

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 548/CENIPA/2017

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PT-IFS
MODEL:	PA-34-200
DATE:	17MAY2011



NOTICE

According to the Law n° 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the different factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree n° 21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of “non-self-incrimination” derived from the “right to remain silent” sheltered by the Federal Constitution.

Consequently, the use of this report for any purpose other than that of preventing future accidents, may induce to erroneous interpretations and conclusions.

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 17MAY2011 accident with the PA-34-200 aircraft, registration PT-IFS. The accident was classified as “[LOC-I] Loss of Control in Flight”.

During an enroute night instruction flight, the aircraft disappeared from the radar display, shortly after starting descent to land on the Piracicaba Aerodrome (SDPW).

Its wreckage was found on 17MAY2011, in the region of *Serra do Facão*, distant approximately 40 NM from Piracicaba.

The aircraft was destroyed.

All occupants perished at the site of the accident.

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



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
APP	Approach Control
APP-YS	Pirassununga Approach Control
CA	Airworthiness Certificate
CCF	Physical Capacity Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CIV	Pilot's Flight Logbook
DE	Spatial Disorientation
FL	Flight Level
IAE	Aeronautics and Space Institute
IAM	Annual Maintenance Inspection
IFRA	Instrument Flight Rating - Airplane
IMC	Instrument Meteorological Conditions
INVA	Flight Instructor Rating - Airplane
METAR	Meteorological Aerodrome Report
MLTE	Airplane Multi Engine Land Rating
MNTE	Airplane Single Engine Land Rating
NM	Nautical Miles
NTSB	National Transportation Safety Board (USA)
PCM	Commercial Pilot – Airplane Category
PPR	Private Pilot – Airplane Category
PCH	Commercial Pilot – Helicopter Category
PRI	Private Aircraft Registration - Instruction Category
RADAR	Radio Detection and Ranging
RBAC	Brazilian Civil Aviation Regulation
RS	Safety Recommendation
SBSR	ICAO Location Designator – São José do Rio Preto Aerodrome - SP
SDPW	ICAO Location Designator - Piracicaba Aerodrome - SP
SERIPA IV	Fourth Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
TPP	Terminal Control Area
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	Model: PA-34-200 Registration: PT-IFS Manufacturer: Piper Aircraft	Operator: Piracicaba Aeroclub
Occurrence	Date/time: 17MAY2011 – 0132 UTC Location: Angeleli Farm – <i>Cruzeiro do Facão</i> Lat. 22°25'44"S Long. 047°53'11" Municipality – State: Piracicaba - SP	Type(s): [LOC-I] Loss of Control in Flight. Subtype(s): NIL

1.1 History of the flight.

The aircraft took off from the Piracicaba Aerodrome - SP (SDPW), to the São José do Rio Preto Aerodrome (SBSR), at 2300 (UTC), in order to perform an enroute night instruction flight with an instructor pilot (IN), a student pilot (ST) and two passengers on board.

The flight comprised the displacement to SBSR, where an instrument approach procedure would be performed, and then it would return to SDPW.

When returning to Piracicaba, during the descent, that had been already cleared by the Pirassununga Approach Control (APP-YS) to do the necessary coordination in the free frequency, the aircraft disappeared from the radar display. In the morning, after verifying that the aircraft had not returned, the Piracicaba Aeroclub activated the Air Search and Rescue System (SALVAERO).

That same day, at about 1630 (UTC), the Air Force aircraft engaged in the search found the wreckage.

The aircraft was destroyed.

All occupants perished at the site of the accident.

1.2 Injuries to persons.

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

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	
	Instructor	Student
Total	865:00	27:00
Total in the last 30 days	73:00	26:00
Total in the last 24 hours	06:00	00:00
In this type of aircraft	60:00	26:00

In this type in the last 30 days	36:00	26:00
In this type in the last 24 hours	06:00	00:00

N.B.: The Data related to the flown hours were obtained from the Piracicaba Aeroclub records.

1.5.2 Personnel training.

The instructor took the PPR course at the Piracicaba Aeroclub – SP, in 2008.

The student took the PPR course at the Piracicaba Aeroclub – SP.

