

COMMAND OF AERONAUTICS
AERONAUTICAL ACCIDENT INVESTIGATION AND
PREVENTION CENTER



FINAL REPORT
A - Nº 006/CENIPA/2010

OCCURRENCE

ACCIDENT

AIRCRAFT

PR-FBA

MODEL

PA-25-235

DATE

11 JAN 2008



NOTICE

The elaboration of this Final Report is in conformity with the item 3.1 of the Annex 13 to the Convention on the International Civil Aviation, known as the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree n ° 21713, dated 27 August 1946.

This technical report reflects the result of the SIPAER investigation conducted for the identification of the circumstances that contributed or may have contributed to trigger this occurrence. According to the Law n° 7565, dated 19 December 1986, Article 86, it is the competence of the Aeronautical Accident Investigation and Prevention System – SIPAER – to plan, guide, coordinate, control and perform the activities of investigation and prevention of aeronautical accidents.

The sole objective of this work is to recommend the study and the establishment of preventative provisions, named Safety Recommendations, the compliance with which is responsibility of the person in the highest hierarchical position of the organization to which they apply.

However, this work does not focus on quantifying the degree of contribution of the contributing factors and variables that conditioned the human performance, be they individual, psychosocial, or organizational ones, whose interaction composed the scenario favorable to the occurrence.

This investigation, which took into account the contributing factors and the hypotheses, did not consider any proof production procedure for the determination of civil or criminal liability. Therefore, the use of this report for any purpose other than that of preventing aeronautical accidents may lead to mistaken interpretations and conclusions.

In order to protect the persons who provided information in the course of the SIPAER investigation, it is worth highlighting that the use of this report for punitive purposes against the collaborators maculates the principle of non-self-incrimination” derived from the “right to remain silent” sheltered by the Federal Constitution.

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SINOPSE

This Final Report refers to the aeronautical accident involving the aircraft PR-FBA, model PA – 25 – 235, on 11 January 2008, which was tipified as in-flight loss of control.

The aircraft departed for a crop dusting flight. On the first reverse turn for the pass, it lost lift, entered a spin and collided with the ground.

The pilot sustained serious injuries and the aircraft was partially destroyed.

GLOSSARY OF TECHNICAL TERMS

AEHC	Carburetant Hydrous-Ethyl Alcohol (Ethanol fuel)
ANAC	National Civil Aviation Agency
APA	Aeronautical Propulsion Division
AVGAS	Aviation Gasoline
CA	Airworthiness Certificate
CCF	Physical Capability Certificate (Medical Certificate)
CENIPA	Aeronautical Accident Investigation and Prevention Center
CHT	Technical Homologation Certificate
CONAC	National Civil Aviation Council
CPAА	Aeronautical Accident Prevention Commission
CTA	General Command of Airspace Technology
DAC	Civil Aviation Department
DIPAA	Division of Investigation and Research of Aeronautical Accidents
DNA	<i>Dirección Nacional de Aeronavigabilidad</i> (Argentine Republic)
ELT	Emergency Locator Transmitter
EMA	Empresa Matogrossense de Aviação (Aircraft Company from Mato Grosso)
FAA	<i>Federal Aviation Administration</i>
FAB	Brazilian Air Force
FIAM	Annual Maintenance Inspection Sheet
FIEV	Flight Equipment Instruments Sheet
FL	<i>Flight Level</i>
IAE	Institute of Aeronautics and Space
IAM	Annual Maintenance Inspection
LAVIASA	Lavia Argentina S.A. (Argentinian agricultural aircraft manufacturer)
METAR	<i>Aviation routine weather report</i>
MG	<i>Minas Gerais State</i>
mph	Miles per hour
MT	<i>Mato Grosso State</i>
RAB	Brazilian Aeronautical Registry
RBHA	Brazilian Aeronautical Homologation Regulation
SAE	Specialized Air Service
SBVC	Varginha Aerodrome (Varginha City-MG)
SIAC	Civil Aviation Computerized System
SINDAG	National Agricultural Aviation Companies Union
SNVI	Mello Viana Aerodrome (Três Corações City -MG)

AIRCRAFT	Model: PA – 25 - 235 Registration: PR - FBA	Operator: Aero Verde Aviação Agrícola Ltda.
OCCURRENCE	Date/time: 11 Jan 2008 11:30 UTC Location: <i>Canário Farm</i> Coordinates: 21°30'76" S / 45° 56'30"W County, State: São Bento do Abade, MG	Type: Inflight Loss of Control

1. FACTUAL INFORMATION

1.1 History of the occurrence

At 0930 local time, the aircraft departed from Mello Viana (SNVI), city of Três Corações, State of Minas Gerais, destined to the Canário Farm, in the county of São Bento do Abade, in order to spray a cornfield and later return to the aerodrome of origin.

