

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 147/CENIPA/2015

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PR-RSA
MODEL:	AT-502B
DATE:	09NOV2015



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 item 3.1, 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 accident with the AT-502B aircraft, registration PR-RSA, on 09NOV2015. The event was classified as “Loss of Control - Inflight” (LOC-I).

The aircraft aggressively pitched up shortly after the takeoff, lost lift and collided with the ground.

The aircraft was destroyed.

The pilot was fatally injured.

An accredited representative from the United States (aircraft manufacturing State) National Transportation Safety Board - NTSB, was designated for participation in the investigation.

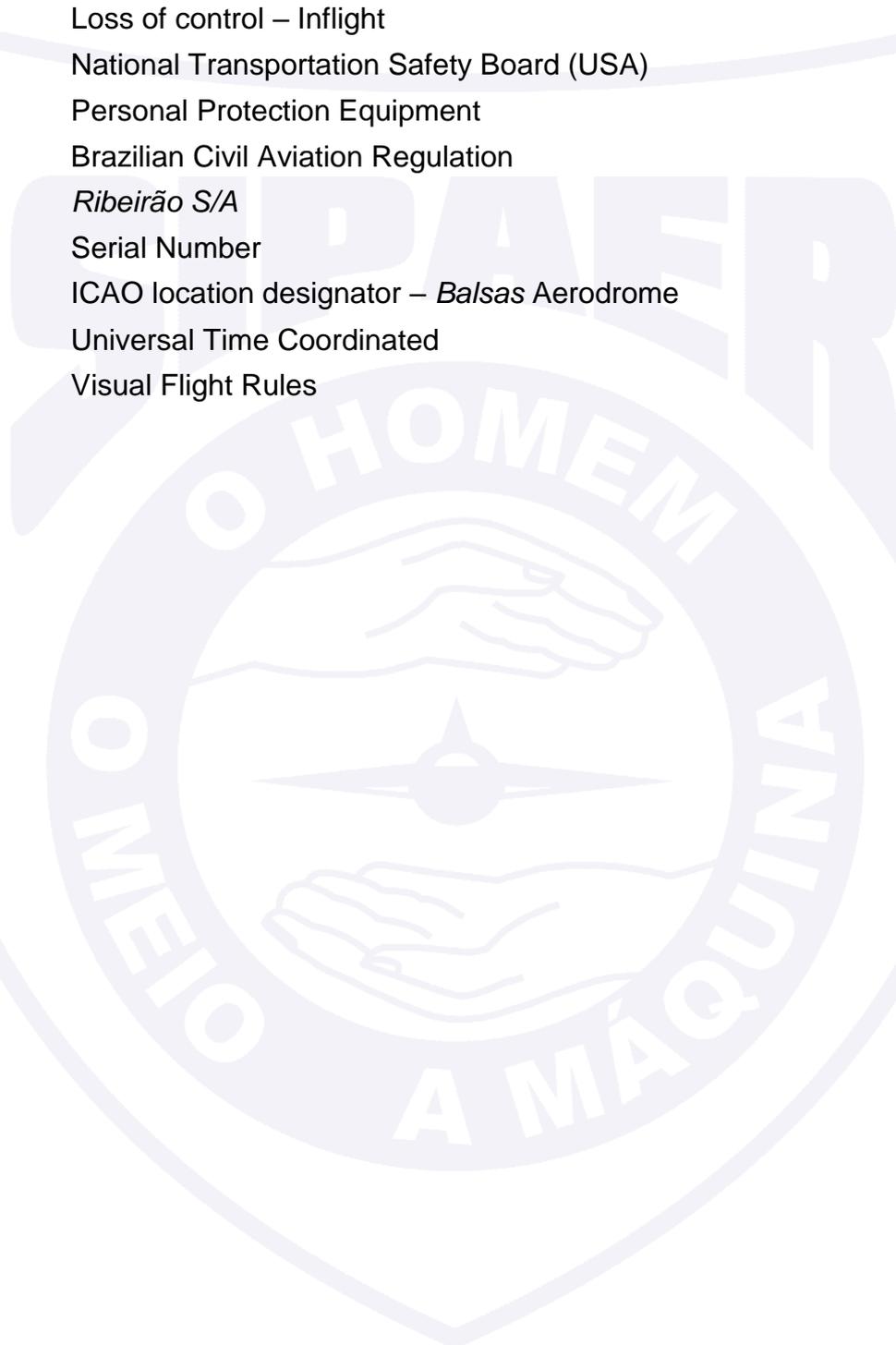


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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CENIPA	Aeronautical Accident Investigation and Prevention Center
GPS	Global Positioning System
LOC-I	Loss of control – Inflight
NTSB	National Transportation Safety Board (USA)
PPE	Personal Protection Equipment
RBAC	Brazilian Civil Aviation Regulation
RISA	<i>Ribeirão S/A</i>
SN	Serial Number
SNBS	ICAO location designator – <i>Balsas Aerodrome</i>
UTC	Universal Time Coordinated
VFR	Visual Flight Rules