1.5.3 Category of licenses and validity of certificates.

The instructor had the PCM License and had valid MLTE, INVA and IFRA Ratings.

The student had the PPR License and had valid MNTE Rating.

1.5.4 Qualification and flight experience.

The pilots were qualified and had experience to perform the flight.

1.5.5 Validity of medical certificate.

The pilots had valid Physical Capacity Certificate (CCF).

1.6 Aircraft information.

The aircraft, serial number 34-7250236, was manufactured by Piper Aircraft, in 1972 and was registered in the PRI category.

The aircraft had valid Airworthiness Certificate (CA).

The airframe, engines and propellers Logbook records were updated.

The last inspection of the aircraft, the “100 hours” type, was performed on 12MAY2011, by the *Baburich* Ltd, shop, in Americana – SP, having flown 59 hours and 42 minutes after the inspection.

1.7 Meteorological information.

Based on the Local Meteorological Aerodrome Report (METAR) of Campinas (SBKP) and Araraquara (SBAQ), distant, respectively, 34 NM and 63 NM from the impact site, the conditions were favorable for the visual flight.

These bulletins provided the following information:

METAR SBKP 170100Z 16013KT 9999 SCT025 SCT080 15/12 Q1019=

METAR SBAQ 170100Z 18006KT CAVOK 17/13=

1.8 Aids to navigation.

Nil.

1.9 Communications.

From the transcriptions of the communication audios between the PT-IFS and the ATC, it was verified that the crew kept radio contact with the Pirassununga Approach Control (APP-YS) and that there was no technical abnormality in the in-flight communication equipment.

As evidenced by the broadcasts highlighted by the Investigation Commission, there appeared to be no abnormality occurring at times believed to have preceded the collision. The following communications schedules are based on Universal Time Coordinated (UTC).

At 01h11min10sec, PT-IFS called the APP-YS and was instructed to maintain flight level FL075 (seven thousand five hundred feet) and inform when it was ready for descent.

At 01h17min31sec, PT-IFS requested APP-YS the descent to flight level FL055 (five thousand five hundred feet) and reported to be 52 NM away from Piracicaba, having received authorization from APP-YS.

At 01h26min39sec, PT-IFS informed APP-YS that it was in visual flight conditions and at the ideal descent point to land on Piracicaba Aerodrome.

At 01h26min45sec, APP-YS reported that the descent to traffic altitude was at the discretion of PT-IFS, allowing the aircraft to call on the free frequency of coordination between pilots.

At 01h26min59sec, PT-IFS acknowledged receipt of the message.

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 collided with *Serra do Facão*, which had a steep profile and hillsides of rocky terrain, covered by trees. The top of the elevation was 1,000 meters high. The impact occurred on the southern hillside, at 930 meters high.

The damage verified in the local vegetation allowed to estimate that the angle of the collision trajectory was of approximately 70° pitched down and that the inclination of the wings was of approximately 30°, curving to the right.

Both propellers presented deformation characteristics, compatible with a collision in soft terrain, in which the engines developed power. There were indications that the right engine propeller cut some tree trunks in the trajectory to the point of the last impact.

The wings were ripped off by the vegetation before the final collision against the ground.



Figure 1 - Place where the aircraft fell down.



Figure 2 - Condition in which the right engine and propeller were found.



Figure 3 - Aircraft trajectory.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

According to the necropsy report, no substances were found that could cause degradation of the pilots' performance. In the same way, there was no evidence that physiological or incapacitation aspects affected the performance of the crew.

Studies show that pilots may experience conflicts between the senses during nighttime curving or under instrument flight conditions (IMC). Such disagreements have been common in many cases of severe disorientation that have resulted in fatal air crashes.

Many crews crash while engaging in tasks that channel their attentions away from flight instruments. Others, even perceiving the disagreement between their bodily senses and the information of these instruments, cannot resolve the conflict, which often results in an aeronautical occurrence.

The limited experience of flight under IMC can greatly increase the possibility of disagreements between the bodily senses and the aircraft instruments.

The most common conflicts are:

- a) vestibular illusions;
- b) visual illusions; and
- c) somatosensory illusions.

The vestibular system, located in the inner ear, consists of two otolithic detectors and three semicircular canals.

