COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-020/CENIPA/2022

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-TAR**
MODEL:	**AT-502B**
DATE:	**09FEV2022**

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 considering 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 distinct 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 Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

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

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

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Considering 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 09 February 2022 accident involving the AT-502B aircraft of registration marks PR-TAR. The accident was typified as “[CTOL] Collision with obstacle during takeoff and landing”.

During takeoff, the aircraft was unable to gain sufficient altitude to clear the obstacles ahead. After colliding with the obstacles, the aircraft returned to the ground without control.

The aircraft sustained substantial damage.

The pilot suffered no injuries.

Being Canada the State of aircraft and engine manufacture, the Canadian TSB (Transportation Safety Board) appointed an Accredited Representative for participation in the investigation of the occurrence.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CENIPA	Brazil's Center for the Investigation and Prevention of Aeronautical Accidents
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
COA	Air Operator Certificate
CVA	Airworthiness-Verfication Certificate
DECEA	Command of Aeronautics' Department of Airspace Control
GRSO	Safety Risks Management
MNTE	Single-Engine Land Airplane Class Rating
PAGA	Agricultural Pilot Rating - Airplane
PCM	Commercial Pilot License - Airplane
PIC	Pilot in Command
PPR	Private Pilot License - Airplane
QAV-1	Aviation Kerosene
RBAC	Brazilian Civil Aviation Regulation
SAE-AG	Specialized Public Air Services Registration Category - Agricultural
PSO-BR	Brazilian Civil Aviation Safety Program
SIPAER	Aeronautical Accidents Investigation and Prevention System
UTC	Coordinated Universal Time

1. FACTUAL INFORMATION.

Aircraft	**Model:** AT-502B **Registration:** PR-TAR **Manufacturer:** Air Tractor.	**Operator:** *Tom Aviação Agrícola Ltda*.
Occurrence	**Date/time**: 09FEV2022 – 13:50 (UTC) **Location:** *Fazenda Santa Clara* **Lat.** 19°29'02"S **Long.** 047°27'56"W **Municipality – State:** *Santa Juliana – Minas Gerais*.	**Type(s):** [CTOL] Collision with obstacle(s) during take-off and landing

1.1. History of the flight.

At approximately 13:50 UTC, the aircraft was taking off from the airstrip for agricultural use of *Fazenda Santa Clara*, in the municipality of *Santa Juliana*, State of Minas *Gerais*, on a crop-dusting flight with 01 POB (pilot).

At takeoff, the aircraft failed to reach enough altitude for clearance of the obstacles past the departure end of the airstrip, and collided with the vegetation ahead, returning to the ground and traveling approximately 100 m until coming to a complete stop.

The aircraft sustained substantial damage.

The pilot suffered no injuries.

1.2. Injuries to persons.

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

1.3. Damage to the aircraft.

The landing gear, propeller, vertical stabilizer, horizontal stabilizer, elevator, and rudder of the aircraft were destroyed.

The aircraft suffered substantial damage to the fuselage, wings, flaps, ailerons, and to most of its structure.

The engine sustained slight damage.

1.4. Other damage.

NIL.

1.5. Personnel information.

1.5.1. Crew's flight experience.

FLIGHT EXPERIENCE	
	PIC
Total	2,030:00
Total in the last 30 days	55:54
Total in the last 24 hours	03:06
In this type of aircraft	260:00
In this type in the last 30 days	55:54
In this type in the last 24 hours	03:06

RMK: Flight Experience data informed by the Pilot in Command (PIC).

1.5.2. Personnel training.

The PIC did his PPR course (Private Pilot – Airplane) in 2016, at the *EJ Escola de Aviação Civil*, located in the municipality of *Itápolis*, State of *São Paulo*.

1.5.3. Category of licenses and validity of certificates.

The PIC held a PCM License (Commercial Pilot - Airplane) and had valid ratings for MNTE (Single-Engine Land Airplane) and PAGA (Agricultural Pilot - Airplane).

1.5.4. Qualification and flight experience.

According to the data collected from his digital Pilot Logbook (CIV), the PIC had qualification and experience for the type of flight.

1.5.5. Validity of medical certificate.

The PIC held a valid CMA (Aeronautical Medical Certificate).

1.6. Aircraft information.

The serial number 502B-2912 aircraft was a product manufactured by Air Tractor in 2013, registered in the Private Registration Category - Specialized Agricultural Aviation Service (SAE-AG).

