COMMAND OF AERONAUTICS

AERONAUTICAL ACCIDENT INVESTIGATION AND PREVENTION CENTER

FINAL REPORT
A - 084/CENIPA/2013

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-VAR**
MODEL:	**AT-502B**
DATE:	**30 APRIL 2013**

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 item 3.1, 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.

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SYNOPSIS

This is the Final Report of the 30 April 2013 accident with the AT-502B aircraft, registration PR-VAR. The accident was classified as loss of control in flight.

After completing a pass for the spraying of agricultural pesticides, the aircraft crashed into the ground.

The pilot perished in the crash.

The aircraft sustained substantial damage.

There was no designation of an NTSB Accredited Representative, but the National Transportation Safety Board appointed an Air Tractor technical advisor to assist in the investigation.

An Accredited Representative of the Canadian TSB was designated for participation in the investigation.

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ABNT	Brazilian Technical Standards Association
AFM	Aircraft Flight Manual
ANAC	(Brazil's) National Civil Aviation Agency
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CHT	Technical Qualification Certificate
CMA	Aeronautical Medical Certificate
GPS	Global Positioning System
Lat	Latitude
Long	Longitude
MNTE	Airplane, Single-Engine, Land
NBR	Brazilian Registered Standard
NTSB	National Transportation Safety Board
PAGR	Agricultural Pilot
PCM	Commercial Pilot License (Airplane category)
PPR	Private Pilot License (Airplane category)
RBHA	Brazilian Aeronautical Homologation Regulation
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SHP	Shaft Horse Power
SINDAG	National Agricultural Aviation Companies Union
SIPAER	Aeronautical Accident Investigation and Prevention System
UTC	Universal Time Coordinated

AIRCRAFT	**Model:** AT-502B **Registration:** PR-VAR **Manufacturer:** *Air Tractor*	**Operator:** Private
OCCURRENCE	**Date/time:** 30 APRIL 2013 / 21:32 UTC **Location:** *Fazenda Bom Jesus* **Lat.** 13°18'47"S – **Long.** 058°02'31"W **Municipality – State:** Campo Novo do Parecis – Mato Grosso	**Type:** Loss of control in flight

1 FACTUAL INFORMATION

1.1 History of the occurrence

The aircraft departed at 17:10 local time with only the pilot on board for a crop dusting flight from a landing strip located on *Bom Jesus* Farm, municipality of Campo Novo do Parecis, State of Mato Grosso.

At 17:32, the aircraft crashed into the ground upon completion of the last pass for the spraying of pesticides.

1.2 Injuries to persons

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

1.3 Damage to the aircraft

The aircraft was completely destroyed.

1.4 Other damage

Nil.

1.5 Personnel information

1.5.1 Information on the crew

HOURS FLOWN	
	PILOT
Total	1,170:00
Total in the last 30 days	49:30
Total in the last 24 hours	05:50
In this type of aircraft	136:00
In this type in the last 30 days	49:30
In this type in the last 24 hours	05:50

NB.: The information on the hours flown was obtained from the pilot's logbook.

1.5.1.1 Professional formation

The pilot did the Private Pilot Course (airplane category) in the Flying School of *Várzea Grande*, State of Mato Grosso in 2003.

1.5.1.2 Validity and category of licenses and certificates

The pilot had a Commercial Pilot license (airplane category), and his ASEL and agricultural pilot technical qualifications were valid.

1.5.1.3 Qualification and flight experience

The pilot had qualification and enough experience for the type of flight.

1.5.1.4 Validity of the medical certificate

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

1.6 Aircraft information

The aircraft (SN 502B-2856) was manufactured by Air Tractor in 2012.

The aircraft had a valid airworthiness certificate.

The airframe, engine, and propeller logbooks records were up-to-date.

The last inspection of the aircraft (type “100 hours”) was made on 13 April 2013 at a workshop by the name of *HAR3 – Hangar, Aviões, Revisões, Recuperações e Revenda de Materiais Aeronáuticos Ltda.* in the municipality of *Santo Antônio de Leverger*, State of Mato Grosso. After the inspection, the aircraft flew 64 hours and 40 minutes.

The aircraft was purchased directly from the manufacturer, and underwent a process of nationalization in January 2013. On the date of the accident, it had a total of 167 airframe hours since new, and had not yet reached the number of hours required for an overhaul.

1.7 Meteorological information

Prevailing weather conditions were VMC.

1.8 Navigational aids

Nil.

1.9 Communications

Nil.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

Neither required nor installed. However, the aircraft had a piece of GPS equipment (*Satloc Bantam Part Number* 806-1034-000#E – Serial Number 1240-161378-0009), which stored a graphic map of the aircraft flight profile in its memory.