The otolithic organs respond to gravitational forces and linear accelerations / decelerations, transmitting to the brain information about the position of the head.

Thus, since the body cannot distinguish the difference between the forces resulting from linear accelerations and gravity, the absence of adequate visual references can produce illusions.

The semicircular canals, one for each plane of the space, are filled by a liquid and endowed with sensors. The movement of this liquid within the channels informs the cerebral cortex, through the sensors, about the linear and angular accelerations to which the person is subjected.

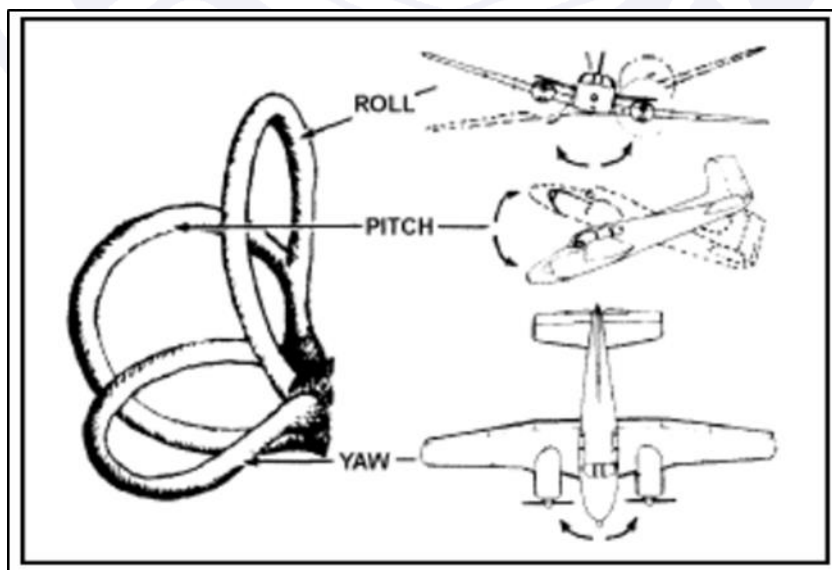


Figure 4 - Illustration of semicircular canals. (Available at: http://code7700.com/spatial_disorientation.htm. Accessed on August 2017).

Vestibular illusions occur due to lack of visual reference, when the vestibular stimuli coming from the semicircular canals and otolithic organs predominate.

Among vestibular illusions, there is one known as the Graveyard Spiral.

After a few seconds on a curve, intentional or not, where the sense of lateral movement is brought to equilibrium, loss of perception of the tilt of wings may occur.

In this case, the rider's feeling is that he is on a descent with level wings, which leads him to pull the stick to increase the pitch of the aircraft.

As a result of this intervention, a part of the lift is directed sideways, curving the radius of the curve and causing an increasing loss of altitude.

Thus, the applied corrections end up aggravating the downward spiral, causing a large angle of impact, with high speed.

