

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A-041/CENIPA/2023

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PS-JCB
MODEL:	AT-402B
DATE:	03MAR2023



NOTICE

According to the Law n^o 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 n^o 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 03 March 2023 accident involving the AT-402B aircraft of registration marks PS-JCB. The occurrence was classified as “[UIMC] Unintentional IMC and [LOC-I] Loss of Control in Flight”.

During the ferry flight destined for the agricultural airstrip of *Fazenda Flor Gaúcha*, in the municipality of *Aripuanã*, State of *Mato Grosso*, the aircraft crashed into the ground after approximately 20 minutes of flight.

It was found that the aircraft inadvertently entered adverse weather conditions.

The aircraft was destroyed in the crash.

Both the pilot and the passenger suffered fatal injuries.

Being the USA the State of aircraft design/manufacture and Canada the State of the aircraft's engine manufacture, accredited representatives from both countries (01 per country) were appointed respectively by the USA's National Transportation Safety Board and Canada's Transportation Safety Board for participation in the investigation of the accident.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AFM	Aircraft Flight Manual
ANAC	Brazil's National Civil Aviation Agency
CB	Cumulonimbus cloud
CIMAER	Command of Aeronautics' Integrated Meteorological Center
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
CVA	Certificate of Airworthiness-Verification
FAA	Federal Aviation Administration
ICA	Command of Aeronautics' Instruction
IFR	Instrument Flight Rules
IFRA	IFR Flight Rating - Airplane
IMC	Instrument Meteorological Conditions
INMET	Brazil's National Institute of Meteorology
IS	Supplementary Instruction
MNTE	Single-Engine Land Airplane Rating
NTSB	USA's National Transportation Safety Board
PAGA	Agricultural Pilot Rating - Airplane
PIC	Pilot in Command
PCM	Commercial Pilot License - Airplane
POB	Persons On Board
PPR	Private Pilot License - Airplane
RBAC	Brazilian Civil Aviation Regulation
REDEMET	Command of Aeronautics' Meteorology Network
SACI	Integrated Civil Aviation Information System
SIGMET	Significant Meteorological Information
SIGWX	Significant Weather Chart
SN	<i>Serial Number</i>
SPECI	Selected Special Aerodrome Meteorological Report
SWJN	ICAO location designator – Aerodrome of <i>Juína, Mato Grosso</i>
TCU	Towering Cumulus cloud
TSB	Canada's Transportation Safety Board
UTC	Coordinated Universal Time
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	Model: AT-402B Registration: PS-JCB Manufacturer: Air Tractor	Operator: <i>Solag Sol e Lua Aviação Agrícola Ltda</i>
Occurrence	Date/time: 03MAR2023 - 15:00 (UTC) Location: <i>Gleba Iracema III Sítio 4R</i> Lat. 11°03'40"S Long. 058°56'14"W Municipality – State: <i>Juína – Mato Grosso.</i>	Type(s): [UIMC] Unintended flight in IMC [LOC-I] Loss of control - inflight

1.1. History of the flight.

At approximately 10:40 UTC, the aircraft took off from SWJN (Aerodrome of Juína, State of Mato Grosso), bound for the landing area for agricultural use of *Fazenda Flor Gaúcha, Aripuanã, Mato Grosso* on a ferry flight with 02 POB (a pilot and a passenger).

After approximately twenty minutes of flight, the aircraft crashed into the ground amid degraded weather conditions.



Figure 1 - View of the PS-JCB at the accident site.

The aircraft was destroyed in the crash.

The pilot and the passenger suffered fatal injuries.

1.2. Injuries to persons.

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

1.3. Damage to the aircraft.

The aircraft was destroyed.

1.4. Other damage.

NIL.

1.5. Personnel information.

1.5.1. Crew's flight experience.

FLIGHT EXPERIENCE	
	PIC
Total	1.289:47
Total in the last 30 days	05:09
Total in the last 24 hours	00:00
In this type of aircraft	345:00
In this type in the last 30 days	05:09
In this type in the last 24 hours	00:00

RMK: flight time data obtained through records of the pilot's Digital Logbook (CIV), records from the ANAC's Integrated Civil Aviation Information System (SACI), and information provided by the aircraft owner.

1.5.2. Personnel training.

The Pilot in Command (PIC) did his PPR course (Private Pilot – Airplane) in 2013, at the *Aeroclub de Ponta Grossa*, State of *Paraná*.

1.5.3. Category of licenses and validity of certificates.

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

The PIC was not rated for IFRA (IFR Flights - Airplane).