Upon arriving at the foreseen location, the pilot did a reconnaissance pass and proceeded for the first spraying round.

After the pass, the aircraft started a positioning for a reverse turn (baloon), moving about 200m, maintaining a flight parallel to the ground (which had a slope of approximately 20 degrees). During the maneuver, the pilot informed having perceived a loss of power and a speed reduction to about 75 mph, and then jettisoned the load of chemical products.

Next, the pilot began a balloon over the terrain whose slope was more accentuated (approximately 30 degrees). This caused the pilot to increase the pitch up angle, in order to obtain separation with the ground, but the speed was further reduced.

During the turn, the aircraft entered a spin. After making a roll of approximately 210 degrees, the aircraft hit the ground, the right wing first, and then the nose and the left wing.

The aircraft was partially destroyed, while the pilot sustained serious injuries on the throat, face, nape and left leg.

1.2 Injuries to persons

Injuries	Crew	Passengers	Third parties
Fatal	-	-	-
Serious	01	-	-
Minor	-	-	-
Unhurt	-	-	-

1.3 Damages to the aircraft

The aircraft was partially destroyed. Both wings, the landing gear, the engine, and the cockpit were damaged. The fuel tank, the spraying equipment and the propeller were destroyed.

1.4 Other damages

Nil.

1.5 Information on the persons involved

1.5.1 Information on the flight crew

Flight hours		
	PILOT	COPILOT
Total	4,150	-
Total in the last 30 days	35	-
Total in the last 24 hours	05	-
In this type of aircraft	150	-
In this type in the last 30 days	15	-
In this type in the last 24 hours	05	-

1.5.1.1 Professional formation

The pilot earned his license at the Aeroclube of Jaciara – MT, in 1998.

1.5.1.2 Validity and category of the licenses and certificates

The pilot held a private pilot license and his qualifications for terrestrial single-engine and agricultural pilot were valid. His IFR operation rating validity had expired.

1.5.1.3 Qualification and experience for the flight type

The pilot was qualified and experienced for the conduction of the flight type. He stated to possess nine hundred flight hours in the agricultural aviation, one hundred and fifty hours in the *Pawnee* airplane and one thousand, five hundred hours in the Ipanema airplane.

1.5.1.4 Validity of the medical certificate

The pilot held a valid Medical Certificate.

1.5.2 Operational aspects

The pilot reported that on the day before he had started work early in the morning (0600 local time) in the area of the accident. He informed not having any problems or difficulties doing the task. He stopped working at the very beginning because the agrochemical product had finished.

On the day of the accident, the pilot returned to the location to resume working a little later (09:00), because in the beginning of the day the conditions were not appropriate.

He also informed that on the day before he would normally inspect the place of work to evaluate the conditions of the area. However, he stressed that in this case he did not go to the area in advance, because he had already overflown it the day before, and did not see any difficulty for the operation.

The pilot said that he observed the weather conditions (winds) and the most appropriate time for the spraying (aspects inherent to the aeroagricultural activity) before starting the flight.

The area where the spraying was carried out was flat, but the overflight on the reverse turn (balloon) was between hills, at an altitude of 4,900 feet with an acclivity of approximately 30 degrees.

The pilot did not have precise information about performance of the engine and aircraft at the altitude of the flight.

The pilot did not have a chart, map or photography of the area so that he could plan the spraying.

After finishing the shot (product application), the pilot started the maneuver for a second pass. With a speed of about 100mph, he flew 200 meters over a terrain with an acclivity of 20 degrees, maintaining the height. Then he perceived a reduction of the engine power along with a reduction of the speed up to 75mph and, immediately, jettisoned the load.

Since the terrain in front of him was an elevation with an inclination of 30 degrees, the pilot noticed that he was about to collide with the ground and, on account of that, he tried to make a turn to the right in an attempt to regain speed, using the inclination of the terrain to his advantage. He informed to have found difficulty, due to the type of propeller utilized (fixed pitch).

At that moment, the airplane entered a pre-stall and, as it was in the turn at low speed, it entered a spin and, after completing 210° of turn, collided with the ground.

The pilot did not apply engine power to recover from the stall, judging that he would exceed the maximum rotation of the propeller.

