

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 124/CENIPA/2016

OCCURRENCE:	ACCIDENT
AIRCRAFT:	N1001R
MODEL:	AT-602
DATE:	21SEPT2016



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 Appendix 2, 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 21SEPT2016 accident with the AT-602 aircraft model, registration N1001R. The accident was classified as “[SCF-PP] System/Component Failure or Malfunction Powerplant – Engine Failure in Flight”.

The aircraft was in the descent phase, 10 NM away from the Mirassol Aerodrome (SDMH), when the engine presented malfunctioned. An emergency landing was performed on a sugarcane field.

The aircraft had substantial damage.

The pilot left unharmed.

An Accredited Representative of the National Transportation Safety Board (NTSB) - USA, (State where the aircraft was registered) was designated for participation in the investigation.

An Accredited Representative of the Transportation Safety Board (TSB) - Canada, (State where the engine was designed) was designated for participation in the investigation.



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

3AR0	ICAO Location Designator - Frost Flying Inc. Airport, USA
ANAC	Brazil's National Civil Aviation Agency
CENIPA	Aeronautical Accident Investigation and Prevention Center
FAA	Federal Aviation Administration
FCU	Fuel Control Unit
KACJ	ICAO Location Designator - Jimmy Carter Regional Airport, USA
KONY	ICAO Location Designator – Olney Aerodrome – Texas, USA
KPBI	ICAO Location Designator - Palm Beach International Airport, USA
MDPC	ICAO Location Designator - Punta Cana International Airport – Dominican Republic
METAR	Aviation Routine Weather Report
MNTE	Airplane Single Engine Land Rating
NTSB	National Transportation Safety Board (USA)
PAGA	Agricultural Pilot Rating
PCM	Commercial Pilot License – Airplane
PNR	Part Number Replacement
PPR	Private Pilot License – Airplane
RAB	Brazilian Aeronautical Registry
RBAC	Brazilian Civil Aviation Regulation
SAE	Aircraft Registration Category of Specialized Air Service
SBCF	ICAO Location Designator – Tancredo Neves Aerodrome, Confins - MG
SBMQ	ICAO Location Designator – Alberto Alcolumbre Aerodrome, Macapá - AP
SBSJ	ICAO Location Designator - São José dos Campos Aerodrome, SP
SBSR	ICAO Location Designator - São José do Rio Preto Aerodrome, SP
SDMH	ICAO Location Designator - Mirassol Aerodrome, SP
SERIPA IV	Fourth Regional Aeronautical Accident Investigation and Prevention Service
SN	Serial Number
SL	Service Letter
SOCA	ICAO Location Designator – Félix Eboué Airport, French Guiana
SWPZ	ICAO Location Designator - Oricanga de Abreu Aerodrome, Posse - GO
TGTY	ICAO Location Designator - St Georges/Maurice Bishop Airport, Grenada
TSB	Transportation Safety Board (Canada)
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	Model: AT-602 Registration: N1001R Manufacturer: Air Tractor	Operator: Air Tractor
Occurrence	Date/time: 21SEPT2016 - 1415 UTC Location: Santa Inês Farm Lat. 20°53'22"S Long. 049°23'17"W Municipality – State: São José do Rio Preto – SP	Type(s): [SCF-PP] System/Component Failure or Malfunction Powerplant Subtype(s): Engine Failure in Flight

1.1 History of the flight.

The aircraft took off from the São José dos Campos Aerodrome (SBSJ) - SP, to the Mirassol Aerodrome (SDMH) - SP, at about 1240 (UTC), in order to deliver the aircraft to the buyer, with one pilot on board.

When in the descent phase, at about 10 NM from SDMH, the engine presented malfunctioned. An emergency landing was carried out in a sugarcane field.

The aircraft had substantial damage. The pilot left unharmed.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft had substantial damage to the wings, to the right main landing gear, to the fuselage, to the horizontal stabilizer, to the flaps, to the ailerons, to the elevator and to the auxiliary landing gear.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	Pilot
Total	11,000:00
Total in the last 30 days	34:00
Total in the last 24 hours	01:35
In this type of aircraft	1,426:00
In this type in the last 30 days	34:00
In this type in the last 24 hours	01:35

N.B.: The data related to the flown hours were obtained through the aircraft logbook and the pilot's declaration.

1.5.2 Personnel training.

The pilot took the PPR course at the São Leopoldo Aeroclub - RS, in 1987.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PCM License and valid MNTE and PAGA Ratings.

The pilot was also qualified and held a medical certificate issued by a US authority as required in RBAC 61, 61.3 (b).

