COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 044/CENIPA/2017

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PT-YHH**
MODEL:	**206B**
DATE:	**17MAR2017**

NOTICE

According to the Law nº 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the different factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with 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. 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 17MAR2017 accident with the 206B aircraft, registration PT-YHH. The accident was classified as “[FUEL] Fuel Related”.

Soon after the take-off from the JIHAD DEHAINI Heliport (SSSE), in Araucária - PR, the PT-YHH aircraft lost rotation and height, colliding against the ground.

The aircraft had substantial damage.

The pilot and the three passengers suffered serious injuries.

An Accredited Representative of the National Transportation Safety Board (NTSB) – USA, (State where the engine was manufactured) and an Accredited Representative of the Transportation Safety Board (TSB) – Canada, (State where the aircraft was designed) were designated for participation in the investigation.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AGL	Above Ground Level
ANAC	Brazil's National Civil Aviation Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CINDACTA	Air Defense and Air Traffic Control Integrated Center
CMA	Aeronautical Medical Certificate
COMAER	Aeronautics Command
FCU	Fuel Control Unit
GSO	Safety Manager
HMNC	Conventional Single Engine Helicopter Rating
HMNT	Turbine Single Engine Helicopter Rating
IAC	Civil Aviation Instruction
IAE	Aeronautics Space Institute
IAM	Annual Maintenance Inspection
IAS	*Indústria de Aviação e Serviços*
ICA	Command of Aeronautics' Instruction
ICU	Intensive Care Unit
METAR	Aviation Routine Weather Report
MGSO	Safety Management Manual
NTSB	National Transportation Safety Board (USA)
PCH	Commercial Pilot License - Helicopter
PPH	Private Pilot License – Helicopter
QAV-1	Aviation Kerosene
RBAC	Brazilian Civil Aviation Regulation
ROTAER	Auxiliary Air Route Manual
SAE	Aircraft Registration Category of Specialized Air Service
SBCT	ICAO Location Designator - Afonso Pena International Aerodrome, Curitiba - PR
SOP	Standard Operational Procedures
SSSE	ICAO Location Designator - JIHAD DEHAINI Heliport, Araucária - PR
S/N	Serial Number
TPX	Non-Regular Public Transportation Service - Air Taxi
TSB	Transportation Safety Board - Canada
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	**Model:** 206B **Registration:** PT-YHH **Manufacturer:** Bell Helicopter	**Operator:** Icaraí Turismo Air Taxi Ltd.
Occurrence	**Date/time:** 17MAR2017 - 1807 UTC **Location:** *Estação* Neighborhood – PR 423 roundabout **Lat.** 25º34'22''S **Long.** 049°23'43''W **Municipality – State:** Araucária – PR	**Type(s):** "[FUEL] Fuel Related" **Subtype(s):** NIL

1.1 History of the flight.

The aircraft took off from the JIHAD DEHAINI Heliport (SSSE) in Araucária - Paraná, at about 1800 (UTC), in order to perform a verification service agreement flight, with a pilot and three passengers on board.

Soon after takeoff, when crossing 300ft Above Ground Level (AGL), the pilot turned left to proceed upwards to 500ft AGL, when he noticed a drop of approximately 5% RPM of the rotor.

The crewmember reduced the collective lever and regained RPM. However, when applying power, both the rotor (NR) and the power turbine (N2) decreased rapidly, triggering the LOW RPM sound and visual alarm when the NR dropped below 90%.

The helicopter lost altitude and crashed into the ground.

The aircraft had substantial damage.

All occupants suffered serious injuries.

Figure 1 - Sketch of the approximate trajectory of the aircraft.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	1	3	-
Minor	-	-	-
None	-	-	-

1.3 Damage to the aircraft.

The aircraft had substantial damage. There was loss of the tail cone, breakage of one of the main rotor blades, breakage of the landing gear, damage to the lateral and bottom of the fuselage (Figure 2).