According to information provided by the pilot, at the end of the spraying operation the propeller was at its maximum rotation (2500RPM), and the engine power was at about 75%.

He mentioned the fact that the propeller utilized was inappropriate for the region, which was much higher from a geographical perspective than those where the airplane used to operate, and where he was accustomed to do his flying.

The pilot had little experience in this model of aircraft, which was equipped with a fixed pitch propeller.

The Flight Manual of the *Pawnee* PA-25 airplane did not show either data concerning the stall speeds, or operation restrictions in regions of relief.

An aspect raised from the company personnel interviewed related to the fact that before they started the flights in the region, they observed that it was higher than those over which they operated more frequently. Thus, they were careful not to fly with the maximum load the aircraft could carry. They decided to fly with approximately 300 liters of pesticide, whereas the total capacity was 550 liters.

1.6 Information on the aircraft

The PA-25-235 model, single engine aircraft, serial number 25-7656074, was manufactured by the *Piper Aircraft* in 1976.

It had a RAB registration in the Specialized Air Service category, since January 2005. The aircraft possessed the Registration Certificate nº 16330 and an Airworthiness Certificate, both of them in normal situation before the SIAC, valid up to September 24, 2009.

The airplane was equipped with an IO-540-B2-C5 model reciprocating engine made by Avco Lycoming and a fixed pitch 1A200/FA8452 model propeller, manufactured by

McCauley Propeller Systems.

The IAM was made by the *Empresa Matogrossense de Aviação Ltda*, and was valid up to November 23, 2008.

The cell, engine and propeller books were up-to-date, but the log book was not.

The aircraft was with 1050 Kg, within its limits of weight and center of gravity.

During the Initial Action, it was verified that the engine had undergone a non-homologated conversion to alcohol use. The aircraft was modified, and neither the pilot nor the owners had performance information concerning the converted engine. There are no modifications officially approved in Brazil concerning the conversion of the PA-25 engine to the use of AEHC.

In the conversion of the engine for the utilization of the hydrated ethanol fuel (AEHC), the carburetor was replaced with a modified fuel injection unit, without approval, to allow a higher flow of fuel.

1.7 Meteorological information

There was no meteorological information available to the pilot in SNVI.

The METAR of Varginha - MG (SBVG) aerodrome, which is about 20 miles from SNVI, indicated visibility more than 10 km, a ceiling of 2,000 feet, temperature 24°C and a wind of 5 knots, coming from the north.

According to a witness that was in the site of the accident, the wind varied from light to moderate, and was coming from the left side of the aircraft.

1.8 Navigational aids

Nil.

1.9 Communications

Nil.

1.10 Information on the aerodrome.

The accident occurred outside the aerodrome area.

1.11 Flight recorders

Not required and not installed.

1.12 Information on the impact and wreckage

The aircraft hit the ground with the right wing first, and then the nose and the left wing. Its approximate attitude at the moment of impact was 90 degrees in relation to the ground.

The right wing was severely damaged, with one third of it (toward the wing tip) presenting a torsion of 180° (leading edge backwards).

After the third impact (left wing), the aircraft jumped backwards, in a clockwise spiral, ending the movement with the landing gear touching the ground in a normal position, aligned with the same direction of the spraying pass, with the engine hanging downwards, at a 90° angle with the fuselage.



Photo 01: area of the impact.



Photo 02: wing tip twisted due to the rotational impact derived from the spin.

1.13 Medical and psychological information

1.13.1 Medical aspects

The pilot reported that he would normally wake up at 04.30 a.m. and start flying at 06.00 a.m. He would fly up to 10.00 a.m., at the most. Then he was set free to rest or to plan the flight for the following day. He also said that he used to go to bed early.

The pilot reported that during the flight he did not visualize the gradual slope of the terrain, and that such fact altered his senses, since he did not perceive the attitude and the inclination he applied to the aircraft.

1.13.2 Ergonomic information

Nil.

1.13.3 Psychological aspects

1.13.3.1 Individual information

The pilot reported that he had a feeling of accomplishment with his current activity.

On account of an indication made by the sellers of the aircraft in Mato Grosso, he had been hired by the owners of the aircraft, and at the end of 2007 he moved to the State of Espírito Santo.

He informed that this move brought improvement to the quality of his life, on account of a better climate which diminished the problems affecting the health of his children, besides bringing more peace to his marriage.

1.13.3.2 Psychosocial information

The pilot said that he had no problems with his bosses, not even in what referred to pressures for the performance of the tasks.

In the opinion of both the pilot and the boss, the work relations as well as the interpersonal relationship were harmonical, in general terms.