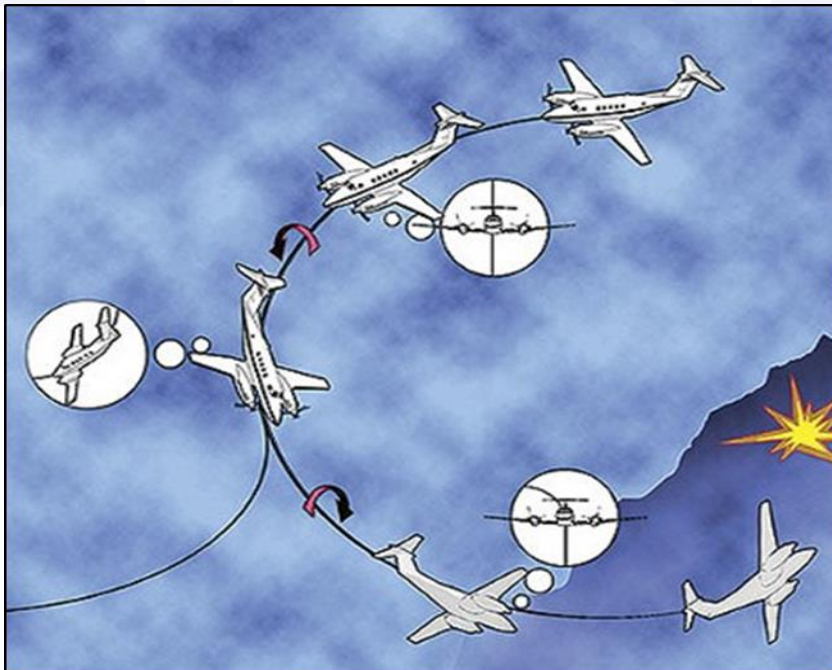


Figure 5 - Illustration of a Graveyard Spiral. (Available at: <https://www.m0a.com/illusions-in-flight/> Accessed August 2017.)

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The flight instructor had been in the Aeroclub for about two years.

The student was completing the training to obtain the Commercial Pilot License and lived in the Aeroclub's lodging.

The passengers were also students of the Aeroclub and had no function on board the aircraft.

1.14 Fire.

No signs of either inflight or post-impact fire.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

The tests performed on the engines by the IAE, in São José dos Campos - SP, showed that they presented similar damages. It was found that both were almost completely destroyed, evidencing that the collision occurred with high speed.

Due to the deformation that the fuel injector presented, it was not possible to assemble them in a test bench to verify performance. However, its partial disassembly revealed that the diaphragms were in good condition, and no evidence of fuel or air leakage was found.



Figure 6 - Front view of left engine.

During the analysis of the internal components of the two engines, no abnormalities were identified that could compromise their operation.

It was not possible to point out evidence of deficiency in lubrication, risks in the bearings, risks in the cylinders, detonation, pre-ignition or malfunction of the spark plugs.

1.17 Organizational and management information.

About the presence of passengers on board an instructional flight, conducted under the responsibility of the Aeroclub, the director of the school at the time of the accident, in a report broadcast by a television station on 19MAY2011, stated:

"We know that, according to ANAC, on the paper, this practice is wrong. The students usually fly with more people like this, even to train and get used to the heavier aircraft on the takeoff and landing. "

"It always happens (other people are on the flight).

"If they were people who had nothing to do with it and were just there to hang out, it's a situation. But this was not the case. The two who accompanied the instructor and the student were also students."

This testimony, reports of people and findings about the practices of Aeroclubs, Schools or Aviation Courses suggest that this was, in fact, a common practice, although contrary to the provisions contained in the Brazilian Civil Aviation Regulation (RBAC) nº 61.

1.18 Operational information.

The 36-year-old instructor had about 800 hours of flying time and taught at the Aeroclub for about two years.

The 30-year-old student had about 27 hours of flight time and was completing training to obtain the PCM License, the MLTE and the IFRA Ratings.

The two passengers were students of the Aeroclub and had no function on board the aircraft.

The route to be flown was known and practiced by the instructor.

According to reports, although it was an instruction flight, which only required the presence of the Instructor and the Student, both consented to the embarkation of the two other students.

According to the information gathered, in the previous fueling, the aircraft received 219 liters of fuel.

Considering the average consumption prevised in the flight manual for a 75% power adjustment, which would be 20.6 gallons per hour (gph) or 77.9 liters per hour (l/h), it was concluded that the aircraft was within the weight limit for landing at the time of the accident and had enough fuel to complete the proposed flight phase.

SENECA	
PERFORMANCE (cont)	
Range at best economy mixture (mph)	
75% power, 6,000 ft	804
65% power, 9,000 ft	885
55% power, 13,300 ft	969
Stalling Speed, gear and flaps down, power off (mph)	69
Stalling Speed, gear down and flaps up, power off (mph)	76
Fuel Consumption, 75% power, both engines (gph)	20.6
Fuel Consumption, 65% power, both engines (gph)	18.3
Landing Roll (flaps down) (ft)	705*
Landing Over 50 ft Barrier (flaps down) (ft)	1335*
* 4000 lb. G.W., Maximum Landing Weight	

Figure 8 - Aircraft performance chart.

According to data collected from ATC agencies, the aircraft made a go-around procedure in São José do Rio Preto at 00:32 (UTC), maintaining instrument flight rules, and ascended to flight level FL070, accelerating to the 140 KT speed.