Figure 1 - CPU of the PR-VAR aircraft GPS.

During the investigation, the data recorded and stored in the non-volatile memory of the GPS was retrieved (altitude, heading and speed information of the flights of the day of the accident and of previous days).

The GPS equipment (after being turned on) was programmed to start storing information when the speed of the aircraft reached a value higher than 39kt (72km/h).

1.12 Wreckage and impact information

There was not detachment of aircraft parts in flight, and the wreckage was found concentrated.

Figure 2 – Front view of the aircraft.

Figure 3 – Aircraft cockpit.

The impact with the ground occurred at an angle of approximately 60º, with almost zero horizontal-displacement.

Figure 4 – Post-impact fuselage breakage.

On account of the angle of impact (approximately 60º), the front part of the aircraft got buried into the ground, and the fuselage structure sustained a rupture at a point ahead of the cockpit.

The ASI pointer was indicating 132kt.

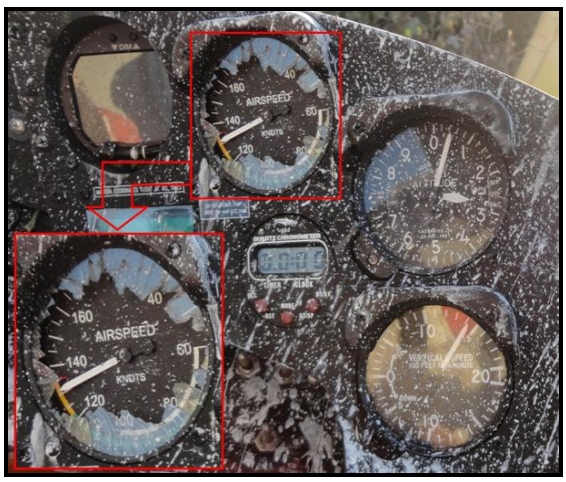

Figure 5 – ASI with indication of 132kt.

1.13 Medical and pathological information

1.13.1 Medical aspects

Nil.

1.13.2 Ergonomic information

Nil.

1.13.3 Psychological aspects

1.13.3.1 Individual information

The pilot worked as an agricultural specialist before starting flying airplanes.

This job in agriculture provided the pilot with good knowledge of the rhythm of work and operational limitations regarding this type of flight, something that, together with his righteous professional profile, made him be admired by the operators of the region.

Although he was known as a prudent pilot, there was also information that he had occasionally been seen performing abrupt maneuvers at low altitude.

According to a description provided by an operator who knew the pilot, the abrupt maneuvers performed by the pilot could be defined as “vertical climbs with leveled wings and pedal reversions at the top”, configuring a flight profile similar to the one described by the witnesses of the accident in question (item 1.18 of this report).

There were accounts that the pilot had been performing tighter and faster reverse turns on crop-dusting flights days before the accident.

On the day of the accident, the pilot had not flown in the morning. He had been running some errands and, at about 2 pm, received a call to report to the farm for the operation of four crop dusting flights.

After the call, the pilot, according to a person who was with him, got rather nervous and went to the farm in a hurry, saying that he would like to complete the flights the soonest possible.

This account was confirmed by the agricultural specialist, who heard the pilot saying that he would like the finish the work as soon as possible on that day.

The agricultural specialist also informed that, on the day of the accident, the pilot seemed a little more anxious, and, even considering the fact that the day was hot, he was sweating more than usual, and appeared nervous.

1.13.3.2 Psychosocial information

Nil.

1.13.3.3 Organizational information

On *Bom Jesus* Farm, up to February 2013, the crop-dusting job was done by the pilot involved in the accident. The aircraft used was an EMB-201.

In February 2013, the EMB-201 aircraft had some technical problems. An AT-502B aircraft (registration PR-VAR) was provided for the crop-dusting services. Then, the pilot began to utilize only the AT-502B aircraft for that purpose.

In the time of the accident, the farm used to store the aircraft fuel in a metal container. However, the fuel was normally carried in a plastic container to the place where the aircraft would be refueled, a procedure that did not comply with the requirements of the ABNT NBR 15216.

The farm had a history of fuel contamination by water due to the utilization of the plastic container, resulting in the discard of approximately 1,000 liters of fuel a few months before the accident.

The landing strip for the operation of the aircraft had also been subjected to improvement. According to information, the landing strip surface had been smoothed two days before the accident, in response to a request made by the pilot, who had said that he would fly again only after the landing strip received appropriate repairs.