In relation to safety in the performance of the activity, the pilot reported that he was very much concerned with this aspect, and had the habit of accompanying the maintenance procedures issued by the flight safety organizations, since it made him feel safer. He also said that he read the reports issued by the flight safety organizations in order to get acquainted with the norms, procedures and recommendations.

1.13.3.3 Organizational information

The *Aero Verde Aviação Agrícola Ltda.* company, as well as other companies of the agricultural aviation have resorted to non-approved modifications for the utilization of ethanol, with the purpose of reducing operational costs.

The owner of the PR-FBA airplane informed that due to the high price of the AVGAS, the operators of aircraft models that were not homologated for the utilization of the AEHC underwent an unfair competition and ended up resorting to non-approved modifications.

1.14 Information on fire

There was no fire.

1.15 Information on the survival and/or evacuation from the aircraft

Local witnesses made provisions for the removal of the pilot from the wreckage, for fear of an explosion or fire.

It was necessary to remove the metal sheet from right side of the cockpit in order to remove the pilot, since the seat had got loose from the floor and the pilot was lying down on the floor, with the back of the seat on the horizontal position.

Through the opening resulting from the removal of the aforementioned metal sheet it was possible to drag the pilot along the floor, trying not to raise him as it would be the necessary if one wanted to take him out through the cockpit windows.

The firefighting brigade rescue team of the nearest town (São Bento do Abade – MG) was summoned, arriving at the site approximately two hours after the accident. They gave the pilot the first aid and took him to the São Francisco de Assis hospital, in Três Corações - MG.

The pilot was wearing his flight suit, helmet and abdominal seat belt, but not the harness.

The pilot sustained a head trauma, cuts and hematomas on the face, a cut on the nape, hematomas on the left side of the neck and a fracture of the left fíbula.

The serious injury sustained by the pilot endangered his life, and it was necessary to make a tracheal intubation and to intern him in an intensive care unit (ICU). He was unable to perform his habitual activities due to the fracture of the left fíbula, a restriction that lasted for about 40 days.

1.16 Exams, tests and researches

The engine, propeller, and the fuel collected from the aircraft were forwarded to the Division of Aeronautical Propulsion (APA) of the Aeronautics and Space Institute (IAE) of the General-Command of Airspace Technology in order to be analyzed.

According to the Technical Report, during the external inspection of the engine, evidence was found that the engine was functioning at low rotation at the collision with the ground. This was confirmed through transversal marks on one of the propeller blades. It was also observed that the engine was not developing power, since the marks were observed on only one of the blades, and just one of the blades was bent backwards (indicating the low power of the engine).

A non-homologated conversion of the engine for the use of ethanol was observed.

Although the bench test did not reveal any significant restriction regarding the flow of fuel, it was not possible to confirm the normal operation of the fuel system during the in-flight functioning of the engine, due to the irregular conversion made.

The following items had been installed in the engine:

- a non-aeronautical fuel filter (diesel car engine), without indication on the engine head;
- hose without identification plate;
- electric conduit utilized in the civil construction;

In face of the large number of irregularities the investigating commission interrupted the exams in the power plant.

1.17 Organizational and management information

The Aero Verde Aviação Agrícola Ltda. had only one aircraft. It was a small company, with only two partners involved in the management and ground support tasks to the aircraft, and one pilot.

The managers were people with little experience in the agricultural aviation activity, besides being considered rather young.

The partner in charge of the management informed that they had an interchange with another agricultural aviation company from São Paulo, through which they obtained a lot of flight safety-related documents.

The maintenance services of the airplane were done by a mechanic recommended by the aforementioned company, together with another professional who resided in Vitória.

The area in which the accident occurred was a much higher and more irregular terrain when compared with other areas of the Três Corações – MG region (about 1,900 feet higher), and the company had been working there for about a week.

All the operating decisions were responsibility of the pilot.

1.18 Additional information

I. The Agricultural Aviation Pilot Course Manual – Airplane (MCA 58-17) does not list (as far as its didactical content is concerned) the procedures for recovery from pré-stall and from stall during the reverse turn.

II. Stall

An aircraft in flight requires a minimum speed for the maintenance of lift and control. Such critical speed, below which the control of the aircraft is lost, is called stall speed and depends on other factors, such as, weight, load factor and altitude.

A stall occurs when the air flow over the wings is discontinued and the lift is quickly lost. This happens when the wing exceeds its critical angle of attack. It may happen at any speed, flight attitude, or engine power.