1. FACTUAL INFORMATION.

Aircraft	Model: AT-502B	Operator: <i>Ribeirão S/A</i>
	Registration: PR-RSA	
	Manufacturer: AIR TRACTOR	
Occurrence	Date/time: 09NOV2015 - 1930 UTC	Type(s): Loss of control - Inflight (LOC-I)
	Location: Balsas Aerodrome (SNBS)	
	Lat. 07°31'31"S Long. 046°03'12"W	Subtype(s):
	Municipality – State: <i>Balsas - Maranhão</i>	

1.1 History of the flight.

The aircraft took off from Balsas Aerodrome (SNBS), Balsas, Maranhão, about 1930 UTC for a local training flight with one pilot (the sole occupant) on board.

The aircraft aggressively pitched up shortly after the takeoff, then lost lift and collided with runway surface. The aircraft came to rest 60 meters from the initial impact point.

Post-impact fire consumed the aircraft, and the pilot was fatally injured.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft was destroyed.

1.4 Other damage.

The SNBS runway surface was damaged.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	20,000:00
Total in the last 30 days	00:57
Total in the last 24 hours	00:37
In this type of aircraft	00:57
In this type in the last 30 days	00:57
In this type in the last 24 hours	00:37

N.B.: Data provided by third parties.

1.5.2 Personnel training.

The pilot earned his private pilot license (airplane) in 1974.

1.5.3 Category of licenses and validity of certificates.

The pilot held a commercial pilot license (airplane), and had valid technical qualification certificate for single-engine land aircraft. However, his agricultural pilot certificate was not valid.

1.5.4 Qualification and flight experience.

The pilot was not proficient at the accident aircraft. It is estimated he had 57 minutes of flight experience in the aircraft model.

1.5.5 Validity of medical certificate.

The pilot had valid aeronautical medical certificate.

1.6 Aircraft information.

The serial number (SN) 502B-2679 aircraft was manufactured by Air Tractor in 2009, and was registered as private aerial service.

The airworthiness certificate was valid.

The part I of the airframe, engine and propeller logbook records were outdated.

The aircraft last inspection (type "100 hours") was fulfilled on 13OCT2015 by *Dino Aviões* workshop, *Balsas, Maranhão*. At the time of the accident, the aircraft had accrued 50 minutes of operation since the inspection.

The aircraft last overhaul (type "1,000 hours") was fulfilled on 11OCT2012 by *Dino Aviões* workshop, *Balsas, Maranhão*. At the time of the accident, the aircraft had accrued 825 hours and 40 minutes of operation since the overhaul.

1.7 Meteorological information.

Visual meteorological conditions prevailed for the flight.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

SNBS was a public aerodrome under the administration of the *Balsas* municipal government. It operated day-time VFR (Visual Flight Rules).

The asphalt runway (15/33) was 1,000 m long and 23 m wide, at an elevation of 932 feet.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The accident occurred on SNBS runway. The wreckage remained concentrated.

The aircraft right wing was the first part to hit the ground, followed by the propeller blades, engine, and then the other parts (Figures 1 and 2).



Figure 1 - Impact marks.



Figure 2 - Impact marks.

The right wing exploded in the impact, and the fire consumed the entire aircraft. One of the propeller blades was cut, and the other propeller blades were distorted. The right landing gear was separated from the fuselage, and the engine twisted at “C” flange (Figure 3).



Figure 3 - C flange twisted by the impact.

The aircraft came to rest 60 meters of the initial impact, on a heading of about 150° magnetic (180° of the takeoff run direction) (Figure 4).



Figure 4 - Aircraft final position.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

As pilot's body was charred, further examinations could not be done. It was not possible to get reliable information of the 48 hours prior to the accident. Neither direct nor indirect preexisting contributing factors to the accident could be identified.

However, due to the operational conditions, pilot's disorientation shortly after takeoff shall not be dismissed.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot started flying at 18 years old, and he also had other family members who were pilots. He was known by his background and large experience in agricultural aviation, especially with *Ipanema* aircraft (EMB-201 and EMB-202 models).

The pilot was admired by the colleagues for being the most expert pilot in the region. He had high productivity rates, and had been awarded prizes as an agricultural pilot (national level).

According to information, the pilot was financially dissatisfied, and decided to stop working for the agricultural company he used to work for. Due to this fact, he stopped flying for six months.

Although he was a highly regarded *Ipanema* pilot, he usually offered resistance to changing his flight manner or learning new specific concepts (mainly of advanced technology), such as the use of GPS in spraying operations.