1.14 Fire

There was an incipient post-impact fire which was promptly extinguished by two people who happened to be passing by at the moment of the accident.

1.15 Survival aspects

The airbag was activated at the moment of the aircraft impact with the ground, but the pilot received fatal injuries.

Figure 6 – Use of a crash test dummy to show the functionality of the AT-502B aircraft airbag.

Figure 7 – Picture showing that the airbag of the PR-VAR was activated.

1.16 Tests and research

During the examination of the wreckage, it was observed that there was no rupture of the propeller cube and that the blades had resistance to the change of pitch. The propeller pitch position was an indication that the engine was developing power at the moment of the collision of the aircraft with the ground.

Besides, upon lifting the aircraft front part (which was buried), it was possible to verify from the forward bent of the propeller that, at the moment of the collision with the ground, the engine was operating with high power regime.

Figure 8 – Propeller blade highlighted by the red circle, indicating that the engine was developing high power at the moment of impact with the ground.

The aircraft control cables were inviolate, except for the one of the left elevator which broke as a result of the impact. The left horizontal stabilizer fixation tube broke and these components remained close to the aircraft.

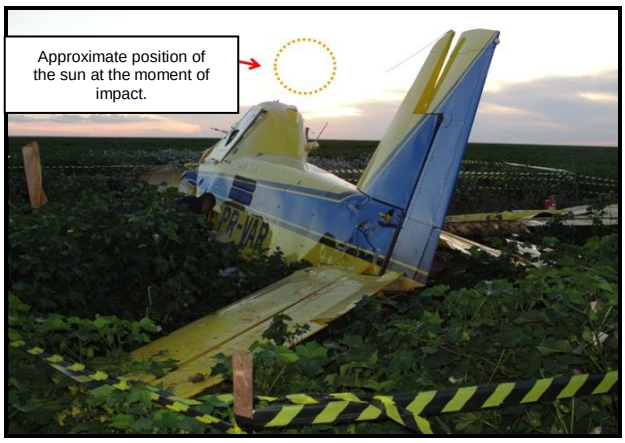

Figure 9 – Breakage of the left horizontal stabilizer as a result of the impact.

Figure 10 – Approximate position of the sun at the moment of impact.

1.17 Organizational and management information

Nil.

1.18 Operational aspects

The information relative to the operation schedule, aircraft speed, flight altitude and headings was obtained from the data recorded in the memory of the GPS.

On the day of the accident, the first takeoff for the beginning of the crop-dusting operation was at 15:16 local time.

The landing strip utilized was beside the area that was to be sprayed.

The agricultural engineer, who was supervising the application of the product, informed that the crop-dusting standard being utilized prescribed that the aircraft had to fly at a height of five meters above the terrain.

According to the GPS, the crop-dusting activity was being performed with the aircraft flying alternately the headings of 090º and 270º at an altitude of 525 meters. However, it is estimated that there was an altitude error in the equipment, with an excess of approximately 20 meters in the GPS indication.

The terrain being sprayed had an average altitude of 504 meters. Along the heading of 270º there was a declivity, which favored a gradual increase of speed during the pass, as indicated by the GPS equipment.

Conversely, when the aircraft was flying at the 090º heading, the speed had a tendency to diminish, as could be observed from the reading of the GPS.

According to the AT-502B Airplane Flight Manual, the spraying has to be done with the aircraft flying at a speed between 117kt and 122kt.

At 15:38, the aircraft finished the first phase of the spraying, at a heading of 090º, altitude of 525 meters, and speed of 118kt.

Then, in preparation for landing, the aircraft made a turn to the right with altitude variation and rolled out at the heading of 169º. On this turn, the maximum altitude reached by the aircraft was 612 meters, and the minimum speed was 89kt, according to the profile highlighted in green in figure 11.

At 15:56, the aircraft took off for the second phase of the spraying. This phase was completed at 16:17, at a heading of 090º, altitude of 527 meters, and speed of 121kt.

Once again, in preparation for landing, the aircraft made a turn to the right, with altitude variation, up to the heading of 169º. On this turn, the maximum altitude reached by the aircraft was 649 meters, and the minimum speed was 75kt, according to the profile marked in red in figure 11.

At 16:37, the aircraft took off for the third phase of the spraying, which was completed at 17:00, at a heading of 090º, altitude of 526 meters, and speed of 124kt.

This time, in order to land, the aircraft made a turn to the right up to heading 169º. On the turn, the maximum altitude of the aircraft was 631 meters, and the minimum speed was 91kt, as highlighted in the profile in yellow of figure 11.