A pilot must recognize the flight conditions favorable to a stall and know how to apply the pertinent corrective action. He must learn to recognize a pré-stall through his or her sight, hearing and senses:

- a) Sight is used for the detection of a pre-stall, by verifying the attitude of the aircraft.
- b) The sense of hearing is also useful in the perception of a pre-stall. In the case of a fixed pitch propeller, it is possible to perceive a change in the sound made by the propeller, due to the reduction of the engine rotation. The change of the sound of the air flowing along the aircraft, as the speed decreases, is also perceivable.
- c) The sensation of change in the direction or speed is probably the best indicator for the experienced pilot.
- d) The ability to feel also helps in the perception of the pressure to be exerted on the flight controls. When the speed falls, more actuation on the controls is needed.

During the stall training, the objective is to learn how to recognize the impending stall and take a corrective action right away.

Three actions must be taken in a coordinated fashion for recovery from a stall:

- a) At the first sign of a stall, one has to positively and immediately diminish the angle of attack, but only to the extent necessary to assure a gain of lift;
- b) The maximum available power has to be applied, in order to increase the aircraft speed, as an aid for the reduction of the angle of attack; the maximum power applied at the moment of the stall, will not generally cause overspeed in a fixed pitch propeller, due to the high load imposed on the propeller at low speeds; and
- c) The direction and level of the flight have to be resumed through the coordinated use of the flight controls.

The accidents with stall, in general, result from an inadvertent entry in a stall condition, at low altitude, when recovery is not possible before the aircraft hits the ground.

III. Comparison to the EMB 200 – Ipanema aircraft

Due to the lack of data concerning the performance of the accident aircraft, it will be compared with the EMB-200. In the EMB-200 Ipanema aircraft, with its maximum weight of 1,550 Kgf, flaps retracted, without power and at an altitude of 6,000 feet, the stall speed with a zero-degree wing angle (level) is 70mph, and with a 45-degree angle of banking, the stall speed is 83 mph.

IV. Engine conversion

The item 1.1.6 of the CONAC Resolution nº 11, dated 20 July 2007 fostered the utilization of alternative fuels in aircraft, in the training of human resources, as a measure to lower costs, as well as the prioritization in the certification of aeronautical products that use those sources of energy for agricultural and instructional purposes.

In accordance to the SINDAG Report of activities relative to 2008, there is a fleet of about 1,300 agricultural aircraft in Brazil, 200 of which are officially approved to use the AEHC, i.e., approximately 15% of the total, considering the aircraft sold (EMB-202A model) and converted by means of “Kits” homologated by the NEIVA.

However, the same report highlights that “in fact, it is estimated that the number of aircraft powered by hydrated ethanol is much larger than the figures afore mentioned, due to the many cases of irregular conversions.”

On December 2, 2008, the Airworthiness Superintendence of the ANAC forwarded the message Nº 0889/2008-GGCP/SAR to the SINDAG, requesting that a survey be made of the number of aircraft, grouped in accordance with models, engines and propellers so that priority could be given to a solution for the regularization of the aircraft converted without the pertinent approval.

V. Type Certification and Flight Manual

The PA-25 aircraft had been originally certified by the Federal Aviation Administration (FAA) in 1959, when the certification requisites required a Flight Manual, although it did not detail the limits of the flight maneuvers.

The PA-25 model does not need to hold the Brazilian Type Homologation Certificate, according to the RBHA 21.29 (d), because there were already aircraft registered in Brazil in

1986, when the Brazilian Code of Aeronautics became effective, requiring a Brazilian Homologation Type Certificate.

In 1999, LAVIASA became the holder of the project, and the DNA from Argentina became the authority responsible for the continuing airworthiness.

1.19 Utilization or effectivation of other investigation techniques

Nil.

2. ANALYSIS

When the planning of the flight was checked, it was possible to see that the altitude of the field and the real topographic characteristics of the terrain (between hills) were not considered. On the other hand, the aircraft manual did not have performance data to support a detailed planning.

The speed reduction during the pass for the application of the pesticide resulted to some extent from the fact that the flight was in the direction of the acclivity. However, the Investigating Commission, based on the testimony of the pilot, as well as on the marks left on the propeller (indicating a collision with the ground at low rotation), sought to evaluate the operating conditions of the engine.

However, as explained in the Technical Report of the CTA, it was not possible to determine whether there was a malfunctioning of the engine, on account of the non-homologated conversion of the engine for the use of ethanol, besides other irregularities that were found.

The flight manual of the *Pawnee* airplane did not contain any item of information about the stall speeds in the various flight configurations and attitudes.