1.5.4. Qualification and flight experience.

The records of the pilot's digital CIV indicated that he had been operating the AT-402B aircraft (registration marks PS-JCB) since April 2021 and was familiar with the region of the flight.

The PIC's operational background was based on his experience with agricultural aviation operations in the region, which included the accident site.

According to the PIC's digital CIV, the latest flight record dated from 29 June 2022.

The recent-experience requirement for any operation in which the pilot acted as the PIC of an aircraft was provided for in section 61.21 of the Brazilian Civil Aviation Regulation n° 61 (RBAC-61), in force on the date of the occurrence.

According to the aforementioned provision, a pilot could only act as the Pilot in Command if, within the 90 (ninety) days preceding the flight, he had performed the following:

(1) for daytime operations:

(i) free balloon and glider: at least 1 (one) takeoff and 1 (one) landing, during which he had effectively operated the controls of the aircraft of the same category; and

(ii) other categories: at least 3 (three) takeoffs and 3 (three) landings during day- or night-time, in which he effectively operated the controls of the aircraft of the same category and class/type. (Our emphasis)

It was not possible to attest to the qualification of the PIC, since no evidence was presented to confirm that he had actually operated in accordance with the aforementioned regulation.

1.5.5. Validity of medical certificate.

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

1.6. Aircraft information.

The SN 402B-1445 aircraft was a product manufactured by Air Tractor in 2021, and registered in the Private Registration Category of Specialized Public Air Service Agricultural Aviation.

The certification of the aircraft prescribed just 01 POB (pilot).

The CVA (Airworthiness-Verification Certificate) of the aircraft was valid.

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

The aircraft's latest inspection ("100-hour" type) took place on the premises of *SOMA - Serviços, Oficina e Manutenção Aeronáutica* on 18 January 2023 in the municipality of *Primavera do Leste*, State of *Mato Grosso*. The aircraft flew 96 hours and 40 minutes after the referred inspection.

1.7. Meteorological information.

The aerodrome in SWJN, located at a distance of 29.1 NM from the crash site, did not have an aeronautical meteorological station for the provision of local weather conditions.

That being said, the GOES-16 satellite image of 03 March 2023 at 1110Z on the Command of Aeronautics' Meteorology Network (REDEMET), made it possible to infer, for the region of the accident (as highlighted in Figure 2), the occurrence of restricted visibility due to presence of fog and low clouds (*stratus - stratocumulus* type) with base between 400 and 600 ft. There was also the possibility of occasional heavy rain showers due to the presence of a TCU (Towering Cumulus) cloud cover.

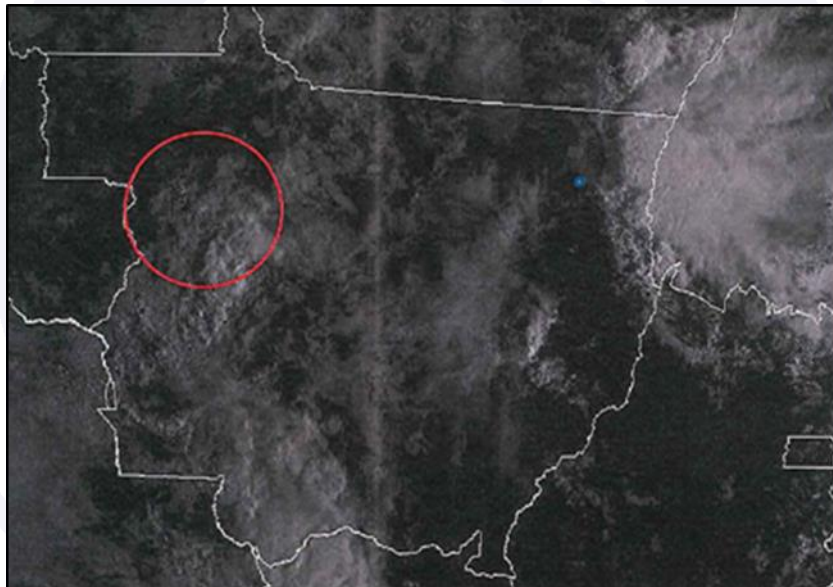


Figure 2 - Image generated by the GOES-16 satellite. Source: REDEMET.

Elaborated by the Command of Aeronautics' Integrated Meteorology Center, and available on the REDEMET website, the SIGWX (Significant Weather Chart), covering from the ground to FL250, valid between 09:00 and 15:00 UTC of 03 March 2023, forecast the following meteorological conditions for the region being analyzed: clouds BKN at 2,500 ft.; BKN at 10,000 ft.; FEW TCU clouds with base at 3,000 ft. and top at 23,000 ft.; extensive areas of precipitation and rain showers (Figure 3).