After being cleared by APP-YS, during the descent from the altitude of 5,500 FT to 4,200 FT it initially kept the heading of Piracicaba and reduced the speed from 140 to 100 KT.

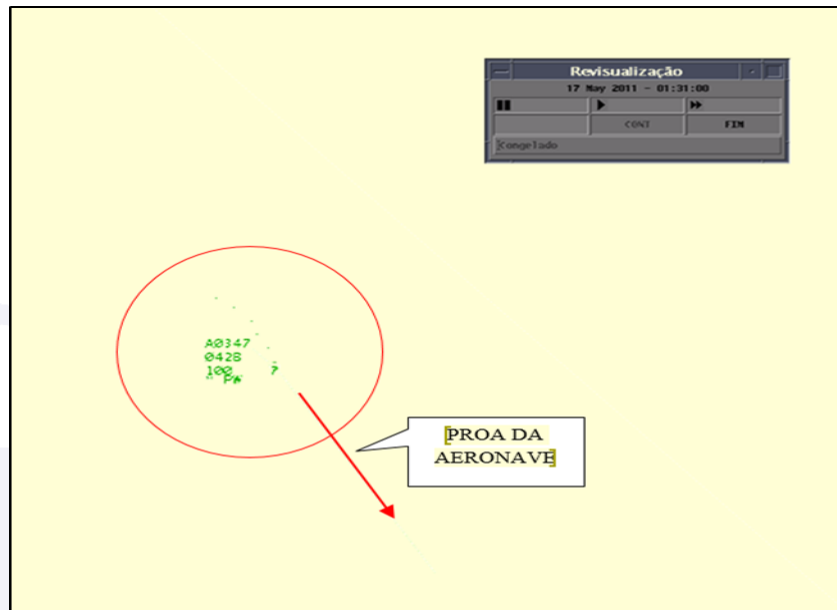


Figure 9 - Radar view 17MAY2011, 01:31:00 (UTC).

At 01h:31min:43sec (UTC), the aircraft started a right turn, accelerating to 174 KT.

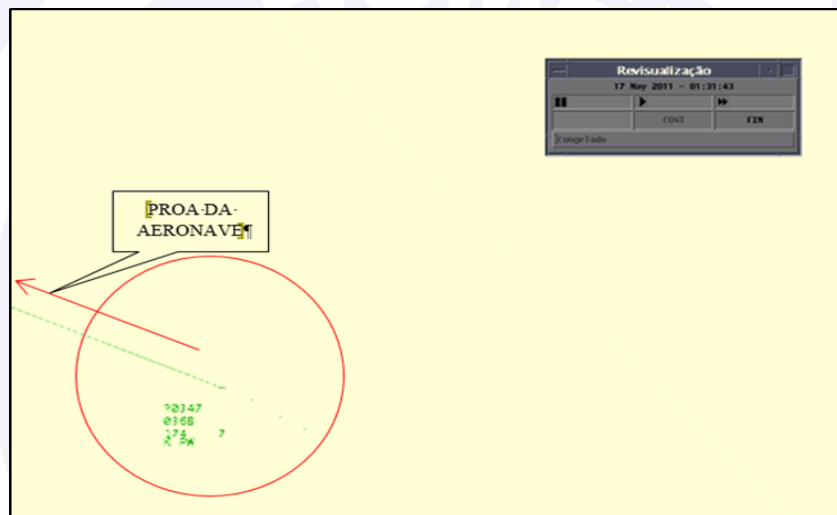


Figure 10 - Radar view 17MAY2011, 01:31:43 (UTC).

At 01h31min55sec, it continued the right turn, but had accelerated to 187 KT.