After the first pass of the aircraft, with a speed of about 100 mph, a run for a reverse turn was initiated, and the aircraft moved for 200 meters over the ground with an acclivity of 20 degrees. Maintaining the height over the ground, the aircraft began to lose speed down to approximately 75 mph, while the terrain ahead showed an inclination of 30 degrees.

Even with the perception of keeping the height above the ground, the aircraft was really climbing, on account of the acclivity of the terrain, and this explains why the speed decreased. According to information provided by the pilot, at that moment the acclivity of the terrain altered his perception of attitude and banking of the aircraft, due to the false horizon that was created, a fact that favored his entering a spin.

During the reverse turn, at low speed, the aircraft entered a pre-stall. It is evident that the aircraft had a further reduction of speed during the climb for the beginning of the reversion. As the stall speed relative to the angle of bank in this aircraft is not known, it may be inferred that the airplane, while turning, may have lost aeronautical efficiency, entering a stall.

Despite the lack of information about the stall speeds of the PA-25, but considering the data of the EMB-200, on account of their similarity, it is verified that the aircraft speed was very close to a stall and, probably, the pre-stall alert was activated, but the load jettisoning did not have the effectivity expected by the pilot.

The pilot did not apply engine power to recover from the pre-stall, judging that the rotation limit of the propeller could be exceeded. However, with a fixed-pitch propeller and with speed reduction, the RPM at the moment of the pre-stall, would be below the maximum rotation, due to the increase of the aerodynamic load on the propeller blades.

Parallely, the very Agricultural Pilot Course Manual – Airplane (MCA 58-17) did not have in its didactical content any reference to pre-stall and stall recovery procedures during the reverse turn.

The weather conditions may have influenced the conduction of the flight, since the wind was blowing from the left and probably with turbulence, changing to a tailwind, generating a tendency of a larger radius of turn, making the pilot increase the angle of banking of the aircraft, something which contributed to the occurrence of a stall. However, it was not possible to determine whether the conditions described in the Varginha METAR were present at the moment of the accident and whether the wind was a contributing factor to the accident.

In relation to the medical aspect, there is evidence that the pilot did not have an adequate sensorial impression, when he did not perceive the gradual acclivity that existed in the terrain.

There was a certain complacency on the part of the pilot, when he did not consider certain specific aspects of the terrain (lack of an adequate study of the site of operation), in addition to tolerating the non-utilization of the harness, impeding the adoption of procedures and additional safety measures to prevent the accident or reduce the injuries.

The interpersonal relations climate in the Aero Verde Aviação Agrícola Ltda. was characterized by the recent start of its activities, with the leadership of persons with little experience in the field of agricultural aviation. This may have favored the lack of a comprehensive evaluation of the risks involving the operation in that region, not considering the geographical peculiarities and the limits of the very aircraft.

Besides, it seems that the pilot, noticeably motivated to perform the activity, (airplane flying in general, and the work he had recently started in the company), did not manage to analyze the situation in due time so that he could prevent the proportions of the accident. However, it must be mentioned that the loss of situational awareness, if any, was relative, since the pilot still tried to perform the procedures prescribed to prevent the accident, by jettisoning the load, for instance.

The pilot was not fully trained and qualified to identify all the elements involved in that type of operation, something which would allow him to take additional preventative measures concerning the situation that generated the stall, as well as provide an effective recovery when the aircraft showed the first signs of a pre-stall. In addition, he did not have accurate information about the aircraft propeller performance.

The owner of the PR-FBA modified his PA-25 airplane in an irregular manner, since there are not approved modifications in Brazil concerning the conversion of the PA-25 engine for the use of ethanol (AEHC).

The aircraft was not being maintained within the standards set by the ANAC, due to the application of a non-approved modification of the fuel system for the utilization of hydrated ethanol.

The injuries were minimized because the pilot was wearing his helmet, but the physical damage could have been reduced even further, should he have worn the harness.

The company had been working for a week in the region of Três Corações – MG, without previous experience in that altitude and type of topography. Even so, there was not perception of the additional risks involving the operation in that specific area, be it on the part of the pilot, be it on the part of the company managers.