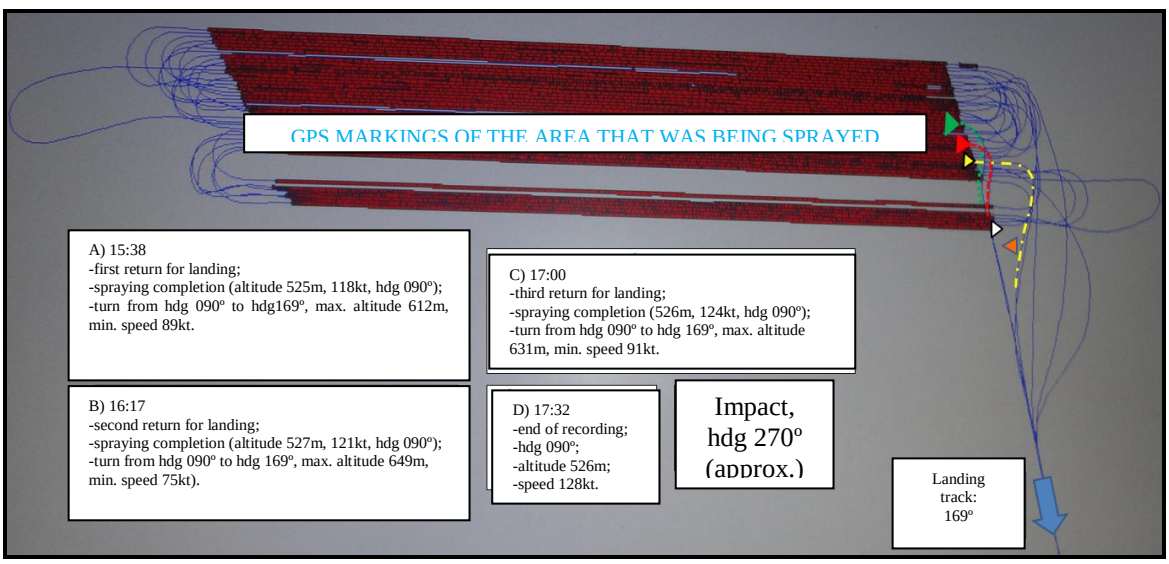

Figure 11 – Flight profile recorded in the GPS.

At 17:03, the aircraft received 108 liters of fuel in its left wing tank, as requested by the pilot.

At 17:10, the pilot took off for the fourth and last phase of the spraying.

At 17:32, at coordinates 13°18’39”S / 058°02’43”W, coincidental with the completion of the last spraying pass (white triangle in figure 11, or P position in figure 12), the GPS stopped recording the flight profile, with the aircraft at a heading of 090º, at an altitude of 526 meters, and speed of 128kt. At the final moments of the recording, the GPS detected an increase of speed.

Four witnesses, at different locations (T1, T2, T3 and T4 – figure 12), observed the aircraft flight profile after completion of the last spraying pass. The interviews with these witnesses were held separately in different places and moments.

The first witness (position T1 – figure 12) was in a vehicle traveling along a road that passed through the cotton plantation, at a distance of about 490 meters from the point of impact. The witness informed that s/he often passed by that area and was accustomed to watching the AT-502B flight profile during crop-dusting operations.

By means of an object, the witness described the maneuver in which the aircraft was climbing longitudinally with a pitch-up attitude close to 90º.

The witness pointed out that s/he was accustomed to observe the execution of the reverse turns, but this time the maneuver was performed in a different way, with no angle of bank at the initial phase of the climb.

According to the witness, the aircraft gained considerable altitude, and in the highest part of the maneuver, the nose of the aircraft, which was pointing upwards, began to fall in the direction of the right wing, up to a downward vertical attitude towards the ground. The witness also informed that the noise of the engine was continuous and only stopped after the impact.

The second witness (position T2 – figure 12) was walking at a distance of approximately 630 meters from the point of impact, and was able to sight the final trajectory of the aircraft.

This witness also emphasized that the ascension of the aircraft was almost vertical, with leveled wings and significant altitude gain.

S/he affirmed not having seen the aircraft reversion from climb to descent, but mentioned having sighted the final trajectory of the aircraft before the impact, with a pitch-down attitude of almost 90º.

The witness also informed that there was a fast oscillation of the wings before the impact, and that the noise of the aircraft engine was continuous until the collision.