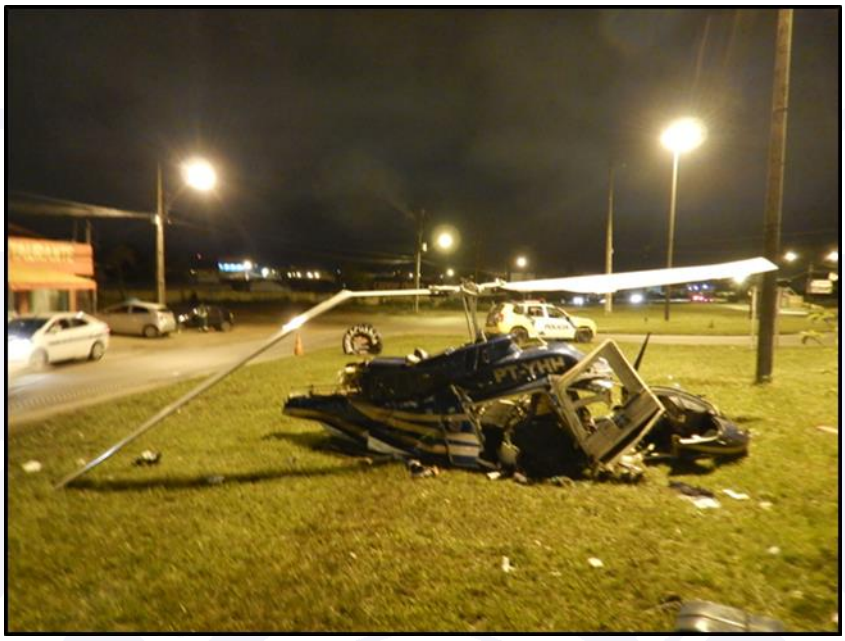


Figure 2 - Right side view of the aircraft.

1.4 Other damage.

There was damage to local urban vegetation.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	Pilot
Total	1.900:00
Total in the last 30 days	21:30
Total in the last 24 hours	00:00
In this type of aircraft	1.600:00
In this type in the last 30 days	21:30
In this type in the last 24 hours	00:00

N.B.: The data on the flown hours were collected from the aircraft logbook and from the pilot's information. The flown hours registers in the National Civil Aviation Agency (ANAC) system were outdated.

1.5.2 Personnel training.

The pilot took the PPH course at the Escola de Aviação Civil Asas Rotativas Ltd. (EACAR) - PR, in 2009.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PCH License and had valid HMNC and HMNT Ratings.

1.5.4 Qualification and flight experience.

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

1.5.5 Validity of medical certificate.

The pilot had valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information.

The aircraft, serial number 4468, was manufactured by the Bell Helicopter, in 1997, and was registered at the TPX and SAE-AN categories.

The aircraft had valid Airworthiness Certificate (CA).

The airframe and engine logbook records were updated.

The last inspection of the aircraft, the "100 hours" type, was carried out on 22FEB2017, by the Atlântico Sul maintenance organization, in Porto Belo – SC, having flown 28 hours and 5 minutes after the inspection.

The last overhaul of the aircraft, the "300 hours" type, was carried out on 20DEC2016, by the Helisul maintenance organization, in Curitiba – PR, having flown 126 hours and 10 minutes after the overhaul.

1.7 Meteorological information.

The METAR of the Afonso Pena International Aerodrome (SBCT), Curitiba - PR, 12 NM away from the accident site, had the following information:

METAR SBCT 171800Z 12007KT 9999 -RA SCT006 OVC013 18/17 Q1018=

The weather conditions showed visibility over 10km, light rain, scattered clouds at 600ft, ceiling of 1,300ft, wind of 120º, with intensity of 7kt. Such conditions were favorable for the visual helicopter flight in accordance with the provisions of the ICA 100-4, from 29DEC2016.

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 impact occurred against the asphalt, with no evidence of previous impact. The distribution of the wreckage was linear.

The impact was recorded by a local commerce security camera (Figure 3).

Figure 3 - Image of the security camera.

The impact occurred in a pitch up attitude (approximately 20º) and without lateral slope, causing the tail cone fracture and the breakage of the landing skis.

There was no fire after the total shutdown. A car mechanic working nearby disconnected the battery from the helicopter.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

According to the information collected during the interviews, there was no evidence of alcohol use, signs or symptoms of anxiety, aerospace disorientation, inadequate diet, dysbarism, pain, nausea, fatigue, hyperventilation, hypoxia, unconsciousness, insomnia, food poisoning, CO2 intoxication, hangover, illicit drug use, vertigo or inappropriate clothing.

The pilot declared to have good health, having the adequate weight for his height, without associated diseases or use of medications. He denied feeling any discomfort or sudden illness at the time of the accident. He said he had not lost consciousness before his fall. He had no prosthesis.

He reported that, in the days before the accident, he was well emotionally, with adequate food and rest. There was no evidence of overwork. The pilot did not fly in the 48 hours before the crash and said he slept between 6 and 7 hours the night before.

The pilot had a valid Aeronautical Medical Certificate (CMA). However, there was an error in the validity of the certificate. The last health inspection was performed on 19JUN2015, at the CINDACTA II and was valid for two years.

According to the RBAC 67 - Requirements for the Granting of Aeronautical Medical Certificates, the validity should be of 6 months:

> "67.15 Validity of CMAs:
>
> (a) Except as provided in paragraph (a) of Subpart H of this Regulation, concerning transitional provisions, and unless otherwise specified in this Regulation, the validity of the CMAs granted shall comply with the following time limits:
>
> (1) 12 months for the categories PLA and PC in the expert health examinations carried out or 6 months under the following conditions:
>
> (i) after the 40 year birthday of the pilot operating commercial passenger transport with only 1 pilot;

At the time of the pilot's certification, in 2015, the Aeronautics Command Health Boards (COMAER) could operate ANAC's CMA update system.