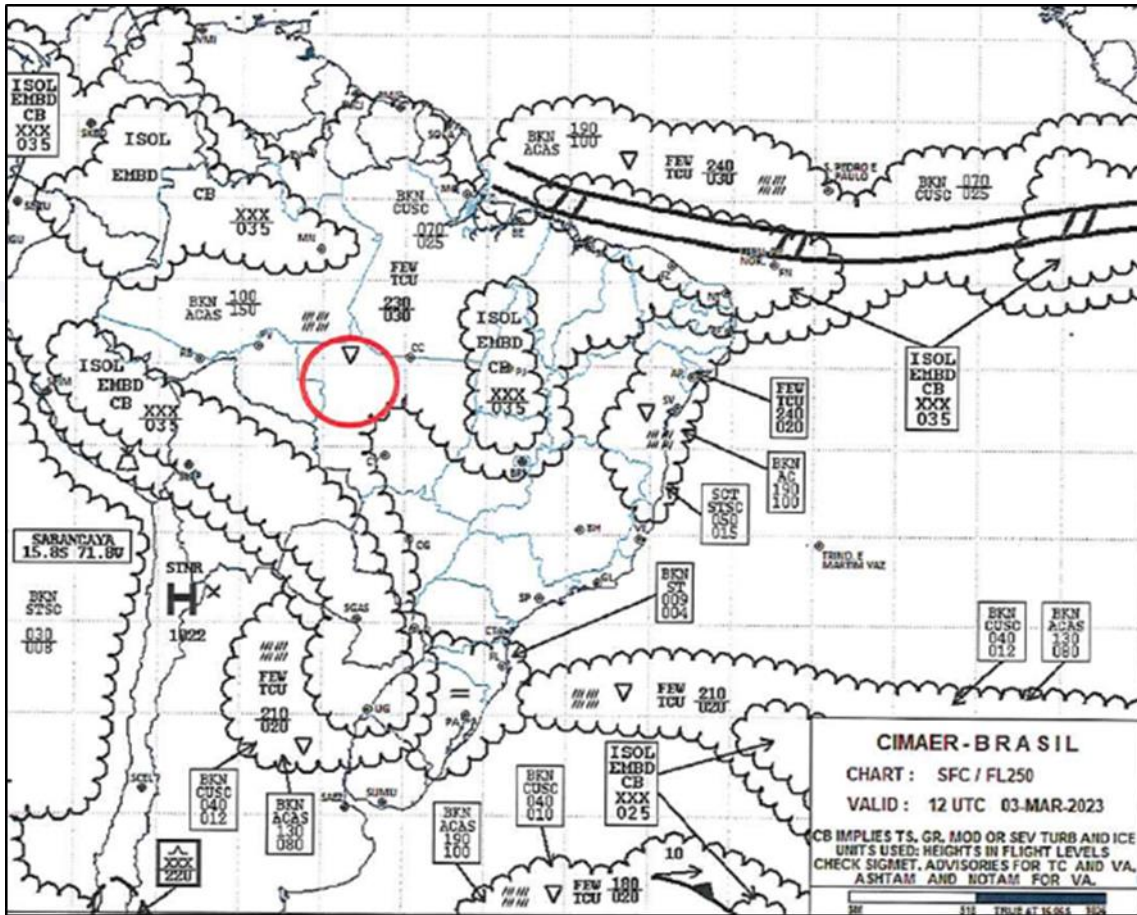


Figure 3 – 12:00 UTC 03 MARCH 2023 SIGWX chart. Source: REDEMET.

In turn, the automatic meteorological station of the National Institute of Meteorology (INMET), located in *Juína*, State of *Mato Grosso*, provided the 03 March 2023 meteorological data presented in Figure 4. The referred station was at a distance of 8.6 km northwest of SWJN.

Hora UTC	PRECIPITAÇÃO (mm)	PRESSAO (mB)	PONTO DE ORVALHO (°C)	TEMP (°C)	UMIDADE RELATIVA DO AR (%)	VENTO (° (gr))	VENTO, RAJADA MAXIMA (m/s)	VENTO (m/s)
1000 UTC	0	970,2	21,7	22,5	96	137	2,9	0,2
1100 UTC	0,4	971	21,9	22,8	95	79	2,5	1,3
1200 UTC	0,4	971,7	22,8	23,9	94	122	3,2	1,6

Figure 4 - Data from the INMET meteorological station in the city of *Juína*, *Mato Grosso*. Source: <https://portal.inmet.gov.br/dadoshistoricos>.