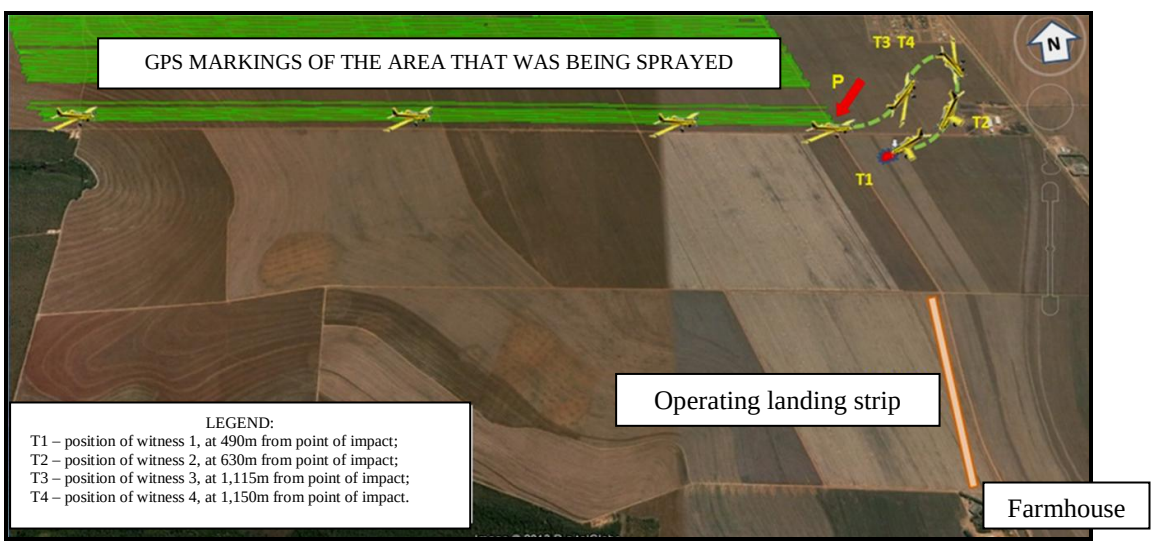

Figure 12 – Location of the witnesses. The flight profile after position “P” was obtained from reports.

The third witness (position T3 – figure 12) was in the backyard of his/her residence, at a distance of 1,115 meters from the point of impact, and said that “*the pilot must have performed a maneuver that did not work*”.

When questioned on the reason for that impression, s/he said that the aircraft climbed in an aggressive manner with the nose pointing upwards, with leveled wings, and gaining lots of height.

The witness described the top of the maneuver as a “*twisted turn to the right, almost with no radius of turn, from which the aircraft left pointing toward the ground*”. Relatively to the engine noise, the witness said: “*the engine was full until crashing into the ground*”.

The fourth witness (position T4 – figure 12) was in the backyard of his/her residence at approximately 1,150 meters from the point of impact, and informed having seen the aircraft begin the climb with the nose pointing upwards. S/he said that the aircraft

disappeared momentarily behind the foliage of a tree and reappeared in a position indicating a considerable gain of altitude.

The witness informed that, at the top of the maneuver, the aircraft nose dropped to the right hand side. S/he said that he lost visual contact with the aircraft for a short time, until it reappeared pointing toward the ground. According to the witness, the engine was making a noise which only ceased after the impact with the ground.

According to the AT-502B Airplane Manual, Aerobatic maneuvers (spin included) are not approved.

The aircraft flight manual shows the stall speeds relative to the weights of 3,629 kg and 2,812 kg, as shown in the table below.

Also according to the manual, when the aircraft weight is 3,629kg, the altitude loss for recovering from a leveled wing stall is 220ft.

STALL SPEEDS

Stall Speeds at 3,629 Kg. gross weight, power IDLE are as follows:

Angle of Bank (Degrees)	0	15	30	45	60
Stall Speed (Knots-CAS) Flaps Up	72	73	77	86	102
Stall Speed (Knots-CAS) Flaps Down	60	61	64	71	84

Stall Speeds at 2,812 Kg. gross weight, power IDLE are as follows:

Angle of Bank (Degrees)	0	15	30	45	60
Stall Speed (Knots-CAS) Flaps Up	62	63	67	75	89
Stall Speed (Knots-CAS) Flaps Down	52	53	56	62	73

Figure 13 – Stall Speeds - *AT-502B Airplane Flight Manual.*

1.19 Additional information

According to the Brazilian Aeronautical Homologation Regulation (RBHA) 91.303(e), no person is allowed to operate an aircraft on aerobatic flights at altitudes below 1,500ft AGL.

