfavorable flight conditions for the maintenance of the visual flight may have happened due to the pilot's lack of experience in air and aircraft activity, especially in adverse conditions like the ones found on the route.

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-023/CENIPA/2015 - 01 **Issued on: 25/06/2018**

Ensure that the knowledge of the recognition of meteorological conditions and favorable conditions for navigational flight under VMC conditions is given to students in civil aviation pilot training schools and flying clubs, as well as the risks caused by inadvertent entries under instrument flight conditions without proper qualification.

A-023/CENIPA/2015 - 02 **Issued on: 25/06/2018**

Work with civil aviation pilot training schools and flying clubs to include in their programmatic content an instruction about the structural limits of the aircraft, emphasizing the risks of exceeding the limits of the in-flight load factors, whose consequences may culminate with structural separation, in cases of loss of control in flight.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On June 25th, 2018.