3. CONCLUSIONS

3.1 Facts

- a) The pilot held a valid Technical Qualification Certificate and a valid Medical Certificate (CCF);
- b) The pilot declared to possess nine hundred flight hours in the agricultural aviation, a hundred and fifty hours in the Pawnee airplane, and a thousand-five-hundred hours in the Ipanema airplane;
- c) The airplane had a valid Airworthiness Certificate;
- d) The Flight Manual of the airplane did not have information about maneuver limits and stall speeds in different configurations, weights, altitudes and bankings;
- e) The maintenance services were considered periodical and inadequate, since the engine of the airplane had been irregularly converted for the use of ethanol;
- f) The owners of the company were little experienced in the aeronautical activity;
- g) In the company, there was a good relationship and mutual confidence between the pilot and the owners;
- h) The owners of the company delegated the operational decision making to the pilot;
- i) The area where the accident occurred was a much higher and more irregular terrain than the other areas of the Três Corações – MG region (about 1,900 feet higher), in which the company had been working for a week;
- j) The planning of the flight did not consider the topographical conditions of the terrain, which lay between hills;
- k) After the first spraying pass, in the direction of the activity, the pilot noticed the reduction of speed to 75mph, and then jettisoned the load of chemical products;
- l) During the reverse turn, the airplane entered a pre-stall, and then a spin;
- m) The pilot did not apply the procedures to recover from the stall;
- n) The pilot was not wearing the harness at the moment of the accident;
- o) The airplane collided with the ground and resulted partially destroyed; and
- p) The pilot was severely injured.

3.2 Contributing factors

3.2.1 Human Factor

3.2.1.1 Medical Aspect

- a) Visual Illusions – A contributor.

According to information provided by the pilot, the acclivity of the terrain gave him a picture of false horizon visual illusion, as he did not perceive the attitude and real banking of the aircraft.

3.2.1.2 Psychological Aspect

a) Perception error – a contributor.

The company did not notice that the characteristics of the area of operation (altitude and presence of hills) required a detailed flight planning. Such fact caused a partial loss of situational awareness which, once associated with the decision-making process, raised the probability of accident occurrence.

3.2.1.3 Operational Aspect

a) Training – a contributor.

The pilot did not have enough knowledge to evaluate all the aspects involved in the air operation in the area where the accident occurred. Besides, he lacked the necessary knowledge to effectively recover from the stall condition.

b) Judgment – a contributor.

Although being qualified for that operation, the pilot failed to consider all the factors involved in the area where the accident occurred, on account of the inadequate evaluation of all the pertinent aspects, such as altitude and terrain topography. Thus, the pilot judged that he could make the reverse turn (“balloon”), beginning the maneuver with a speed showing a tendency to decrease below 75mph, without increasing the engine power.

c) Planning – a contributor.

The inadequate preparation of the flight is demonstrated by the incomplete evaluation of the spraying area, located between hills and at an altitude of 4,900 feet, and of the area utilized to return to the plantation area, since it had an acclivity of approximately 30 degrees.

d) Maintenance – undetermined.

Due to the non-homologated engine conversion for the use of ethanol, in addition to other irregularities that were found in the engine, it was not possible to determine whether the engine as a contributing factor to the accident.

e) Meteorology – undetermined.

On account of the wind direction verified in the Varginha (SBVG) METAR, although it was a light wind, the aircraft could have entered a turbulent area in the lee side, contributing to the degradation of its aerodynamic performance, during the pre-stall situation. However, it was not possible to determine whether the conditions described in the METAR were present at the time of the accident and whether the wind was a contributing factor to the accident.

3.2.2 Material Factor

a) Design – a contributor.

In the *Pawnee* PA-25 Aircraft Manual, known as the “Owner’s Handbook” of the *Piper Aircraft*, there is no information about the stall speed relative to the angle of bank, varying with the weight of the aircraft, the temperature and flight altitude. These data would be essential for an adequate flight planning.

4. SAFETY RECOMMENDATION

It is defined as the establishment of an action which the Aeronautical Authority or the SIPAER-Link issues to their area of actuation, aiming at eliminating or mitigating the risk of a latent condition or consequence of an active failure. From the perspective of the SIPAER, it is essential for the operational safety, refers to a specific hazard, and has to be complied with within a determined time period.

Safety Recommendations issued by the SERIPA III

To the Aero Verde Aviação Agrícola Ltda., it is recommended:

RSO (A) 322/2008 – SERIPA III

1. To oversee the correct utilization by all the employees, including the pilots, of all the safety equipment items prescribed for the activities performed, such as: flight suit, helmet, abdominal safety belt, harness, mask and other ones deemed necessary.

RSO (A) 323/2008 – SERIPA III

2. To standardize a guidance for the operational planning to be made (before starting the spraying services in non-habitual areas) by the pilot, support personnel and other persons involved, including considerations about the performance of the aircraft in relation to atmospheric variations associated with the topography and altitude of the terrain.