The NBR 15216, which deals with “Storage of Flammable Fluids and Fuels – Quality Control of Storage, Transportation and Delivery of Aviation Fuels”, prescribed the following procedures:

Transport equipment requirements

“In the construction of tanks, pipes, or any other component that makes direct contact with aviation fuels, the following material shall not be used: plastic, galvanized steel, copper, zinc, cadmium, or their alloys. For the internal coating one shall not shall utilize a paint derived from zinc silicate. Pipes which cannot be coated internally due to their diameter must be made of stainless steel or aluminum.”

1.20 Utilization of other investigation techniques

Nil.

2 ANALYSIS

The investigation sought to identify the factors that could have favored the loss of control of the aircraft, such as failure of systems, lock of controls, structural failure, physiological restrictions, operating procedures, psychological aspects, or support infrastructure relative to the operation.

During the research conducted on the aircraft wreckage, it was verified that the propeller hub had not broken and that the propeller pitch setting was compatible with the developing of normal power by the engine.

It was verified that the tip of the propeller blade that ended up getting buried in the ground at the moment of the impact, had a forward bent, indicating that it was developing traction.

In the last crop-dusting pass (heading 090º), with the aircraft maintaining constant speed and altitude in relation to the ground, the expectation was a reduction of speed due to the acclivity of the terrain.

This reduction of speed was verified by means of the GPS in the earlier passes at heading 090º. However, in the last pass with this heading, at the final moments of the GPS recording, the aircraft was in a process of acceleration, which was an indication that power was being increased.

In addition, four witnesses (located between 490 meters and 1,150 meters from the point of impact) confirmed having heard the continuous noise of an operating engine up to the moment of the collision. Such information indicated normal functioning of the aircraft power plant.

No abnormalities were observed during the tests of the fuel collected from the metal reservoir. As for the plastic container utilized for transporting the fuel to the aircraft during the initial action of the investigation, it had no fuel available for analysis. However, it is a known fact that the plastic container was not compliant with the specifications of the ABNT NBR 15216.

At the moment of the impact of the aircraft with the ground, the left horizontal stabilizer attachment tube broke, causing the rupture of the left elevator control cable. All these components remained connected to the aircraft structure, indicating that there had not been detachments of the control surfaces in flight.

The loss of control was not a consequence of a failure of the cables, since they were found intact, with the exception of the left elevator cable, which broke as a result of the impact.

The flight profile described by the witnesses, with an almost vertical climb with leveled wings, followed by a nose rotation to the right at the top of the maneuver, counteracting the torque which pulled the aircraft nose to the left, indicated the need to operate the controls in different positions.

Therefore, it was not possible to determine whether there was a locking of the controls or a pilot’s sudden illness.

The quick oscillation of the wings prior to the impact, as informed by the second witness, indicated a possible high-speed stall.

This situation occurs with the aircraft at a high speed, when the pilot suddenly moves the control column all the way in order to lift the nose of the aircraft.

The critical angle of attack is reached and there is detachment of the limit layer of the wing surface. It is worth pointing out that the impact possibly occurred at a speed of 132kt, according to the indication of the ASI pointer.

On the day of the accident, the pilot took off four times as part of the crop-dusting operations.

According to the information stored in the GPS, in the three first flights, the final pass was performed at a heading of 090º, with the speed between 117kt and 124kt.

After the pass, the aircraft would make a climbing turn to the right up to heading 169º, for alignment with the landing strip.

On the fourth flight, contrary to what had happened on the previous flights, there was not a start of a turn to the right, and the GPS discontinued the recording, just after the completion of the spraying pass.

Such interruption of the recording might be explained by a failure of the equipment, intentional turn-off, or an aircraft ground speed below 39kt, but it was not possible to determine the cause of the interruption.

The first and second options mentioned above would be viable, and the third one could be explained by the rapid ascension of the aircraft, as sighted by the witnesses.

Thus, the speed reduction from 124kt to 39kt (ground speed) would have taken place almost on the vertical plane, with little forward displacement.

This hypothesis may be observed in the figure 14 below, as the rapid ascension would justify the fact that the aircraft finished the spraying at a heading of 090º and, with little forward movement, impacted the ground at an angle of approximately 60º at a heading of about 270º.

On the three previous flights, the GPS recorded all the flight profile, even after the finish of the crop-dusting, up to the point that the aircraft was flying over the landing strip before landing, when the speed was reduced below 39kt.

The fact that the GPS stopped recording at the exact moment of the completion of the crop-dusting activity could possibly indicate that it was turned off on purpose, but it was not possible to confirm such hypothesis.

The maneuver described by the witnesses is similar to a stall turn. In this maneuver, the aircraft climbs almost vertically, and is taken to a stall condition, with a 180º-turn at the top, for a subsequent recovery with loss of altitude (figure 14).