From August 2017 on, due to the termination of the COMAER agreement with the ANAC, health inspections for the purpose of obtaining CMA were only carried out in accredited clinics with ANAC.

The system updating was done exclusively by the ANAC, which conferred the validity of the certificates.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot joined the company in 2008 as maintenance director and, after completing the training in PCH, he started to exercise the role of pilot. He reported periodic trainings at the company and denied previous air crashes.

He had other duties in the company, besides working as a pilot and also worked as a maintenance director in another company.

The crewmember reported that the accident flight was his first takeoff of the day, having not been operating for four days.

In the morning, he followed the inspection of the documentary part of the aircraft and then accompanied the fueling.

Boarding took place under the supervision of the air taxi owner.

Soon after the takeoff, the pilot realized that he had lost rotation, but managed to recover and decided to continue the flight.

Then the commander realized that the engine was losing power and that the rotors were losing rotation. He also reported hearing a horn sound as well as a light from the panel.

At first, the pilot checked to see if it was not an electric failure, tapping the aircraft panel with his fingers to check if there were no pointers locked.

The crewmember remembered that at the moment of the crash, he thought he could do nothing wrong not to aggravate the situation. He said he did not have enough height to do an autorotation, opting to turn left to identify some landing area, however, he did not see the power grid or the vehicle on its landing approach.

In addition to the pilot, the auditor (the owner of the flight safety technical auditing company and aeronautical consultants) was on board the helicopter, the auditor's inspector (employee of the contracting company, responsible for ducts and gas lines inspections) and an aircraft operator’s employee.

The employee was in the company since 2015 and was responsible for boarding, disembarking, refueling, cleaning and conducting the fuel truck for out-of-town events.

The auditor had a company that performed air surveys and maintenance and audited the present air taxi company for eight years.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

The pilot and passengers suffered serious injuries. All of them suffered multi-trauma and were hospitalized for more than 48 hours after the accident.

The rescue of the victims was done by the emergency service in Araucária, immediately after the fall. The wounded were taken to hospitals in Curitiba and to the Metropolitan Region.

The pilot was hospitalized for twelve days at the Rocio Hospital, Campo Largo - PR, with 11 days in the ICU. He was discharged on 29MAR2017. He suffered a fracture in the spine and underwent surgical correction.

The auditors inspector had spinal cord trauma and cervical and thoracic spine fractures.

The auditor suffered a fracture of the cervical and thoracic spine, with spinal cord trauma.

The other employee of the company had hip fracture and displacement, spine trauma, and elbow trauma.

1.16 Tests and research.

The Rolls Royce engine, model M250-C20J, S/N CAE 270839, which equipped the aircraft, had no severe damage resulting from the accident. The Investigation Team decided to transfer it to the *Indústria de Aviação e Serviços* (IAS), where it was installed in the test bench for functional testing.

The engine was manually turned and no bump or strange noise was observed that could prevent its activation in the test bench.

Inspection was initiated by examining the lower and upper filling detectors, the main oil filter and the last chance filter of the oil injector of bearings 6 and 7. All were clean and free of contaminant. The pneumatic lines of the engine were tested without leaks. The bleed valve was open and normal.

Fuel was collected from the aircraft's filter and a test was performed, not detecting the presence of water. The fuel filter was clean and free of contaminants, however, particles were found in the fuel remaining inside the filter housing.

This fuel was collected and sent to the chemistry laboratory of the IAE, in order to try to identify the contaminant.

After the unsuccessful attempt to start the engine on the bench, the Fuel Control Unit (FCU) was replaced and other departures started, unsuccessfully.

The functional nozzle test of the engine nozzle was then carried out. Upon inspecting this nozzle, contamination was detected in the fuel nozzle's last chance filter.

The fuel nozzle with abnormal operation was replaced and the engine ran for a period of 20 minutes, with 100% rotation, but no load. Soon the engine decelerated alone and, when it reached less than 40% of N1 (turbine), it was necessary to cut it down.

Since the replacement nozzle was normal, it was decided to test it on a specific bench. The result was its disapproval.

Thus, the fuel nozzle was disassembled, where a large amount of the same contaminating material found on the first nozzle was identified. This material was collected and sent to the IAE chemistry laboratory to try to identify it.

Figure 4 - Contaminated Fuel nozzle highlighted.

The chemical analyzes did not identify similarity between the material of the aircraft's fuel hose and the contamination found in the nozzles. The IAE laboratory was also unable to identify precisely the contamination, even compared to possible contaminants: ardrox, diesel and other substances.