Close persons to the pilot described him as an anxious man, worried about his family. He had lost two sons, and was affected by the tragedies. One of them had died in an agricultural aviation accident.

Despite the good wages on bumper crop time, the pilot had always had financial and family problems.

According to colleagues, he did not use to follow standardized procedures. This behavior was related to the endeavor to enhance his productivity. He was known as a practical and operational pilot, but not much devoted to aviation study.

All interviewees stated that the accident pilot used to work harder than the other ones in the region. According to a friend that had worked with him for years, the pilot was a calm person even in adversities, but he was a workaholic. This attribute was visible in the moment he was living in his career, in which he was fulfilling his son's wish: "flying a turbo", referring to the Air Tractor aircraft.

It was reported that the pilot was proud of being considered a good pilot and having recorded so many flying hours. He was also a very confident person about his operations.

According to all colleagues it was known he needed money and needed to be back to work because of family financial obligations.

The interviewees stated that the opportunity of being hired by the new company was really important for him because of the financial problems.

In that moment, the pilot was living in a room inside former employer's hangar, near *Balsas* city. As he had not been working since May 2015, he had still many debts.

There is also information that the pilot had earned advance payment for health examination in order to renew his aeronautical medical certificate.

Some people who work in the aerial activity were in the aerodrome area on the day of the accident, and observed the pilot's flights and the accident.

According to witnesses, in the first flight the pilot showed some lack of experience in the accident airplane as he attempted to take off with the propeller lever in wrong position. He seemed to be anxious and upset about the error. For the witnesses, the second and third flights were uneventful despite the fact that the pilot had performed short field takeoffs (he became airborne before lifting the tail section).

The pilot had told some colleagues about his difficulty with the aircraft operation. He had little technical proficiency, and the airplane was much powerful. He was afraid of being unsuccessful in its operation.

Although he was quickly learning to operate the aircraft, he complained about the sensibility of the aircraft controls.

For some interviewees, an experienced Air Tractor instructor could have helped him to understand better the aircraft operation. One stated that an Air Tractor pilot offered some help, but he denied.

The only information about previous accident/incident with the pilot is that he had made a forced landing once, due to a breakdown in his aircraft, at the beginning of his career.

There are no records (in pilot's background) of any specific updating course in the past few years.

The pilot was deemed a sociable person.

He had told a friend about some fear of not satisfying the new company's expectations (others could notice it too).

1.14 Fire.

A post-impact fire ensued due to the attrition associated with the fuel in the tanks.

The firefighting personnel arrived soon, but the fire consumed the aircraft so quickly that substantial damage could not be avoided. The fact the aircraft had been fueled before the flights of that day (the tanks were almost full) worsened the situation.

1.15 Survival aspects.

Pilot's corpse was found next to the aircraft, in a position that seemed he was attempting to escape from the fire. Thus, it is possible that he tried to leave the aircraft by the right side. However, due to injuries, he could not reach a safe area.

Analysis of the corpse at the accident site showed intact arms and legs despite the charred body. Part of the seat was adhered to pilot's body. It indicates the pilot was already on fire while inside the aircraft. This shows he was not wearing appropriate clothes that could have protected him against fire burn.

1.16 Tests and research.

The turbo-propeller powered (PT6-34AG 750 SHP) airplane was limited to a maximum takeoff weight of 3,629 Kg. The engine was substantially damaged by the fire. Its components went through high temperatures so as it was not possible to check the engine operation, nor adjustments, nor leakage occurrence.

However, the damage observed on the propeller and on C flange was consistent with engine power development, what shows that the aircraft impacted the ground with operating engines. This fact was confirmed by interviewing the accident witnesses.

No discrepancies with seat adjustment that could act over aircraft controls were noted. The seat could be adjusted only in height. It could not be adjusted forward or backward.

All flight control surfaces were attached to the aircraft, except the right aileron, that was destroyed by the fire. Despite the great damage caused by the fire, those surfaces could be examined. The examination revealed there were no abnormalities on the surfaces that could be associated with the aircraft attitude after takeoff, and it was not found any evidence of aircraft control surface stuck in any position.

The aircraft maintenance had been done according to the maintenance program scheduled by the manufacturer.

1.17 Organizational and management information.

Ribeirão S/A (RISA) was a company that had more than 30 years' experience. It owned five farms over the states where it operated (especially *Maranhão* and *Piauí*), totaling 68,000 hectares of grain crop.

RISA was *Piauí's* biggest agribusiness company, and one of the biggest in Brazil, with more than 1,000 employees.

The company had one pilot for administrative headship flights, and hired agricultural pilots in harvest time.

The process of hiring pilots was informal. As usual in the region, pilots' or headship's friends indicated new pilots to be hired.

Despite the fact the company had a human resources department, there was no specific formal process to hire new pilots. The psychologists of this department did not take part in the process of hiring pilots.