If the pilot really performed a stall turn, he started the maneuver with the sun at ‘six o’clock” and, after the reversion at the top of the maneuver the sun was ahead of him, next to the line of the horizon, and the pilot would be exposed to a glaring, which may have favored spatial disorientation.

The stall turn with a reverse turn by the right at the top of the maneuver is more difficult to perform. In this phase of the maneuver, with speeds which are next to zero, torque is present and pulls the nose of the aircraft to the left. The pilot, then, should be well aware and effective in the application of the rudder control, counteracting the torque.

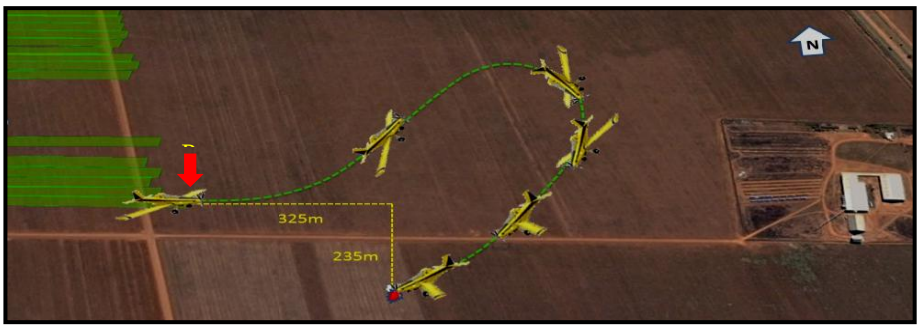

Figure 14 – Aircraft maneuver as described by the witnesses.

According to the aircraft flight manual, aerobatic maneuvers are not approved for the AT-502B. The manual mentions that the loss of altitude for recovering from a leveled-wing stall is approximately 220ft when the weight is 3,629kg.

In addition to the inadequacy of the aircraft for aerobatic maneuvers, the pilot lacked qualification for carrying them out. Moreover, the RBHA 91.303(e) forbids aerobatic maneuvers below 1550ft AGL.

It is estimated that the aircraft started the maneuver at 10ft AGL. It was not possible to determine the gain of height but, judging from the profile described by the witnesses, shortly before the impact the longitudinal attitude of the aircraft was still close to a 90º pitch-down , denoting insufficient altitude for recovery.

The angle of impact, the damage to the aircraft, and the ASI indication of 132kt show correlation with the final result expected for the flight profile described by the witnesses.

However, the lack of a flight data recorder made it impossible to confirm whether the pilot performed a stall turn at low height.

Another aspect that has been analyzed, based on the earlier crop-dusting completions at a heading of 090º, followed by climbing turns to the right in order to settle in the altitude and speed parameters for landing with a heading of 169º, refers to the pilot's anxiety relative to finishing the service on that day.

This may have motivated the pilot to attempt a quick maneuver, with alignment with the runway, which was almost 90º top the right.

Considering that it was the last flight of the day, on completing a work-day that had not been planned in advance and that had caused discontinuation of private tasks and dissatisfaction on the part of the pilot, it is possible that, reinforced by his growing confidence in the aircraft, the pilot followed an impulse to perform an unplanned maneuver.

In this sense, and based on the conclusions that, at the moment of the accident, the pilot was acting in the flight controls and the engine was developing power, one cannot discard the hypothesis that the vulnerable emotional state of the pilot, added to his dissatisfaction in carrying out crop-dusting flights on that day, may have created in him a need for compensation, strengthening a probable impulse to perform a bolder unplanned procedure.

It is also worth considering that, possibly due to the same reasons, the stress influencing the pilot may have favored a perception and a judgment which lacked precision at the final moments of the flight, leading him to a poor evaluation regarding the execution of a maneuver that was incompatible with the type of the aircraft being flown, and (probably) to exceeding his own limits.

3 CONCLUSIONS

3.1 Facts

a) The pilot had a valid Aeronautical Medical Certificate;

b) The pilot had a valid Technical Qualification Certificate;

c) The pilot had qualification and enough experience for the flight;

d) The aircraft had a valid Airworthiness Certificate;

e) The aircraft was within the limits of weight and balance;

f) The prevailing weather conditions were VMC;

g) The first takeoff for the beginning of the crop dusting operation was at 15:16;

h) At 17:10, the pilot took off for his fourth and last phase of the operation;

i) At 17:32, at coordinates 13°18'39"S 058°02'43"W, coincidental with the completion of the crop dusting pass, the GPS stopped recording the flight profile, with the aircraft at a heading of 090º, altitude of 526 meters, and speed of 128kt.

j) At 17:32, the aircraft crashed into the ground; and

k) The aircraft sustained substantial damage; and

l) The pilot sustained fatal injuries.