The aircraft's CVA (Airworthiness-Verification Certificate) was valid.

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

The aircraft's empty weight was 2,062 kg. It had been fueled with 500 liters of QAV-1, equivalent to a weight of 385 kg; it also had been loaded with 1,400 kg of agricultural pesticides. The PIC weighed 80 kg; therefore, the gross weight of the aircraft was 3,927 kg.

1.7. Meteorological information.

According to data collected, the weather conditions were above the minimums for the operation of the proposed flight.

According to information, there was fog over the airstrip in the period from 09:00 UTC until 12:30 UTC.

The PIC stated that, at the first takeoff, the ambient temperature was around 20°C and the aircraft took off upwind. He also reported that, during the sixth takeoff (the one of the occurrence), at about 13:50 UTC), the external temperature was around 29°C and that the wind was no longer an upwind.

1.8. Aids to navigation.

NIL.

1.9. Communications.

NIL.

1.10. Aerodrome information.

The airstrip for agricultural aviation use had a length of 1,100 m and, in relation to the gradient, there was an elevation difference of approximately 3 m between the thresholds. According to the PIC, takeoffs were always performed from the lower to the higher threshold (positive gradient), due to the presence of obstacles near the lower threshold, and landings were made in the opposite direction.

Figure 1 shows the abovementioned obstacles.

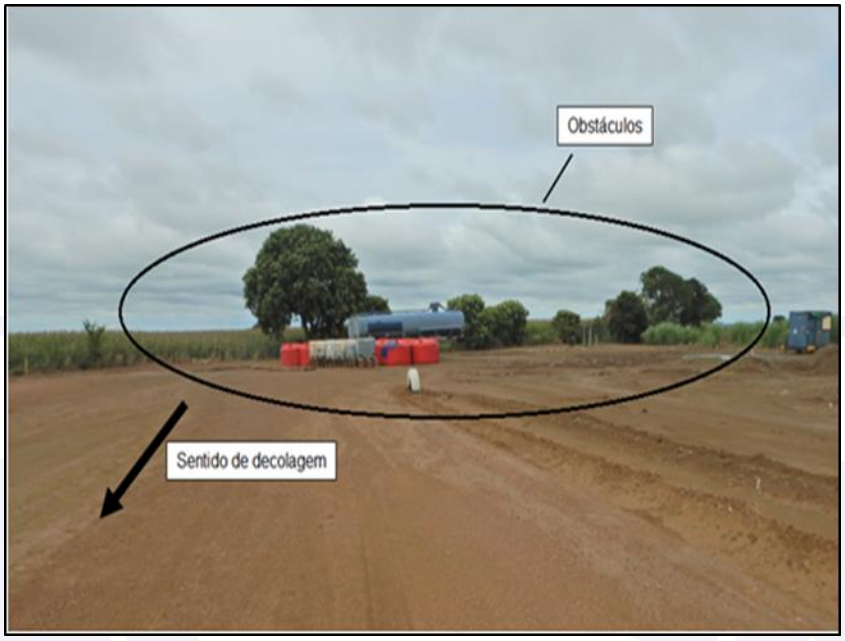

Figure 1 - Obstacles near the threshold used for takeoff.

The Investigation Committee learned from the PIC that it had rained heavily both the day before and in the early morning, and that the dirt airstrip was still wet.

1.11. Flight recorders.

Not required and not fitted.

1.12. Wreckage and impact information.

The aircraft flew approximately 150 m after getting airborne, maintaining a height of approximately 5 ft. above the terrain. Such height that was not sufficient for the aircraft to fly over the sugarcane plantation lying ahead. The airplane initially hit the crop with the main landing gear wheels and the spray bar, returning to the ground and travelling for about 100 m in contact with the plantation, after which it flipped over and rotated 180° in relation to its original direction of flight before coming to a complete stop (Figure 2).

Figure 2 - Final position of the aircraft.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

NIL.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

NIL.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

NIL.

1.16. Tests and research.

The aircraft's powerplant was examined by the Investigation Committee, which identified no evidence of failure or malfunction of the referred system.

All damage found to the engine resulted from the impact.

1.17. Organizational and management information.

The Brazilian Civil Aviation Regulation n° 137 (RBAC-137), amendment 4, dealing with certification and requirements for agricultural aviation operations, established that the operator, holder of the Air Operator Certificate (COA), should comply with the requirements established for the intended operation.