According to the numbers shown, it is possible to observe that there was a precipitation of 0.4 mm at the time of the occurrence, with relative humidity of 95% and temperature of 22.8°C. The wind direction was 079°, with a strength of 1.3 m/s (2.5 kt), with minor gusts of 2.5 m/s (4.85 kt).

During the period analyzed, due to the presence of weak winds, little variation in temperature, and high humidity, there was the possibility of restricted visibility caused by fog and low clouds (*stratus stratocumulus* type) with base between 400 and 600 ft.

The image of the PS-JCB wreckage in Figure 5 was extracted from a video made by local residents approximately 5 minutes after the aircraft crashed into the ground.



Figure 5 - Image of the PS-JCB extracted from a video made by local residents.

In view of this scenario, one concluded that the enroute meteorological conditions were below the minimums required for VFR operations.

The Command of Aeronautics' Instruction ICA 100-39 - "Agricultural Aviation Operation", which had the purpose of "establishing air traffic rules and procedures for agricultural aviation operations within the COMAER jurisdiction", contained the following provisions:

3.1 This ICA regulates the rules and procedures related to the agricultural aviation operation, which, as a specific operation, uses scenarios appropriate for its execution, which are divided into three distinct phases, namely:

- a) the first phase comprises the takeoff and the flight to the application area;
- b) the second phase involves the flight over the area of application; and
- c) the third and final phase is the flight from the area of application to the area of landing.

3.2 During the first and third phases of the flight, and when operating at altitudes equal to or greater than 500 feet AGL, agricultural aviation operations shall be carried out under Visual Flight Rules (VFR) (our emphasis).

3.3 During the second phase of the flight, in terms of visibility and ceiling, agricultural aviation operations shall be carried out under the rules established by the National Civil Aviation Agency (ANAC).

With regard to visual flight rules, the ICA 100-12 - "Rules of the Air", in force on the date of the accident, established the following:

5 VISUAL FLIGHT RULES

5.1 GENERAL CRITERIA

5.1.1 With the exception of *special* VFR flights, VFR flights must be conducted so that aircraft fly in conditions of visibility and cloud clearance equal to or greater than those specified in Table 1.

5.1.2 Notwithstanding the provisions of 5.1.1 above, VFR flights are only permitted when the following conditions can be simultaneously and continuously met:

- a) maintaining reference to the ground or water, so that weather formations below the level of the flight do not obstruct more than half of the pilot's area of sight;
- b) flying below FL 150; and
- c) flying at the speed established in Table 1.

Figure 6 shows the Table 1 contained in the ICA 100-12/2016, referring to the minimum visibility, distance from clouds, and speed in visual flight conditions for Class G airspace, in which the PS-JCB aircraft was operating.

4.9 MÍNIMOS DE VISIBILIDADE E DE DISTÂNCIA DE NUVENS EM VMC
Os mínimos de visibilidade e de distância de nuvens em VMC estão contidos na tabela 1.

Tabela 1

Classe de Espaço Aéreo	B	C D E	FG	
			Acima de 900 m (3000 pés) AMSL ou acima de 300 m (1000 pés) sobre o terreno o que for maior	A 900 m (3000 pés) AMSL abaixo ou 300m (1000 pés) acima do terreno, o que for maior
Distância das Nuvens	Livre de Nuvens	1500 m horizontalmente 300 m(1000 pés) verticalmente	1500 m horizontalmente 300m verticalmente	Livre de nuvens e avistando o solo
Visibilidade	8 km se voando no ou acima do FL100	8 km se voando no ou acima do FL100	8 km se voando no ou acima do FL100	5 km
	5 km se voando abaixo do FL100	5 km se voando abaixo do FL100	5 km se voando abaixo do FL100	
Limite de Velocidade	380 kt	250 kt IAS se voando abaixo do FL100 380 kt IAS se voando acima do FL100		

Figure 6 - Table 1 of the ICA 100-12/2016.

1.8. Aids to navigation.

NIL.

1.9. Communications.

NIL.

1.10. Aerodrome information.

The accident occurred out of aerodrome area.

1.11. Flight recorders.

Not required and not fitted.

1.12. Wreckage and impact information.

The wreckage was located at a distance of 29.1 NM from SWJN.

According to the physical evidence at the point of impact, the aircraft collided directly with the ground in an upside-down position, with a high impact angle and speed, and with no indication of a previous impact. The location of the crash site was in the rural area of *Juína*, State of *Mato Grosso*, a region of difficult access.

The wreckage remained concentrated in a depression of the terrain, with the longitudinal axis aligned with the magnetic heading 230°, and with the fuselage on the ground in an upside-down position (Figure 7).



Figure 7 – Position of the wreckage of the PS-JCB.