1.5.4 Qualification and flight experience.

The pilot was qualified and had experience in the kind of flight.

1.5.5 Validity of medical certificate.

The pilot had valid medical certificate issued by a US authority.

1.6 Aircraft information.

The aircraft, serial number 602-1274, was manufactured by Air Tractor Inc., in 2016 and had a reserve of brands expected to be registered in the SAE Category.

The aircraft flew as a holder of a Special Airworthiness Certificate (Special Flight Permit) with transfer authorization from the Olney Aerodrome (KONY), Texas - USA to the São José do Rio Preto Aerodrome (SBSR) - SP.

The Brazilian civil aviation authority had not issued an Airworthiness Certificate (CA). The aircraft had only the PR-REJ brand reserve, with the ANAC, which did not allow its operation and did not generate rights or prerogatives, as described in the brand reserve certificate, issued by the RAB.

To the aircraft enter, fly over and land in Brazil, on 08SEPT2016, the ANAC issued an AVANAC0670N16 and the Temporary Entry and Admission Term (TEAT), number 024010016058975TECAT01. The expiration date of the TEAT and the AVANAC was 19OCT2016.

A temporary fuel system for the ferry had been installed on the aircraft that used the hopper as a fuel tank, according to the drawing 50280 of Air Tractor and in compliance with Service Letter (SL) # 219, allowing the aircraft to make much longer transfer flights.

There were no records of uninstalling the system. It should be noted that, according to the aforementioned SL, the temporary fuel system was not certified by the FAA.

The aircraft had only flown 37 hours and 55 minutes and had not undergone any inspection or maintenance reviews after manufacture.

1.7 Meteorological information.

The weather conditions were favorable for the visual flight.

The São José do Rio Preto Aerodrome (SBSR) METAR, 4.5 NM away from the accident site, contained the following information:

METAR SBSR 211400Z 11012KT CAVOK 22/04 Q1021=

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place outside of the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The pilot performed a forced landing at approximately 4.5 NM from SBSR.

Before the impact on the ground, the aircraft crashed into a stream vegetation, which was dense, but of low height, about three meters.

Then, marks of the aircraft were found on the ground and also of a collision against a fence, before its total stop.

The landing gear, of the fixed type, had substantial damage on its right side. The flaps were also extended.

The left wing had substantial damage, mainly on the leading edge, indicating that it was possibly the part of the aircraft that absorbed most of the first impact against the vegetation.

The pilot reported that after the impact, he verified that the engine operation had not been interrupted by the shocks and that he cut the engines off when checking the situation.



Figure 1 - Aircraft after the occurrence.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Not investigated.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Not investigated.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

Samples of the aircraft kerosene and engine oil were sent for testing. The results attested that the fuel samples were in accordance with the technical specifications and showed no evidence of contamination. As for the sample of the lubricating oil, it showed a kinematic viscosity value at 100°C, slightly above the range specified by MIL PRF 23699G.

The engine was sent to Pratt & Whitney Canada for testing on a test bench (Figure 2).



Figure 2 - Aircraft engine before testing.

The Pratt & Whitney engine, model PT6A-60AG, Serial Number (SN) PCE - RG0205 was sent by the manufacturer itself to the headquarters facilities.

For the transportation of the engine, the Py line was removed, which for this model was a flexible pipe. During the removal procedure, there was no representative of the SERIPA IV present. However, Pratt & Whitney Canada ensured that there was torque in fixing the line.

As for the tests, the engine was first inspected with the aid of a borescope, checking the integrity of the compressor and the hot section. After this check, the engine was installed on a test bench where it was heated.

After the heating period, an attempt was made to accelerate the engine, which was unsuccessful. In order to identify the problem, the FCU that was installed at the time of the accident was replaced.

After replacing the FCU, the engine could be accelerated and did not show any malfunctions in its operation, showing that the occurred failure was restricted to this component.

Thereafter, the tests at the FCU, identified as Part Number Replacement (PNR) 8063-645, SN 19613248, continued. The FCU was installed on a bench and tested in the presence of a representative of the equipment manufacturer.

A functional test was carried out and, initially, the FCU did not fully respond to the requests to which it was submitted. However, after a certain period of time, it started to work as expected for the test.

Subsequently, the FCU was disassembled and debris was found in the fuel valve. Subsequently, the residues of the FCU screens were analyzed and particles of glass and ferrous fibers, calcium and chlorinated rubber were identified.