The company did not know the pilot could not operate that aircraft, as he did not have that specific aircraft certificate. The company only had the information he was the best agricultural pilot in the region, and was indicated by reliable friends. As he had almost 35 years of experience in agricultural operations, the company deemed him a great hiring.

The company did not have any politics of flight safety in agricultural operations or in administrative transport flights. There was not any formation or training program for the pilots, and the aerial operations supervision was not conducted properly.

Despite the availability of an Air Tractor simulator in *São Paulo*, neither the pilot nor the company considered this type of training..

1.18 Operational information.

The pilot had conducted agricultural flights since 1982. According to third parties, he had accrued more than 20,000 flight hours, essentially, in EMB-201 and EMB-202 Ipanema aircraft. These aircraft were limited to a maximum takeoff weight of 1,800 Kg, and equipped with a conventional engine (300 HP and 320 HP, respectively).

As the pilot had accepted RISA's proposal to work on aerial application flights aboard the Air Tractor, he would be responsible for training and adapting himself in this aircraft. The pilot hadn't been formally hired yet.

The transition to the new aircraft model would occur by pilot's experience in *Ipanema* model. The pilot did not take any course neither did any flight training in the accident aircraft model. The pilot only had third parties' instruction about engine start-up, and some information about the airplane characteristics.

On 18OCT2015 the pilot flew the AT-502B for 20 minutes. This flight data was recorded by the workshop where the aircraft was stowed. According to information, the pilot had not been flying for 6 months.

The aircraft was refueled on 30OCT2015 with approximately 818 liters QAV-1 (aviation kerosene density 0.7850 at 20°C), that is, tanks completely full, and the aircraft totaling 642 Kg.

The pilot flew this aircraft three times before the accident flight. They were brief flights and aimed the training of takeoffs, traffic circuits and landings for pilot's proficiency.

On 09NOV2015, the pilot arrived in the hangar at 1030 UTC, and the aircraft was prepared for the flights. The pilot took off about 1100 UTC and flew for five minutes.

While preparing for takeoff, the pilot accelerated the engine with propeller lever aft (wrong position). As prescribed in the flight manual, the propeller lever should be in the flight position (fully forward) for takeoff. (Figure 5).

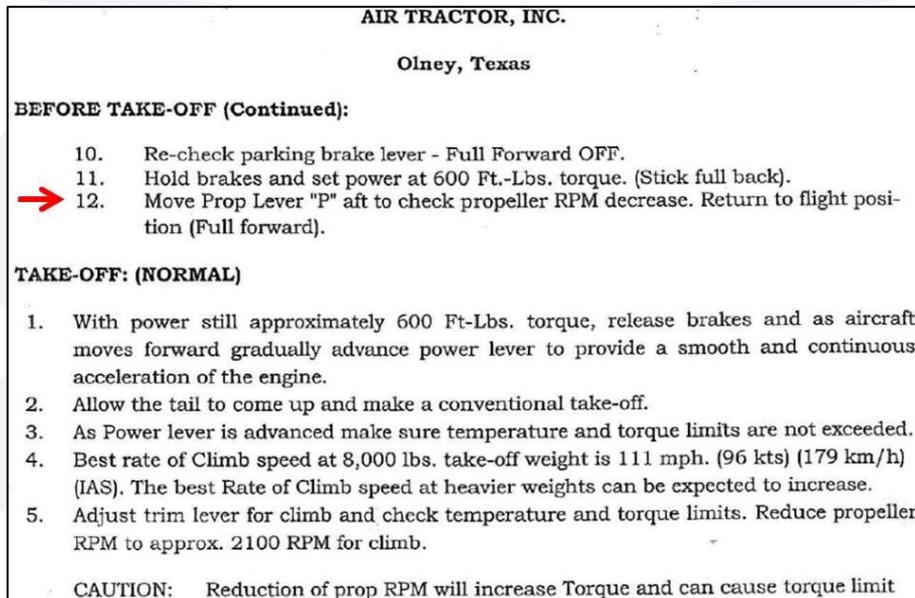


Figure 5 - Propeller lever position for takeoff according to AT-502B flight manual.