The front section of the PS-JCB aircraft ended up buried, making it impossible to observe the propeller blades. The power, propeller, and fuel levers, as well as the cockpit instruments, could not be checked due to the extent of the cockpit's destruction.

The front part of the fuselage sustained substantial damage, and the powerplant penetrated the ground. The rear part showed deformation caused by deceleration and impact with the terrain.

There was wrinkling of the leading edges of the wings and considerable denting in the upper part of the cockpit. The flaps were in the retracted position.

There was no loss of aircraft components before the impact.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

Toxicology and blood alcohol tests showed negative results.

The PIC's most recent health checkup showed no records related to the use of medication. Laboratory tests, electrocardiogram and psychological tests did not reveal any significant changes.

According to reports from persons close to the PIC, he was not undergoing any medical treatments, but there were reports that he was recovering from *dengue fever* and had returned to work a few days before the accident. Due to dengue fever episode, he had been resting at home for a few days in an effort to get better.

According to his family members, he had slept normally the night before the accident, although they did not specify the time he went to bed. The PIC woke up around 4:30 am (local time).

On the day of the accident, the PIC began his work at 5:30 am, and took off from SWJN at 6:40 am (local time).

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

NIL.

1.14. Fire.

Local residents, arriving at the scene a few minutes after the accident, extinguished the post-impact fire that had followed.

1.15. Survival aspects.

Nearby dwellers rushed to the crash site and attempted to rescue the occupants of the aircraft but immediately verified that there were no survivors.

1.16. Tests and research.

NIL.

1.17. Organizational and management information.

The operator was a limited liability company in the municipality of *Nova Mutum*, State of *Mato Grosso*, whose main business was the provision of crop-dusting and pest control services in agriculture. The company operated in accordance with the requirements established in the RBAC-137 - "*Certification and Operational Requirements: Agricultural Aviation Operations*".

The PIC had been working for the company for approximately 3 years and, according to information, had received a job offer from another organization, but turned it down, because he liked the work environment and the socio-professional relationships of the company of which he was an employee.

The passenger on board the PS-JCB aircraft had been working for the company for approximately 4 months, and dealt with technical support for pesticide application operations. Information gathered revealed that he wanted to be an airplane pilot, and also that he and the PIC had a close relationship.

According to reports, the airplanes regularly underwent periodical inspections, and there was no pressure or urgency on the part of the company regarding service deadlines. Information gathered also indicated that there was a family-like atmosphere within the organization.

According to data collected, the pilots normally received information about their duty schedule with at least one-day notice.

Observers reported that, on the date of the occurrence, the owner of the company had dropped off the pilot in the hangar where the aircraft was, and that there was no other ground-support staff on site.

Although the operator's organizational rules did not allow passengers on board aircraft during agricultural operations, it was found that there were two people on board at the time of the accident.

Also according to reports, one of the ground-support team members found it strange that the passenger was not in the group that was heading overland to the application area.

1.18. Operational information.

The PS-JCB aircraft was performing a ferry flight estimated to last approximately 45 minutes from SWJN to the landing strip for agricultural use of *Fazenda Flor Gaúcha*, in the municipality of *Aripuanã*, State of *Mato Grosso*. After taking off, the aircraft flew direct toward the destination.

Since it was a ferry flight, the aircraft operation was in accordance with the requirements established in the RBAC-91. In this case, the transport of passengers in aircraft of a restricted category was forbidden, as provided for in section 91.313, letter (d):

91.313 Restricted category civil aircraft

(a) A restricted category civil aircraft is exclusively allowed to operate:

(1) for the purposes defined in its certification; or

(2) in operations necessary to fulfill work activities directly related to the special purposes for which the aircraft was certified.

(b) For the objectives of paragraph (a) of this section, the operation of a restricted category civil aircraft aiming at providing flight crew training in the special purpose operation for which the aircraft is certified is considered a special purpose operation.

(c) It is prohibited to operate a restricted category civil aircraft carrying passengers or cargo for profit. For the purposes of this paragraph, a special purpose operation involving the transportation of persons and materials necessary to perform such operation (such as spraying, seeding, and towing of banners and including the transportation of persons and materials to the site of operation) and an operation intended to provide training for flight crew members in special purpose operation are not considered to be operations of transportation of passengers and cargo for profit.

(d) A person is only allowed to be transported on a restricted category civil aircraft if:

(1) such person is a flight crewmember;

(2) such person is a flight crewmember in training;

(3) such person performs an essential function on board related to the special purpose operation for which the aircraft was certified; or

(4) the transport is necessary for the performance of a work activity directly related to the special purposes of the operation (our emphasis).