Among these requirements, for the case in question, the operator would need to prepare an Operational Safety Risk Management (GRSO) manual and maintain it at headquarters, as can be seen in the excerpt from the aforementioned regulation, transcribed below:

> SUBPART D
>
> LANDING AREA FOR AGRICULTURAL AVIATION USE AND AGRICULTURAL AVIATION OPERATIONS AT AERODROMES
>
> 137.301 Landing area for agricultural aviation use
>
> [...]
>
> (c) the COA holder must prepare the GRSO analysis and maintain it at the operational headquarters.
>
> [...]

The data collected in the organizational part indicated a continuous operation in the landing area for agricultural aviation use, where the calculations necessary for risk management were not performed, either by the operator or by the PIC.

1.18. Operational information.

The purpose of the flight was to spray pesticides in a nearby sugarcane plantation. The PIC arrived at the takeoff site at approximately 09:00 UTC, but had to wait until 12:30 UTC to begin the operation due to weather conditions, as there had been fog over the field since dawn.

There were no abnormalities or malfunctions related to the performance of the aircraft or its systems in any stages of the flight carried out before, from the flight preparation actions, including the five previous sorties, until the sixth takeoff, in which the accident occurred.

The PIC reported that he had made five uneventful sorties, and that he stopped to refuel the aircraft before the sixth sortie. He stated that he supplied the aircraft with the same amount of fuel and agricultural product as he did for the first takeoff, so that the aircraft had the same weight and balance configuration as at the beginning of the operation.

The Investigation Committee found that it had rained heavily the previous day and in the early morning of the day of the occurrence. According to a report from the PIC, the ground surface was wet and this condition was evident in the maneuvers of the aircraft on the ground, for example, during the backtracking on the airstrip, the "aircraft moving with difficulty and skidding". Despite these conditions, the airplane took off with flaps at 10° (Figure 3).

Figure 3 - Indication of the position of the flaps, at the accident site, in an intermediate position between 10º and 20º.

During the takeoff run, at approximately 13:50 UTC, with an outside temperature of 29°C, the PIC noticed that the wind had changed (it was no longer a headwind) and that the aircraft required more distance to get airborne than on previous takeoffs. When the aircraft reached the point where it would normally rotate, it had not yet reached the speed to do so, but he still acted on the controls trying, unsuccessfully, to get off the ground.

The PIC reported that he, subsequently, jettisoned the agricultural product and finally managed to get off the ground after having traveled approximately 1,000 m on the airstrip. The aircraft left the ground precariously, destabilized and unable to gain altitude, losing the takeoff axis to the left, crossing the departure end with approximately a 5-degree lateral offset (Figure 4).