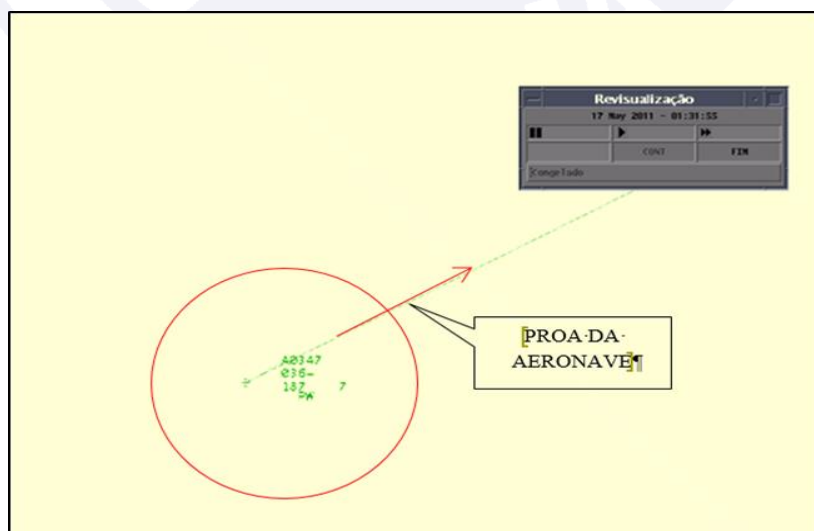


Figure 11 - Radar view 17MAY2011, 01:31:55 (UTC).

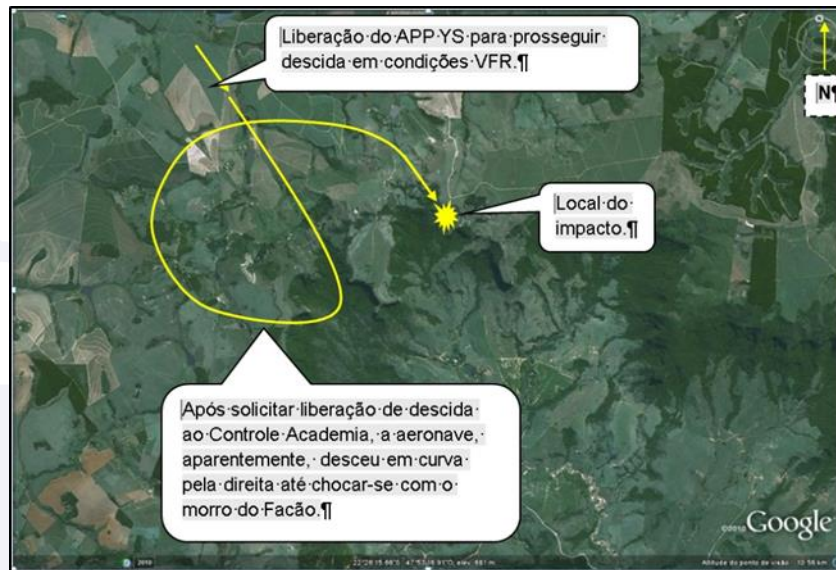


Figure 12 - Sketch of the occurrence.

It was not possible to determine the reason for the performance of this curve on the right, however, by the visualization presented by the radars, it was verified that it started with horizontal and vertical speeds compatible with a controlled curve.

After the first 90 degrees of curve, the gradual increase of the horizontal speed of the aircraft was verified, which accelerated until near the maximum structural speed in cruise prevised in flight manual.

E. AIRSPEED LIMITATIONS AND INDICATOR MARKINGS (Calibrated Airspeed)	
NEVER EXCEED SPEED	217 MPH
MAXIMUM STRUCTURAL CRUISING SPEED	190 MPH
DESIGN MANEUVERING SPEEDS	
Minimum Weight (2743 lbs.)	133 MPH
Maximum Weight (4200 lbs.)	146 MPH
MAXIMUM FLAPS EXTENDED SPEED	125 MPH
MAXIMUM GEAR EXTENDED SPEED	150 MPH
MAXIMUM GEAR RETRACT SPEED	125 MPH
MINIMUM CONTROL SPEED (Single Engine)	80 MPH

Figure 13 - Aircraft speed limits table.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was an instruction flight, with takeoff from Piracicaba, landing and performing go-around procedure in São José do Rio Preto and returning to Piracicaba.

Tests carried out in the wreckage revealed no evidence of mechanical failure, which led the investigators to rule out the possibility that factors related to aircraft systems contributed to the occurrence.

In particular, the checks conducted on the engines and propellers indicated that these components appeared to work properly at the time of the occurrence.