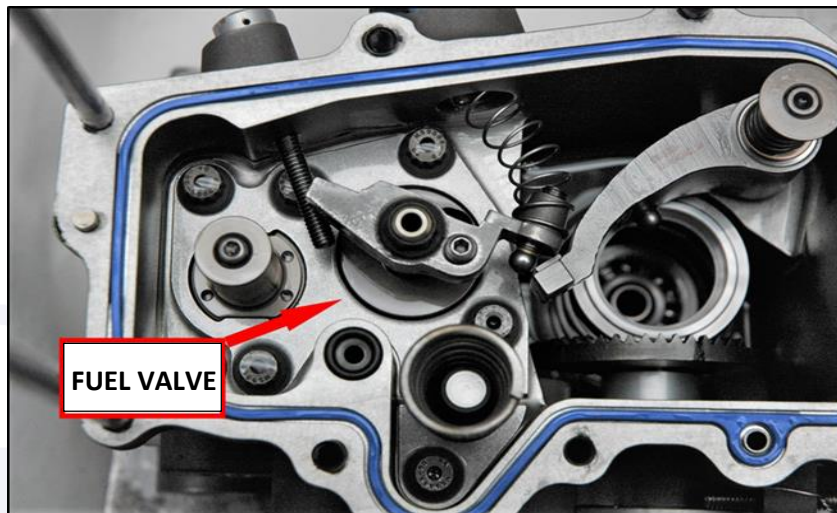


Figure 3 - Internal view of the FCU.

With interest in the contamination found in the FCU, the fuel pump identified as PNR 3040760, SN 014557 was disassembled and, when looking at the entrance screens, residues were also found. On that occasion, molybdenum disulfide was found with the presence of silicon, magnesium and fiberglass.

Residual fluid was collected before the fuel pump was disassembled and silicon-rich particles were found, with the presence of sulfur, magnesium and traces of sodium and calcium.

Finally, the contaminant found in the aircraft fuel airframe filter was analyzed. The results indicated the presence of aromatic material, cellulose, polypropylene, zinc stearate and amine compounds with aliphatic groups (Figure 4).



Figure 4 - Debris found in the fuel airframe filter.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

The aircraft was within the weight and balance limits specified by the manufacturer.

According to the flyover authorization issued by the ANAC, n° AVANAC0670N16, issued on 06SEPT2016, the permitted route for the aircraft was: Olney Aerodrome (KONY); Frost Flying Inc. Airport (3AR0) – USA; Palm Beach International Airport (KPBI) – USA; Punta Cana International Airport (MDPC) - Dominican Republic; St Georges/Maurice Bishop Airport (TGPY) – Grenada; Alberto Alcolumbre Aerodrome (SBMQ), Macapá – AP; Tancredo Neves Aerodrome (SBCF), Confins – MG and São José do Rio Preto Aerodrome (SBSR) - SP.

The aircraft performed a transfer flight from the manufacturer's facilities in Olney, Texas - USA, until its buyer at SBMH, an Aerodrome that is close to SBSR, but in the authorization, SBSR was listed as the delivery location.

Despite the authorized route described above, the pilot made the following route: KONY; Jimmy Carter Regional Airport (KACJ) – USA; KPBI, MDPC, TGPY, Félix Eboué Airport (SOCA) - French Guiana; SBMQ; Oricanga de Abreu Aerodrome (SWPZ), Posse – GO; SDMH; SBSJ. The accident occurred in the next section, with takeoff from SBSJ to SDMH.

The transfer was considered a complex operation, which in this case involved approximately 35 flight hours and 17 days.

To enable flights of this duration to be performed, the hopper was fueled and a line was installed to connect it to the aircraft normal system.

The pilot had already performed similar transfer flights and had established a system to avoid problems regarding fuel consumption, for example, takeoffs and landings were always carried out using fuel from the main tanks.

In addition, he initially consumed a quarter of the fuel in the main tanks before using the hopper and never allowed this tank to be exhausted during the flight to prevent air from entering the lines. The SL # 219 prevised that the pilot should make sure to use the hopper's fuel first.

At the time of the accident, the pilot was already in the descent phase, having descended from FL105, in which he was cruising to FL065, using low power with the lever close to the idle position.

When trying to increase the engine power, the pilot realized that it did not respond correctly to the command and that the rotation of the power turbine had dropped to 70%.

The pilot tried to accelerate and decelerate the engine, but there was no response to the increase in power. Finally, he tried to make a forced landing on a dirt runway on Santa Inês Farm, but ended up landing before the runway.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

The aircraft had an engine monitoring system called MVP-50T, from which it was possible to recover data from the last flights.