3.2 Contributing factors

3.2.1 Human Factor

3.2.1.1 Medical Aspect

a) Spatial Disorientation – undetermined

If the pilot really performed a stall turn, the position of the sun and the changes in longitudinal attitude may have favored alteration of the referential and may have contributed to spatial disorientation.

3.2.1.2 Psychological Aspect

3.2.1.2.1 Individual information

a) Attention – undetermined

It is possible that the level of attention of the pilot was low at the moment of the accident on account of alterations of his emotional state and the context of stress under which he assumed the flights on the day of the accident.

b) Attitude – undetermined

The relative increase of the confidence that the pilot had been developing in regards to his ability to fly the aircraft, the vulnerable emotional state shown by him on the day of the accident, and the dissatisfaction displayed in relation to the crop dusting flights on that day may have generated in the pilot a need for compensation capable of strengthening a probable impulse toward the execution of an unplanned and more daring aircraft maneuver.

c) Emotional State – undetermined

The nervous and anxious emotional state with which the pilot assumed the crop dusting flights on the day of the accident may have contributed to his attempting to perform a maneuver that was incompatible with the type of the aircraft and altitude of flight.

d) Evidence of Stress – undetermined

The crop dusting flights of the day of the accident had not been programmed in advance. This fact was a source of annoyance for the pilot, and may have generated a context of stress, in which he agreed to an activity which he wanted to complete the soonest possible.

e) Perception – undetermined

The possible conditions of stress and anxiety under which the crop dusting flights were done on the day of the accident may have contributed to a progressive lowering of the pilot's situational awareness, compromising his precise perception of the factors and conditions influencing a possible maneuver incompatible with the aircraft and altitude of flight.

f) Decision-Making Process – undetermined

In the hypothesis of an intentional inflight maneuver, there was an inadequate previous evaluation, since it was a procedure not recommended for the type of aircraft, for the altitude of flight, and for the pilot, who lacked qualification to perform it.

3.2.1.2.2 Psychosocial information

Not a contributor.

3.2.1.2.3 Organizational information

Nil.

3.2.2 Operational Factor

3.2.2.1 Concerning the operation of the aircraft

a) Flight indiscipline – undetermined

There was evidence (which could not be confirmed, though) of a maneuver not compatible with the type of aircraft and altitude of the flight, in addition to the fact that the pilot lacked proper qualification for it.

b) Piloting Judgment – undetermined

According to the accounts of four witnesses, the pilot did maneuver in a way similar to a *stall turn*. If this was really the case, he was not qualified for acrobatic maneuvers, besides the fact that they were not compatible with the AT-502B and the altitude of the flight, something that was not duly evaluated by the pilot.

3.2.2.2 Concerning ATS units

Not a contributor.

3.2.3 Material Factor

3.2.3.1 Concerning the aircraft

Not a contributor.

3.2.3.2 Concerning ATS technology systems and equipment

Not a contributor.

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 liability.

In accordance with the Law n°12970/2014, recommendations are made solely for the benefit of the air activity operational safety.

Compliance with a Safety Recommendation is the responsibility of the holder of the highest executive position in the organization to which the recommendation is being made. An addressee who judges to be unable to comply with a Safety Recommendation must inform the CENIPA on the reason(s) for the non-compliance.

Safety Recommendations made by the CENIPA:

To the National Civil Aviation Agency (ANAC):

A-084/CENIPA/2013 – 001 Issued on 08/10/2014

Publicize the content of this report at seminars, lectures, and like activities targeted at owners, operators, and explorers of agricultural aircraft.

To the SINDAG:

A-084/CENIPA/2013 – 002 Issued on 08/10/2014

Disseminate the lessons learned from this accident as a way to cohibit maneuvers not suitable to this type of aircraft and flight altitude.

5 CORRECTIVE/PREVENTATIVE ACTION ALREADY TAKEN

–Despite the fact that a contamination of the fuel was not confirmed, the utilization of a plastic container for fuel transportation to the location of aircraft refueling made the SERIPA VI send (on 19 September 2013) the Official Document nº 40/CH/1164 (COMAER Protocol nº 67018.000489/2013-24) to the operator with the instructions contained in the ABNT NBR 15216.

6 DISSEMINATION

–(Brazil's) National Civil Aviation Agency - ANAC

–National Union of Agricultural Aviation Enterprises (SINDAG)

–SERIPA VI

–Transportation Safety Board of Canada

–National Transportation Safety Board - USA

7 APPENDICES

Nil.

On 08 Oct 2014.