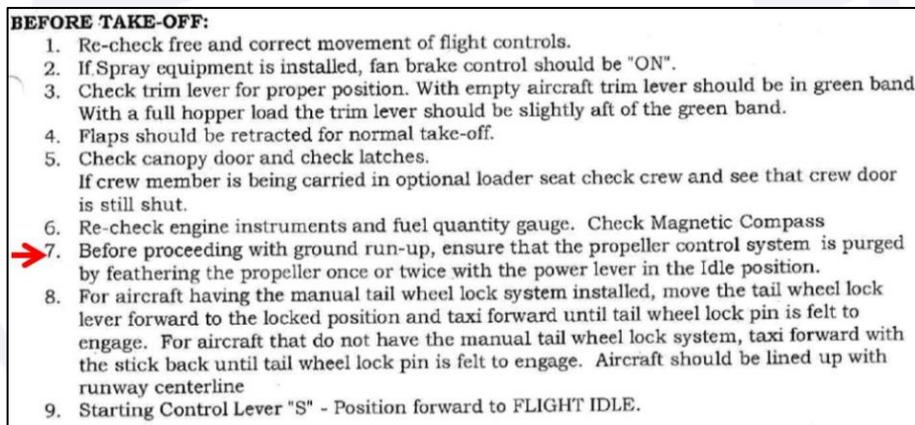


Figure 6 - Propeller control system check. (AT-502B flight manual)

Due to the aircraft reaction, the pilot corrected it abruptly and proceeded with the takeoff. He flew only one traffic circuit, and landed for assessment of the aircraft by the workshop.

After this flight, the owner of the workshop instructed the pilot about the propeller lever position for takeoff, although these instructions were in the flight manual.

The flight manual available in the workshop was written in English, and the pilot had not developed the skill of reading in such language.

In addition, the pilot did not know the aircraft emergency procedures, neither specific AT-502B characteristics. It indicated that the pilot did not use to study flight manuals, and had not undergone any AT-502B training.

He departed for his second flight on that day at 1430 UTC. It lasted 20 minutes. The third flight departed at 1745 UTC, and lasted 12 minutes.

The pilot performed all departures as short field takeoffs. He was instructed to travel a larger piece of runway during the takeoff roll. However, he reported difficulty to keep the aircraft on the ground due to the high torque.

The accident flight departed from the runway 33 at 1930 UTC on a local flight in order to check the GPS.

The aircraft started the takeoff roll normally and, as in the previous departures, the aircraft became airborne before lifting the tail section. However, the aircraft pitched aggressively up immediately after takeoff.

It was not possible to allege the exactly climb angle the aircraft reached. Based on several reports and on the dynamics of the flight, it is likely that the aircraft exceeded 60° climb angle.

In such situation, the aircraft climbed for a while, but then entered a stall. The aircraft was observed in a steep nose down attitude, followed by the changing attitude consistent with recovering to a normal attitude. However, the aircraft collided with the ground about 400 meters from the departing point.

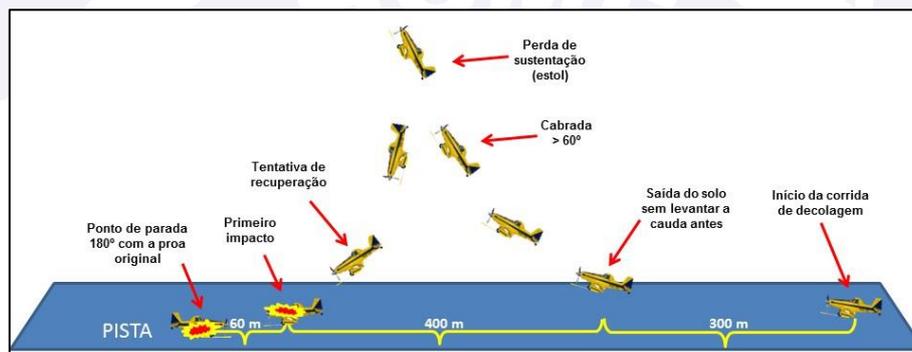


Figure 7 - Airplane trajectory in the vertical plane

Considering pilot's weight as 90 kg and an empty hopper, the aircraft was within the prescribed weight & balance limits.

1.19 Additional information.

Brazilian Civil Aviation Regulation 137 (RBAC 137)

The pilot was not proficient at English language.

Brazilian aeronautical regulations do not require the foreign manufacturer to provide their publications in Portuguese for aircraft sold to Brazil.

According to RBAC 137:

I) 137.201 Aircraft and equipment requirements

(a) An operator of an agricultural aircraft can use it for this kind of operation only if:

(3) operation manual, technical publications, service bulletins, equipment manuals and other documents required for performing the operation are available to pilots and maintenance personnel.

Mandatory Personal Protection Equipment (PPE) according to RBAC 137.

The item 137.209 of RBAC 137 prescribes the use of some protection equipment for agricultural flight, such as helmet, gas-mask and others. However, it does not prescribe the use of flight gloves nor anti-flame overall.

The PT-WFX final report (20JAN2016) found that not wearing these kinds of PPE contributed to worsen aircraft occupants injuries caused by fire on at least three occasions, according to search done with CENIPA's final reports since 2005.

Civil Aviation Brazilian Regulation 61 (RBAC 61)

The pilot held a pilot's license for airplane single engine land, which allowed him to fly aircraft such as Ipanema and Air Tractor (same class aircraft despite different characteristics). However, he had not been operating any aircraft for six months, and did not have any valid instruction to safely operate AT-502B.