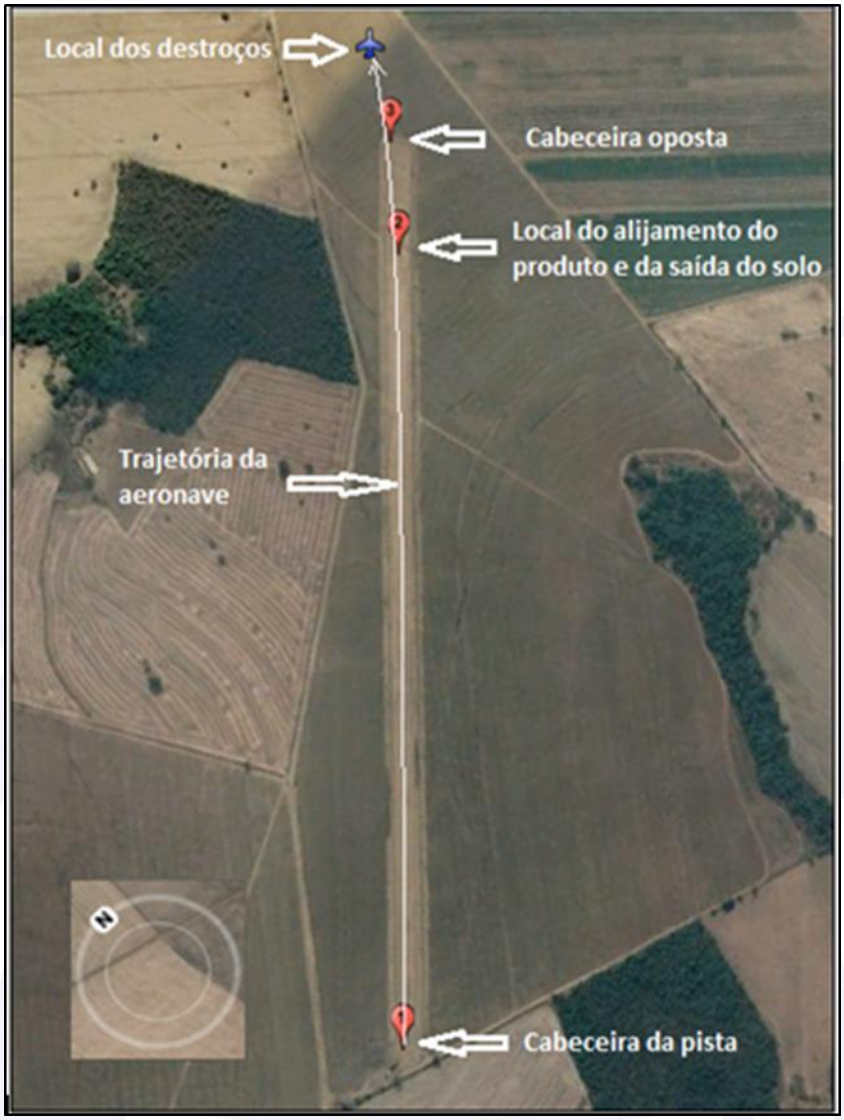

Figure 4 - Trajectory of the accident aircraft until coming to a complete stop.

The aircraft weight at takeoff was 3,927 kg (8,657.5 lb.). The Supplement 02-0144 to the Aircraft Flight Manual (*Brazilian Agricultural Operations above Certificated Maximum Weight*) specified that takeoffs with weights above 8,000 lb. (3,629 kg) were to be performed with flaps positioned at 20° (and not 10°, as in normal takeoffs). Takeoff power would be fully applied at the departure runway threshold, with the brakes depressed and released in the sequence, for the aircraft to complete the takeoff normally.

The aforementioned supplement described the actions, as follows:

> *[...] TAKEOFF AT WEIGHTS ABOVE 3629KG (8000LB):*
>
> *Take into account density altitude, runway length/conditions, and terrain. Reduce your aircraft weight as necessary to allow for a safe takeoff and flight. […]*
>
> *[…] 1. Lower flaps to 20° position (second mark).*
>
> *2. Hold the brakes and slowly apply full power (within torque and temperature limits).*
>
> *3. Release the brakes and allow the aircraft to accelerate. […]*

When asked about the weight and balance calculations for the operation in that agricultural-use airstrip, the PIC said that he had done the calculations from the top of his head; he had not done them using the graphs and tables of the aircraft's flight manual.

He also stated that there was a consensus among the pilots that the airstrip in question was “bad” for that type of aircraft, and that he thought that the ideal runway for the Air Tractor would have a length between 1,300 and 1,400 m.

The Investigation Committee used the data collected to make the calculations for takeoff in that operational context: an aircraft weight of 3,927 kg (8,657.5 lb.); a landing area at an elevation of 3,400 ft.; an outside temperature 29°C; and a calm wind. From the Takeoff-Distance table of the aforementioned supplement, one found that the minimum runway length required was 1,302 m.

The Investigation Committee also observed that the operator had not conducted a detailed study of the operating conditions in that landing area, with regard to the minimum runway length required to operate safely, and addressing mandatory aspects for that type of operation, such as: aircraft weight, runway gradient and altitude, obstacles at the thresholds, terrain conditions, wind, temperature, etc.

1.19. Additional information.

NIL.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

The Investigation Committee learned that the five takeoffs prior to the accident had been uneventful. However, on the sixth takeoff, despite the fact that it took place under the same conditions of aircraft weight (3,927 kg - 8,657.5 lb.) and runway humidity, the wind had changed direction and that the temperature had risen to 29°C, as reported by the PIC.

The Supplement 02-0144 to the Aircraft Flight Manual prescribed that takeoffs with weights above 8,000 lb. (3,629 kg) should be performed with the flaps positioned at 20°, and that takeoff power should be fully applied at the departure runway threshold with the brakes depressed and released in sequence, with the aircraft completing the takeoff normally.