[...]

During the flight, the PIC made contact with another employee of the company, who was near the destination landing strip. During the contact, the PIC received information of the adverse weather conditions in the destination area.

Observers near the accident site reported that the aircraft was orbiting within the cloud layer, possibly without reference to the ground, and that, subsequently, they heard the noise of the aircraft's impact with the ground.

With regard to IFR operations, the RBAC-91 established the aircraft and crew requirements, according to section 91.5, letter (b):

91.5 Requirements for crews

(a) The operation of a civil aircraft registered in Brazil is permitted only if:

(1) the flight crew complies with the aircraft's minimum crew requirements, as established in the aircraft's airworthiness certificate;

(2) the operator designates a pilot to act as pilot in command; and

(3) the operation is conducted by crewmembers who are properly licensed/certified and qualified for the aircraft according to the RBAC-61 or RBHA-63, or the RBAC that supersedes it for the function they perform on board, with recent experience, and holders of valid aeronautical medical certificates (CMA), issued in accordance with the RBAC-67.

(b) In addition to the requirements of paragraph (a) of this section, if the operation involves an IFR flight:

(1) the aircraft has to be certified for IFR flights and the crew must conduct the operation according to the procedures for IFR flights established by the approved flight manual or by the aircraft operations manual; (emphasis added)

[...]

As for the weight and balance limits, the aircraft weight was below the Maximum Takeoff Weight (MTOW), but its center of gravity was outside the rear limit recommended by the aircraft manufacturer.

A recommendation in the Aircraft Flight Manual read that, should the operation be performed with the Loader Seat occupied (an extra seat that could be installed in the aircraft for training operations), the aircraft balance was to be controlled by adjusting the fuel quantity and filling the agricultural-product tank with the necessary volume of water so that the CG did not exceed its rear limit.

BRAZILIAN AIRPLANE FLIGHT MANUAL 01-0025

AIR TRACTOR MODEL AT-402B

PLACARDS AND MARKINGS:

When optional loader seat is occupied, the hopper rinse tank must be filled with water and/or fuel quantity must be adjusted to prevent exceeding the AFT C.G. weight limit. Loader seat must not be occupied during Chemical application.

At the time of the accident, the product tank was empty, and the aircraft had an estimated QAV-1 volume of 640 liters.

1.19. Additional information.

Limitations

The 01-0025 Aircraft Flight Manual of the AT-402B model (BRAZIL), Page 6 (Section 1 - *Limitations*) emphasized that the aircraft model was certified in a restricted category and its operation had to be in accordance with the following limitations related to weather:

- day VFR;
- flight into icing conditions is prohibited; and
- flight in the vicinity of thunderstorms prohibited.

Disorientation

The Final Report A-013/CENIPA/2017 of the 19 January 2017 accident involving the PR-SOM aircraft described *spatial disorientation* as “an occurrence in which the pilot in command becomes confused in interpreting the aircraft’s attitude, whether or not it enters an abnormal attitude”.

Changes in linear acceleration, angular acceleration, and gravity are detected by receptors in the vestibular and proprioceptive systems, and are compared in the brain with visual information.

Any difference or discrepancy between sensory stimuli from the visual, vestibular, and proprioceptive systems may lead to sensory incompatibility, with a potential to create illusions and lead to spatial disorientation.

Therefore, an illusion is a false impression of reality, or the mistaken perception of something that exists objectively. Illusions are divided into two large groups:

- vestibular illusions, and
- visual illusions.

In addition to illusions, there are other situations capable of contributing to the process of spatial disorientation, such as, overload in the cockpit, stress, adverse weather conditions alternating between VMC and IMC, as well as lack of adequate training.

Graveyard Spiral

Graveyard Spiral is a type of spiral dive inadvertently performed by a pilot not trained or not proficient in flying under Instrument Meteorological Conditions (Figure 8).