Item 61.199 from RBAC 61 in force on the accident date:

I) 61.199 Prerogatives and limitations of the category and class license holder.

(a) The prerogatives of the category or class license holder are: to pilot category or class aircraft in which is certified, in the function of pilot in command.

(b) ... The category or class license holder must have had instruction (with a certified instructor) to safely operate the aircraft before being able to conduct operation in such aircraft. The instruction must be registered in pilot's flight records, where the instructor shall declare that the pilot is apt to safely operate the aircraft.

II) 61.21 Recent experience

(a) ... No pilot can act as an aircraft pilot in command or second pilot in command if, within the 90 previous days, they have not made:

(1) for day-time operations: at least three takeoffs and three landings in visual flight conditions, in which they have effectively controlled the same category, class and model/type aircraft, as required.

Supplementary Instruction 61-006 (IS 61-006), B revision – Procedures for endorsement entry in pilot's flight records.

According to this legislation (IS 61-006), an *Ipanema* pilot does not need any endorsement to operate an Air Tractor.

AT-502B accident record, similar to this occurrence.

PR-TPL – 01MAR2013

The aircraft became airborne about three meters before the departure end, lost height, and collided with two fences (86m and 98m of the departure end), followed by the impact with the ground. The aircraft came to rest about 140m of the departure end, and with operating engine.

The aircraft was substantially damaged, and the pilot was uninjured.



Figure 8 - PR-TPL after crash.

In this accident, the pilot had been working in agricultural aviation for more than ten years, and had accrued flight experience by operating aircraft such as EMB-202 (320 HP and maximum takeoff weight of 1,800 kg).

The pilot was on his first aerial application flight with AT-502B Air Tractor (750 SHP and maximum takeoff weight of 3,629 kg).

PT-SUL – 07JUNE2013

It was an aerial application flight with departure from a contingent airstrip.

During takeoff roll, the pilot started to jettison the hopper load. Then, it entered a cotton crop beyond the departure end, flipped over, and came to rest up-side-down.

A left wing fire ensued. An agricultural assistant helped the pilot to exit the aircraft.



Figure 9 - PT-SUL after crash.

The pilot had operated EMB-201 and EMB-202 on previous aerial applications.

The pilot was on aerial application with AT-502B Air Tractor for the first time on the accident.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

The pilot was licensed for flying airplane single engine land, what allowed him to fly the AT-502B Air Tractor within the required conditions. However, even with a large experience on agricultural aircraft (EMB-201 and EMB-202), he was not able to safely operate AT-502B.

According to RBAC 61, item 61.199, in force on the day of the accident, to be able to fly an aircraft the pilot must have had instruction with certified instructor for learning the safe operation of the aircraft. Such instruction must be registered in pilot's flight records. The requirements were not fulfilled, and the pilot was trying to learn the AT-502B operation by himself.

The lack of instruction and Air Tractor knowledge posed considerable risk in its operation, as the pilot was unaware of the parameters to safely operate the aircraft.

The company that hired the pilot did not consider this issue. It assumed pilot's background was sufficient, and allowed the pilot operating the AT-502B to adapt to the aircraft by himself.

The adaptation to the Air Tractor was likely hindered by pilot's reluctance to modify his flight style or learn how to operate with new technologies.

Although IS 61-006 revision B required a recorded instructor endorsement for the pilots who wanted to operate an aircraft of the same class of another aircraft they were already licensed to operate, this requirement was not mandatory for airplanes single engine land class (*Ipanema* and Air Tractor class).

The company did not have any formal process of hiring pilots. It was done informally by reliable person influence. The convocation did not consider pilots' ability in the specific aircraft, and did not check recent background or if they would need any instruction before the flights.

By a simple check, the company could have noticed the pilot had not been operating any aircraft within six previous months. This condition disabled the pilot to operate any aircraft (according to RBAC 61, item 61.21 in force on the accident date).

The period the pilot was not in a job (6 months) harmed his financial means to support the family duties. It likely increased his anxiety to be back to work in the new company, with a new airplane, so as he was motivated to learn the new equipment operation even faster.

Such circumstances may have influenced the pilot's neglect of the risks entailed in trying to operate a new aircraft without specialized instruction or previous flights on a simulator.

In addition, the pilot had earned advance payment for health examination in order to renew his aeronautical medical certificate. It was another obligation he would have to comply with.

The company informality characteristic in pilots hiring process and in the lack of monitoring and evaluation of pilots' performance harmed the effective management of the issues related to the ability of the accident pilot.

This fault deteriorated the safety level of company's operations, as the pilot had complete autonomy to conduct his own training, without any company interference or support.