RSO (A) 324/2008 – SERIPA III

3. To cohibit the execution of non-certified maintenance services on their aircraft, such as, non-homologated conversions for the utilization of fuel different from that published in the aircraft and engine manufacturer's manual.

Safety Recommendations issued by the CENIPA

To the ANAC, it is recommended:

RSO (A) 042/2010 – CENIPA

Issued on 19/03/2010

1. To conduct a special technical audit on the EMA – Empresa Matogrossense de Aviação, to clarify the circumstances of the last Annual Maintenance Inspection of the PR-FBA aircraft was made, as well as the conversion of its engine for the use of ethanol.

RSO (A) 043/2010 – CENIPA

Issued on 19/03/2010

2. To add, in the minimum syllabus of the agricultural pilot training course manual (MCA 58-17), the subject Agricultural Aircraft, unit Agricultural Aircraft – Airplane, sub unit Operational Performance, information relative to the variation, in terms of altitude, atmospheric pressure and ambient temperature, of the performance of agricultural airplanes powered by reciprocating and turboprop engines, with either fixed-pitch or variable pitch propellers, as well as studies relative to the variation of the stall speed according to the variation of altitude, atmospheric pressure, ambient temperature, aircraft weight, G force and angle of bank.

RSO (A) 044/2010 – CENIPA**Issued on 19/03/2010**

3. To add, in the minimum syllabus of the agricultural pilot training course manual (MCA 58-17), practice training and practice of recovery from pre-stall/stall situations during the reverse turn (“balloon”).

RSO (A) 045/2010 – CENIPA**Issued on 19/03/2010**

4. To evaluate before the *Dirección Nacional de Aeronavegabilidad* (DNA), current authority of the Project State and responsible for the continuing airworthiness, as well as before the LAVIA Argentina S.A. (LAVIASA), holder of the Type Certificate, the feasibility of elaboration of a supplement to the PA-25 aircraft Owner’s Handbook, containing the maneuver limits, comprising the stall speeds at various configurations, weights, altitudes and bankings, besides studying the application of complementary measures (installation of aircraft performance warning placards) and other alternative measures.

RSO (A) 046/2010 – CENIPA**Issued on 19/03/2010**

5. To implement actions of incentive to the homologation of aircraft regarding the use of ethanol (AEHC) in the agricultural aviation, in accordance with the guidance contained in the item 1.1.6 of the CONAC Resolution nº 11, dated 20 July 2007, which “stimulates the use of alternative fuels in aircraft, in the training of human resources, as well as the prioritization of the certification of aeronautical products with the use of those sources of energy, for agricultural and instructional purposes”.

To the *Dirección Nacional de Aeronavegabilidad* (DNA) of the Argentine Republic, it is recommended:

RSO (A) 047/2010 – CENIPA**Issued on 19/03/2010**

1. To evaluate before the Brazilian National Civil Aviation Agency and the Argentinian LAVIA S.A. (LAVIASA), holder of the Type Certificate, the feasibility of elaboration of a supplement to the PA-25 Owner Manual, containing the limits of maneuvers, including the stall speeds in different configurations, weights, attitudes and bankings, as well as to study the application of complementary measures (installation of aircraft performance warning placards) and other alternative measures.

To the LAVIA Argentina S.A., it is recommended:

RSO (A) 048/2010 – CENIPA**Issued on 19/03/2010**

1. To elaborate a supplement to the PA-25 Aircraft Owner Manual, containing the limits of maneuvers, comprising the stall speeds in different configurations, weights, attitudes and bankings, as well as to study the application of complementary measures (installation of an aircraft performance warning placard).

The SERIPAs I, II, III, IV, V, VI e VII shall, immediately:

RSO (A) 049/A/2010 – CENIPA**Issued on 19/03/2010**

1. To forward this Report to the aircraft maintenance companies, to the pilot training schools and agricultural aviation companies within their respective areas of jurisdiction, in order to disseminate the lessons learned in this investigation.

5. CORRECTIVE AND/OR PREVENTATIVE ACTION ALREADY ADOPTED

NIL.

6. DISSEMINATION

- Aero Verde Aviação Agrícola Ltda;
- ANAC;
- *Dirección Nacional de Aeronavegabilidad* (DNA) da República Argentina;
- Empresa Matogrossense de Aviação;
- LAVIA Argentina S.A.; and
- SERIPA I, II, III, IV, V, VI and VII.

7. ANNEXES

NIL.

On 19/03/2010