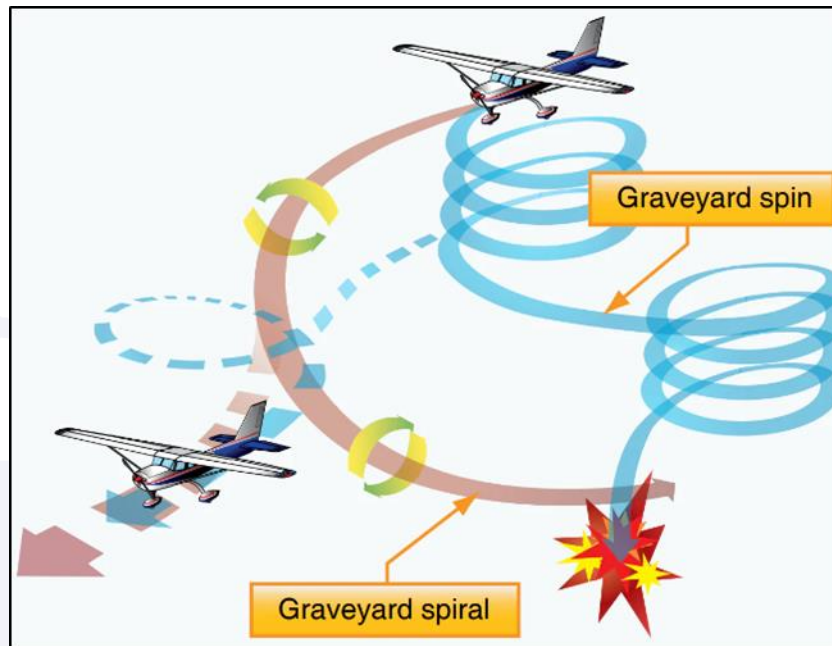


Figure 8 - Graveyard Spiral. Source: Federal Aviation Administration (FAA)
– Pilots Handbook of Aeronautical Knowledge.

The *Graveyard Spiral* phenomenon is most common at night or in adverse weather conditions, in which there are no external visual references (horizon) to correct the false sensations coming from the inner ear. It results from several sensory illusions that can occur in real or simulated IMC, when the pilot experiences spatial disorientation and loses awareness of the aircraft's attitude. The pilot loses the ability to judge the orientation of his aircraft due to false and/or misinterpreted sensory impressions.

In this case, the pilot feels as if he is descending with wings level, which leads him to pull back on the stick to increase the aircraft's pitch angle. As a result from this intervention, part of the lift is directed to the sides, reducing the radius of turn and resulting in an increasing loss of altitude.

Thus, the corrections applied end up aggravating the downward spiral, resulting in a large angle of impact at high speed.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was a ferry flight with 02 POB between SWJN and the agricultural airstrip of *Fazenda Flor Gaúcha*, located in the municipality of *Aripuanã*, State of *Mato Grosso*,

There was no evidence of any contributions of the aircraft systems to the accident.

The PIC did not have an IFRA rating (IFR Flight - Airplane), and the aircraft was not certified to operate in IMC.

In the PIC's Digital CIV, the latest flight record dated from 29 June 2022. It was not possible to confirm that the pilot, despite being experienced in the type of flight, had the required qualification, given the lack of formal records to show that he had performed at least 3 (three) takeoffs and 3 (three) landings during day- or night-time, effectively operating the controls of aircraft of the same category and class.

Notwithstanding the fact that the RBAC-91, Amendment 03, dealing with *General Operational Requirements for Civil Aircraft*, prohibited the transport of passengers on restricted category aircraft, and the fact that the operator's organizational rules did not allow

the presence of passengers on board the aircraft, there were two people on board the airplane at the time of the accident.

In such context, after twenty minutes of flight, in degraded weather conditions, the aircraft crashed into the ground.

According to reports, there was neither pressure from the company nor urgency on the part of the operator for the accomplishment of the services.

However, during the flight, despite receiving information of adverse weather conditions in the destination area, the PIC, without being qualified or trained to do so, decided to proceed with the mission, evidencing impairments in his ability to recognize, understand, and project the risks involved in a visual flight under those circumstances.

The reduction in his situational awareness and the difficulty in perceiving, analyzing, and choosing appropriate alternatives for that situation affected his decision-making process and his ability to judge when faced with an unfavorable environment.

Observers on the ground reported having heard the noise of the aircraft's engine in the middle of the clouds. In addition, a video made by local residents approximately 5 minutes after the aircraft crashed into the ground, confirmed that the weather conditions were below the minima for VFR operations in Class G airspace in which the PS-JCB aircraft was operating. In such airspace, the pilot had to keep the aircraft away from clouds, in visual contact with the ground, and with a horizontal visibility of at least 5 km.

Additionally, the AT-402B's Aircraft Flight Manual 01-0025 (BRAZIL), on page 6, Section 1 – *Limitations* – highlighted that the model in question should only operate in visual meteorological conditions.

With the inclusion of a passenger, the internal cabin space was reduced, potentially affecting the PIC's performance in his piloting tasks, making it difficult to maintain a coordinated flight.

Furthermore, the operation with two people in the cabin contributed to moving the aircraft's Center of Gravity beyond the rear limit, due to the aircraft's basic weight configuration, the volume of fuel on board, and the lack of mass in the product tank. The operation with the aircraft outside the stipulated CG limits contributed to control difficulties, especially in relation to the aircraft pitch.