The pilot was used to operate in an informal work environment of little discipline. As the situation permitted him to actuate out of standardized procedures, based only on his previous professional experience, everything was contributing to an aeronautical accident occurrence.

By analyzing all collected data it was possible to presume that pilot's colleagues would hardly contest him about any subject related to aerial activity, as he was considered the best agricultural pilot in the region. Although his friendly relationship, there was some resistance to accepting other pilots' assistance in AT-502B training. Thus, despite some pilots offered this assistance, nobody would question his denial.

Pilot's large experience in addition to his image among partners probably raised his self-confidence, and contributed to his decision to refuse assistance.

Pilot's aeronautical medical certificate was valid, and it was not found anything that could forbid him to conduct a flight as a pilot according to medical or psychological data.

Visual meteorological conditions prevailed at the time of the accident. SNBS was a public aerodrome under the administration of the *Balsas* municipal government. It operated day-time VFR, and was compatible with Air Tractor operation.

According to collected data, the pilot had operated the Air Tractor aircraft at least four times before the flight of the accident. The first time was a 20 minutes flight on

18OCT2015. The others were on 09NOV2015. None of them was supervised by an instructor.

On the day of the accident, the pilot aimed the training of takeoffs, traffic circuits and landings for his proficiency. He was trying to adapt to the aircraft by himself.

After the first flight on 09NOV2015, the pilot was advised about the propeller lever position (fully forward) for takeoff, as he had accelerated the engine with propeller lever aft (wrong position). As this procedure was prescribed in the aircraft operation manual, it was noticed pilot's lack of knowledge/study.

As the AT-502B manual was available only in English, and the pilot was not proficient at this language (what can have contributed to the lack of knowledge about the procedures and aircraft operation limits), the workshop owner instructed the pilot about some aircraft characteristics, in an informal Air Tractor operation culture.

Brazil's National Civil Aviation Agency (ANAC) had not issued any regulation that required pilots to be proficient at English language before operating an aircraft in Brazil's territory.

RBAC 137, item 137.201 (a) (3), required only that the agricultural aircraft operator provided operation manuals, technical publications, service bulletins, equipment manuals and other documents required for performing the operation to the pilots and maintenance personnel.

As the hiring process was informal and there was no control on pilot's development, the company did not identify this problem. Thus, it did not provide any English training for the pilot, what could have helped him to understand the manual and the Air Tractor operation.

During the accident flight short field takeoff (just like all previous takeoffs on that day) the pilot rolled through 300 meters of the runway 33. The short field takeoff recurrence was an evidence of pilot's difficulty in aircraft control. Even after other pilot's guidance he was not able to make an AT-502B satisfactory takeoff. An instructor could have avoided the mistakes (condition required on RBAC 61 in force on the day of the accident).

It was not possible to assert what caused the aircraft abrupt pitch (exceeding 60° climb angle) shortly after it became airborne.

A hypothesis is related to the engine power differences between *Ipanema* and Air Tractor 502B (AT-502B is two times more powerful than *Ipanema*). In addition, Air Tractor was taking off with approximately 2,686kg (almost 1,000kg below the maximum takeoff weight). As the pilot did not know well the aircraft, he may have had a sensory perception of exceeding performance that prompted him to inappropriate operation of the aircraft.

The excessive climb angle can also be related to a possible spatial disorientation, as entire takeoff roll was done with the tail section on the ground (reduced horizon view). Pilot's situational awareness of the aircraft position (attitude) during takeoff roll can have been affected by the anxiety at the difficulties in Air Tractor operating. Pilot's sudden incapacitation can also be considered.

Due to Air Tractor engine power, the aircraft climbed for a while. Then the reduced aerodynamic lift caused a stall. The aircraft descended in a steep nose down attitude toward the ground, but before the impact the aircraft started changing its attitude as though the pilot had tried to pitch up the airplane. Thus, it is likely that the pilot was conscious right before the crash.

The aircraft collided with the runway about 400 meters of the point it became airborne.

In the impact the right wing exploded, and the fire consumed entire aircraft, what hindered further analysis of engine and its components.

The engine twisted at "C" flange. This fact reinforced the idea that engine was developing power at the moment of the accident.

Pilot's body was found next to the aircraft with a piece of the seat attached to him. He was probably trying to escape from the aircraft on fire, and he was not wearing appropriate clothes to protect him against fire burn.

According to research in previous agricultural accidents data, there are other cases of serious/fatal injuries caused by postimpact fire.

The RBAC 137 regulation, item 137.209, determines some mandatory PPE for agricultural aviation, such as helmet and closed shoes, but it does not require the use of gloves nor anti-flame overall. This is the only ANAC regulation that requires PPE for an operation, probably because it enhances survival chances in case of an accident.

Mandatory use of gloves and anti-flame overall could have avoided serious fire injuries, and could have enhanced pilot's survival chances.