When making calculations based on the available data, i.e. weight 3,927 kg (8,657.5 lb.); altitude 3,400 ft.; outside temperature 29°C; and calm wind, using the Takeoff Distance table contained in the aforementioned manual, one found that the minimum length required would be 1,302 m, that is, 202 m more that the available length of the airstrip.

Furthermore, the PIC reported that he had performed a normal takeoff (with flaps positioned at 10º, without holding the aircraft with the brakes at the departure runway threshold during the application of power) and that the wind had changed direction. Therefore, since the takeoff configuration was not in accordance with the parameters prescribed by the manufacturer, there was not a way to ensure that the aircraft's takeoff performance would correspond to the one expressed in the Takeoff Distance table, a fact the compromised the aircraft performance issue even further.

Therefore, one found that important aspects related to the operation in that operational context were not properly evaluated by the PIC, casting doubts on the aircraft's performance under the conditions observed in the occurrence, especially in relation to the consultation of diagrams and tables related to runway length contained in the flight manual and its supplements.

The Investigation Committee verified that the operator did not exercise management of the risks to safety (GRSO) resulting from the conditions of operation in that airstrip with reference to the minimum parameters necessary for a safe operation. Such management would have to include much needed aspects for that type of operation, such as: aircraft weight, runway gradient and altitude, obstacles at the thresholds, terrain conditions, wind, temperature, etc.

The continuous operation on that airstrip, without the required calculations for risk management on the part of the operator or on the part of the PIC, demonstrated the adoption of informal practices and rules resulting from a complacent attitude.

Thus, one found that, without the necessary planning, previously prepared by the operator and verified by the PIC, loopholes were created which favored operation outside the required parameters and, consequently, with safety levels below the acceptable minimums.

3. CONCLUSIONS.

3.1. Findings.

a) the PIC held a valid CMA (Aeronautical Medical Certificate);

b) the PIC held valid MNTE and PAGA ratings;

c) the PIC had qualification and experience for the type of flight;

d) the aircraft had a valid CVA (Airworthiness-Verification Certificate);

e) the aircraft was outside its weight and balance limits;

f) the records of the airframe, engine, and propeller logbooks were up to date;

g) the weather conditions were above the minimums for the flight;

h) no abnormalities or malfunctions were observed in the performance of the aircraft or its systems;

i) there was an elevation difference of approximately 3 m between the runway thresholds, and the takeoff was performed with a positive gradient, in addition to an outside temperature of approximately 29°C;

j) the operator did not have a detailed study (GRSO) on the operating conditions in that airstrip;

k) the takeoff was not performed in accordance with the prescriptions of the Supplement 02-0144 to the Aircraft Flight Manual (*Brazilian Agricultural Operations above Certificated Maximum Weight*) for those conditions, which established that the flaps should be positioned at 20° and that takeoff power should be applied with the brakes depressed at the departure runway threshold;

l) the PIC jettisoned the agricultural product after the aircraft had already traveled approximately 1,000 m of the airstrip for agricultural aviation use;

m) the aircraft flew approximately 150 m, but failed to clear the plantation ahead, returning to the ground and dragging in contact with the vegetation for about 100 m, eventually flipping over and rotating 180 degrees from its direction of travel before coming to a complete stop;

n) the aircraft sustained substantial damage; and

o) the PIC suffered no injuries.

3.2. Contributing factors.

- **Attitude – a contributor.**

The continuous operation on that airstrip, without the making of necessary calculations for risk management either by the operator or by the PIC, demonstrated the adoption of informal practices and rules that showed an attitude of complacency in relation to the safety of operations.

- **Piloting judgment – a contributor.**

The takeoff performed was not in accordance with the configuration prescribed in the flight manual for those operating conditions. A normal takeoff was performed with flaps at 10°, and without the brakes being depressed at the departure runway threshold during the

application of power, something that contributed to the aircraft not clearing the obstacles near the departure end of the airstrip.

- **Decision-making process – a contributor.**

The decision to perform the flight outside the standards established by the flight manual revealed flaws in the decision-making process that ended up leading to scenario of the occurrence.

- **Managerial oversight – a contributor.**

The lack of management of the risks to safety (GRSO) posed by the operating conditions in that airstrip, relative to the minimum parameters necessary to operate safely, allowed the emergence of loopholes that favored the conduction of operations outside the required parameters and, consequently, with safety levels below the acceptable minimums.

4. SAFETY RECOMMENDATIONS

None.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On August 14th, 2024.