From the observed distribution of the PS-JCB aircraft wreckage, it was found that the aircraft collided directly with the ground in an upside down position at a high angle and speed, without any indication of previous impact. Based on this dynamic, one inferred that the aircraft entered a flight path similar to a *Graveyard Spiral*.

This event, common in adverse weather conditions, is a type of spiral dive inadvertently performed by a pilot not trained or not proficient in flying IMC, as was the case of the PIC of the PS-JCB aircraft. In this sense, one inferred that the pilot lost the ability to perceive the orientation of his aircraft due to vestibular illusions.

These illusions may have caused sensory incompatibility, leading to a likely spatial disorientation.

Since spatial disorientation possibly came as a surprise to the PIC, his attempts of correction ended up worsening the downward spiral, resulting in an uncontrolled descent until impact with the terrain, at a high angle and high speed, as confirmed by the distribution of the aircraft wreckage at the accident site.

3. CONCLUSIONS.

3.1. Findings.

- a) The PIC held a valid CMA (Aeronautical Medical Certificate);

- b) the PIC held valid MNTE and PAGA ratings but did not have an IFRA rating;
- c) the latest record of the PIC's Digital Logbook dated from 29 June 2022;
- d) the PIC's toxicology and blood alcohol tests were negative;
- e) it was not possible to attest to the PIC's qualification for the flight;
- f) the aircraft had a valid CVA (Airworthiness-Verification Certificate);
- g) the aircraft was within the weight limits, but out of the balance limits;
- h) the records of the airframe, engine, and propeller logbooks were up to date;
- i) there was no evidence of any contributions of the aircraft systems to the occurrence of the accident;
- j) the meteorological conditions were below the minima for VFR flights;
- k) the PIC decided to proceed with the mission, despite having received information of adverse meteorological conditions in the area of destination;
- l) observers on the ground reported having heard the sound of the aircraft's engine inside the clouds;
- m) the PS-JCB aircraft had 02 POB, in disagreement with the section 91.313, letter (d) of the RBAC-91;
- n) the aircraft collided directly with the ground at high speed and high angle in an upside down position and without indication of previous impact;
- o) the aircraft was destroyed; and
- p) both the PIC and the passenger sustained fatal injuries.

3.2. Contributing factors.

Attitude – a contributor.

The transport of a passenger aboard the aircraft, in disagreement with the norms of the company, the prescriptions of the manufacturer, and the ANAC's regulations, revealed improvisation and non-compliance with the provisions of previously established operational procedures.

Likewise, the act of continuing the flight in conditions below the meteorological minima for the conduction of the operation under visual flight rules, and without the necessary training, demonstrated complacency and overconfidence.

Physical workplace-conditions – undetermined.

The conditions of the workplace, characterized by reduction of the physical space in the cockpit, with the presence of a passenger without adequate accommodation, may have interfered with the pilot's operational performance in the piloting activity.

Adverse meteorological conditions – a contributor.

The meteorological conditions en route were below the minima for the conduction of the operation under visual flight rules, leading the aircraft to enter a situation of unintended flight in instrument meteorological conditions, with the PIC lacking qualification for IFR flights.

Disorientation – undetermined.

Based on the dynamic of the accident, one inferred that the aircraft entered a flight path similar to a type of spiral dive inadvertently performed by a pilot neither trained nor proficient in flying IMC.

Illusions – undetermined.

Observers near the accident site reported that the aircraft was orbiting within the clouds and that, subsequently, they heard the noise of the aircraft as it impacted against the ground. Thus, during those turns made without external references, the PIC probably lost the ability to discern the orientation of his aircraft, due to false and/or misinterpreted sensory impressions.

Piloting judgment – undetermined.

The PIC did not adequately assess the flight parameters related to the operation of the aircraft with a passenger in the cabin. Without adequate balance management, the aircraft's CG moved backwards, possibly contributing to the loss of control in flight.

Perception – a contributor.

It was possible to identify impairments in the PIC's ability to recognize, understand, and project the risks involved in a visual flight in adverse weather conditions. As a result, there was a reduction in his situational awareness and degradation of his decision-making process and judgment capacity.

4. SAFETY RECOMMENDATIONS

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of 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”.

To the ANAC (Brazil’s National Civil Aviation Agency):**A-041/CENIPA/2023 - 01****Issued on 11/25/2024**

Disseminate the lessons learned in this investigation, in order to alert pilots and agricultural aviation operators alike on the risks arising from operations under instrument meteorological conditions by unqualified and untrained personnel, utilizing an aircraft not certified for IFR flights.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On November 25th, 2024.