3. CONCLUSIONS.

3.1 Facts.

- a) The pilot had valid Aeronautical Medical Certificate;
- b) The pilot had valid technical qualification certificate for single-engine land aircraft. However, his agricultural pilot certificate was not valid.
- c) The pilot was not proficient at the accident aircraft, and had 57 minutes of flight in the aircraft model.
- d) The aircraft had a valid Airworthiness Certificate.
- e) The aircraft was within the weight & balance limits;
- f) The part I of the airframe, engine and propeller logbook records were outdated.
- g) The company did not have formal hiring process for pilots;
- h) The pilot was adapting to Air Tractor by himself, without any certified instructor guidance;
- i) All takeoffs were performed without lifting the tail section;
- j) In the accident takeoff, the aircraft pitched up abruptly soon after becoming airborne;
- k) The aircraft stalled and impacted the ground;
- l) The engine was developing power;
- m) A postimpact fire ensued, and the aircraft was destroyed; and
- n) The pilot was fatally injured.

3.2 Contributing factors.

- **Control skills - a contributor.**

As the pilot was not adapted to Air Tractor, he actuated improperly on aircraft controls so as it got an aggressive pitched up attitude right after takeoff.

- **Attitude - undetermined.**

The pilot decided to operate the Air Tractor without any appropriate training probably based only on his large experience and proficiency on other aircraft models (what generated excessive his self-confidence).

- **Organizational climate - a contributor.**

Informal procedures were usually adopted in the operations of the company. Such informality contributed to pilot's disregarding of the risks of adapting to Air Tractor without any certified instructor and actuating out of the standardized procedures.

- **Disorientation - undetermined.**

The pilot may have lost visual contact with references that could support him to keep the aircraft in the correct attitude. It may have influenced the over 60 degrees pitched up attitude after takeoff.

- **Emotional state - undetermined.**

Pilot's anxiety to adapt himself to the new aircraft, and his necessity to restart working to comply with his financial obligations can have diminished his ability to operate the Air Tractor (more powerful aircraft than the ones he was used to pilot).

- **Training - a contributor.**

The company had no training program for pilots and did not support the pilot (informally hired) to get any instruction before operating the Air Tractor. The AT-502B manual was available only in English, and the pilot was not proficient at this language. The stall could have been prevented if there was an instructor during pilot's adaptation.

- **Instruction - a contributor.**

The lack of instruction is a relevant point that contributed to this occurrence, as the pilot did not have technical ability and appropriate manual knowledge to safely operate the Air Tractor.

- **Motivation - undetermined.**

Pilot's financial difficulties can have influenced him not to assess the risks of training without previous instruction and appropriate aircraft knowledge.

- **Insufficient pilot's experience - a contributor.**

Despite his considerable and practical professional experience of agricultural aviation on board EMB-201 and EMB-202 aircraft, he had no practice in operating the AT-502B.

- **Organizational processes - a contributor.**

The company had an informal process of hiring pilots (indication). This process did not consider specific qualification that should be required for the aerial operation, and did not set any systemic standard of supervision or pilots monitoring. The lack of prescribed formal process contributed to pilot's self-instruction and to the accident occurrence.

- **Managerial oversight - a contributor.**

The informal hiring process made unsafe conditions for flight, as pilot's inability to operate AT-502B, unidentifiable. It was also noticed the company had no action toward flight safety.

- **Other - self-imposed pressure - undetermined.**

As the pilot was probably trying to operate the Air Tractor as fast as he could (to be back to work), he decided to do it without formal instruction or previous simulator training. It is also possible that he was in a hurry because the aircraft would soon be used on harvest.

4. SAFETY RECOMMENDATION.

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

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

Recommendations issued prior to the publication of this report:

None.

Recommendations issued at the publication of this report:

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

A-147/CENIPA/2015 - 01

Issued on 05/04/2018

To review Supplementary Instruction 61-006 - appendix A, and verify the possibility of inclusion of the AT-502B as a class aircraft which needs specific endorsement, due to the accident recurrence in transition from *Ipanema* to Air Tractor aircraft.

A-147/CENIPA/2015 - 02

Issued on 05/04/2018

To enforce *Ribeirão S.A.* to manage its supervision process of hiring pilots, and make it formal, so as it can be possible to ensure pilots’ knowledge before operating the aircraft.

A-147/CENIPA/2015 - 03

Issued on 05/04/2018

To consider the inclusion of gloves and anti-flame overall as required Personal Protection Equipment (PPE) in the item 209 of RBAC 137.

A-147/CENIPA/2015 - 04

Issued on 05/04/2018

To appreciate the necessity of minimum proficiency in English language for civil aircraft operation when the aircraft manual is not available in Portuguese, but only in English.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On April 5th, 2018.