In the same way, the data collected in relation to the consumption of the aircraft, last fueling, duration of flight and meteorological conditions indicated that the planning of the instruction had no influence in the accident.

On the other hand, the data obtained from the radar visualization of the last minutes of the flight allowed to verify that, after the descent to land on Piracicaba, during a right turn, a significant and unexplained increase occurred in the speed of the aircraft.

The trajectory of the airplane from the moment it began the descent, performing a continuous curve, accelerating to a speed close to the structural maximum and colliding against the ground with high angle of impact, presented characteristics compatible with those of a Graveyard Spiral.

Thus, it is possible that the performance of a prolonged curve and the acceleration involved have interfered in the sensorial impressions of the pilot, making it difficult to apprehend the position of the aircraft in relation to the space.

Therefore, it could be assumed that a spatial disorientation led to the inadvertent conduction of the aircraft to an attitude that resulted in the loss of control and subsequent collision against the ground. Regarding the presence of passengers on board, it was not possible to determine the impact of this situation on the conduct of the instruction and the level of situational alert of the crew.

However, the belief, shared by members of the working group, that the presence on board of persons not directly involved in the instruction was normal and would not affect the quality of the flight, characterized a fragility in the culture of that group.

Likewise, the approval of the direction of the institution in charge of managing and supervising the instruction regarding the embarkation of passengers in the instructional aircraft suggested that there were vulnerabilities that could compromise flight safety, also in the organizational culture.

3. CONCLUSIONS.

3.1 Facts.

- a) the pilots had valid Physical Capacity Certificate (CCF);
- b) the pilots had valid Licenses;
- c) the pilots were qualified to perform the flight;
- d) the instructor was experienced in that kind of flight;
- e) the aircraft had valid Airworthiness Certificate (CA);
- f) the aircraft was within the weight and balance specified by the manufacturer;
- g) the airframe, engines and propellers logbook records were updated;
- h) the weather conditions were favorable for the visual flight;
- i) until the moment of the last communication of the aircraft with the ATC, no abnormality was verified on the flight;
- j) after starting the descent to land on Piracicaba, the aircraft entered a right turn;
- k) during this curve, there was a significant increase in velocity, which came close to the structural maximum;
- l) the aircraft collided with the ground with a high descent angle;
- m) the aircraft was destroyed; and
- n) all occupants perished at the site of the accident.

3.2 Contributing factors.

- Handling of aircraft flight controls – undetermined.

It is possible that improper performance on flight commands, motivated by spatial disorientation, has led the aircraft to an attitude that resulted in the loss of its control and subsequent collision against the ground.

- Disorientation – undetermined.

The transition from instrument flight to night visual flight, coupled with extended curve performance may have led the instructor and student to suffer the consequences of the phenomenon identified as spatial disorientation.

It is possible that this disorientation led to the inadvertent conduction of the aircraft to an attitude that resulted in the loss of control and subsequent collision against the ground.

- Perception - undetermined.

The trajectory of the aircraft, after the start of the descent, together with the acceleration and visual night flight, may have contributed to the loss of the pilot's perception of the position of the equipment in relation to the space, culminating in its subsequent collision against the ground.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 “Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State”.

Recommendations issued at the publication of this report:

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

A-548/CENIPA/2017 - 01

Issued on 09/04/2018

Evaluate the pertinence of updating the Manual of the Commercial Pilot Course - Airplane, in order to adapt it to the current reality of the Brazilian Civil Aviation and also to insert in its Curricular Plan disciplines related to human physiology and the effects of the flight conditions on the crew.

A-548/CENIPA/2017 - 02

Issued on 09/04/2018

Act with the Piracicaba Aeroclub, in order to alert the operator about the risks arising from the presence of passengers on instructional flights and to implant a change in the culture of the group that operates in that organization, with the objective of raising the collective perception about the importance of the faithful compliance with the rules established by the regulatory bodies of the Civil Aviation System.

A-548/CENIPA/2017 - 03

Issued on 09/04/2018

Disseminate the lessons learned in the present investigation, in order to alert Brazilian civil aviation pilots and operators to the risk of the occurrence of Spatial Disorientation (whether or not followed by a Graveyard Spiral) on night flights.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On September 4th, 2018.