Parameters were raised such as torque, engine speed, fuel flow, among others.

2. ANALYSIS.

It was a transfer flight for the delivery of the aircraft by the manufacturer to the buyer. The transfer was considered a complex operation, due to the number of legs, landings, hours and days to be used.

The accident occurred on the leg between SBSJ and SDMH; therefore, the aircraft was operating outside the route authorized by the civil aviation authority.

An adaptation had been installed on the aircraft that allowed its hopper to be used as a fuel tank.

According to the data collected through the engine monitoring system, the parameters were shown to be incompatible with the normal operation of the engine in any possible power regime for the model.

Tests on the crashed engine, carried out on the bench, confirmed the malfunction and identified debris in the fuel valve of the FCU PNR 8063-645, SN 19613248.

In the sequence of tests, the contaminated FCU was replaced by another one in good condition. The engine was tested again and presented expected performance on bench. Thus, it was inferred that the identified contaminants interfered with the correct functioning of the FCU PNR 8063-645, SN 19613248, as tested by the technical report issued by the component manufacturer.

It should be added that the fact that the contaminants were found in the FCU, in the fuel pump inlet net and, even in the fuel filter of the airframe, in the latter, in a much higher amount than expected, indicated that the contamination came from the system of fuel for the engine system.

The use of the hopper as a fuel tank may have contributed to the accident, given that its use was for the transport of agricultural products, water, etc. Its use as a fuel tank was occasional and not certified.

As a result, it is believed that the care to keep the hopper free from contamination has been significantly inferior to that used to ensure that the fuel tank has been decontaminated since manufacture.

The fact that fiberglass and zinc stearate was found reinforces the possibility that the contamination originated from the hopper, since the first contaminant can be used as a material for manufacturing and the second as a release agent.

In addition, because an amine compound with aliphatic groups has been found, there is a possibility that the hopper was previously used to apply fertilizer or another product for agricultural use.

Based on the contamination found in the FCU, the fuel pump and the aircraft airframe filter, it was understood that the engine malfunction was related to the fuel, even though no contaminants were found in it.

All analyzes indicate that the contamination of the turbo propulsion system has caused the loss of engine performance.

Thus, it was considered as the most likely hypothesis that the contamination found in the FCU, the pump and the fuel filter came from the hopper, which was used as a fuel tank. Throughout the transfer, this contamination reached the turbo machinery and affected its operation, leading to engine loss of power in flight.

3. CONCLUSIONS.

3.1 Facts.

- a) the pilot had a medical certificate issued by a valid American authority;
- b) the pilot had valid MNTE and PAGA Ratings;
- c) the pilot was qualified and had experience in that kind of flight;
- d) the aircraft had valid Special Airworthiness Certificate;
- e) the aircraft was within the weight and balance specified by the manufacturer;
- f) the aircraft was making a transfer from the USA to Brazil, outside the authorized route;
- g) weather conditions were favorable for the flight;
- h) the hopper was used as a fuel tank during the transfer of the aircraft;
- i) there was a failure in the operation of the aircraft engine;
- j) debris was found in the FCU and in the fuel pump of the aircraft engine;
- k) a large amount of debris was found in the fuel filter of the aircraft airframe;
- l) there was loss of engine power in flight;
- m) the aircraft made a forced landing;
- n) the aircraft had substantial damage; and
- o) the pilot left unharmed.

3.2 Contributing factors.

- **Other – undetermined.**

It is possible that the contamination found in the FCU, in the pump and in the fuel filter came from the hopper, which was used as a fuel tank. Throughout the transfer, this contamination reached the turbo machinery and affected its operation, leading to engine loss of power in flight.

4. SAFETY RECOMMENDATION.

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 addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

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 at the publication of this report:

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

A-124/CENIPA/2016 - 01

Issued on 02/12/2021

Act with the US Civil Aviation Authority - FAA, so that the Air Tractor Inc., before dispatching its aircraft for transfer flights using the hopper as a fuel tank, make sure that the auxiliary and temporary fuel system installed is in compliance with Drawing 50280 and in perfect conditions of cleaning and use, aiming to prevent aeronautical occurrences.

A-124/CENIPA/2016 - 02**Issued on 02/12/2021**

Act with the United States Civil Aviation Administration - FAA, so that the Air Tractor Inc. guide pilots who conduct their aircraft to strictly follow the routes established in Special Airworthiness Certificates, in order to prevent aeronautical occurrences, especially when operating in Brazilian territory.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On February 12th, 2021.