Part of the material was sent to the Rolls Royce laboratory in the United States of America, where the identification was also difficult. This laboratory stated with 78% reliability, that it was PAM or polyacrilamide, whose main use is as a flocculant of solids in liquids and can also be used in the water treatment.

Rolls Royce pointed out that the methodology adopted in the infrared test only guarantees the result when the reliability is at least of 95%.

During the investigation, contaminating material was found inside the fuel tank at the airline's headquarters. This material was collected and sent to the laboratory at the IAE, in order to compare with the contaminant found in the engine. Visually they were identical, but the tests showed that they had different spectra, not being able to unequivocally identify these materials.

1.17 Organizational and management information.

The Icaraí Turismo Air Taxi Ltd. operated for approximately 20 years in the South region. It had six employees and three helicopters.

The company had the required management personnel for operations, in accordance with RBAC 135 - Operational Requirements: Complementary and On Demand Operations. It performed people transportation, panoramic flights and participation in events, as well as ducts and gas lines inspections.

There was a change of ownership in 2014. The former owner, however, continued to be present and accompanying the administration and operations. The administrative base was located in a former owner's hotel room and the hangar and heliport (operational base) were located at the back of the former owner's residence.

In the company's Safety Management Manual (MGSO), safety meetings and surveys were planned throughout the period. According to reports, at these meetings, only the Safety Manager and the pilot participated. Safety surveys have never been done.

The most recent version of the MGSO, the Standard Operational Procedures (SOP) and the Training Program dated back to 2014, just when the change of ownership took place. In these documents, there were still some pages dated of 2011, containing the name of the former owner and directors who had already left the company.

One of the company's contracts was to charter a helicopter to perform air inspection on ducts in the southern region. Under this contract, the contracting company could inspect them or it could delegate the inspection service to a third company. They decided on the second option.

The survey was performed through documentary research and completed with a verification flight, which included performing a power check.

The audit company carried out two surveys in 2016 on the PT-YHH aircraft and found seven nonconformities related to the powertrain: component life cycle control, record updating and component installation.

Although the survey company repeatedly issued safety recommendations to the air taxi company, there was a recurrence of problems related to its management processes.

As the discrepancies were solved on the flight’s eve, the survey released the aircraft for power check and it followed, if approved, for the contracted flight.

The Jihad Dehaini Heliport (SSSE) used by the company had an Aviation Kerosene Reservoir (QAV-1). The aircraft was fueled in this heliport. The Auxiliary Air Route Manual (ROTAER) did not include the availability of fuel at this location.

These reservoirs were cleaned and maintained by the Air Taxi Company or contracted service using Aluminox or Intercap. These were professional anti-scaling and stripping agents used for cold cleaning.

According to the technical specifications, they are indicated for automotive cleaning: engine, chassis, aluminum wheels and pieces, aluminum engines, alloy rims, aluminum frames, stainless steel parts and ducts.

The ANP was consulted to verify if the tanks used to store fuel and supply the aircraft met the requirements, complying with proven procedures and techniques for the safety of the operations.

During the inspection of the ANP at the address, the resident of the house (and former owner of the taxi company) invited the team to check the conditions of the heliport that was at the back of the house. He said the company had been sold four years ago and that it was not operating at that moment.

At the back of the residence, there was a heliport, a hangar and two tanks for fuel storage (Figure 5), one with a capacity of 4,000 liters and another of 15,000 liters, where the QAV-1 was stored.

Figure 5 - Fuel reservoirs of SSSE.

The tanks had the valves opened by the resident himself to show that there was no fuel. After being questioned by the agent, the former owner acknowledged that he had not previously informed the ANP of the existence of fuel tanks in the area.

1.18 Operational information.

The aircraft was within the weight and balancing limits specified by the manufacturer. The calculation showed that the helicopter was below the certified limit of 1.519,50 kg, according to the supplement of 12JUL2004, in manual BHT-206B3-FMS-37 (Figure 6).

Cálculo de peso da aeronave PT-YHH	
Peso Básico da Aeronave	867,70 kg
Peso do piloto	80,00 kg
Peso dos passageiros	237,00 kg
Peso do combustível	272,16 kg
Peso total	**1.456,86 kg**

Cálculo do peso do combustível

- 1 galão americano = 3,78 litros
- 90 gal x 3,78 = 340,2 litros (conforme abastecedor)
- Densidade do QAV-1 = 0,775 à 0,840 kg/m^3 (15° C)
- 340,2 litros x 0,8 kg/m^3 = 272,16 kg

Figure 6 - Calculation of the aircraft weight.

Considering that the temperature by the METAR of SBCT was of 18ºC and that the altitude of the heliport was of 2.972ft, it was obtained the density altitude of 4,000ft (Figure 7).

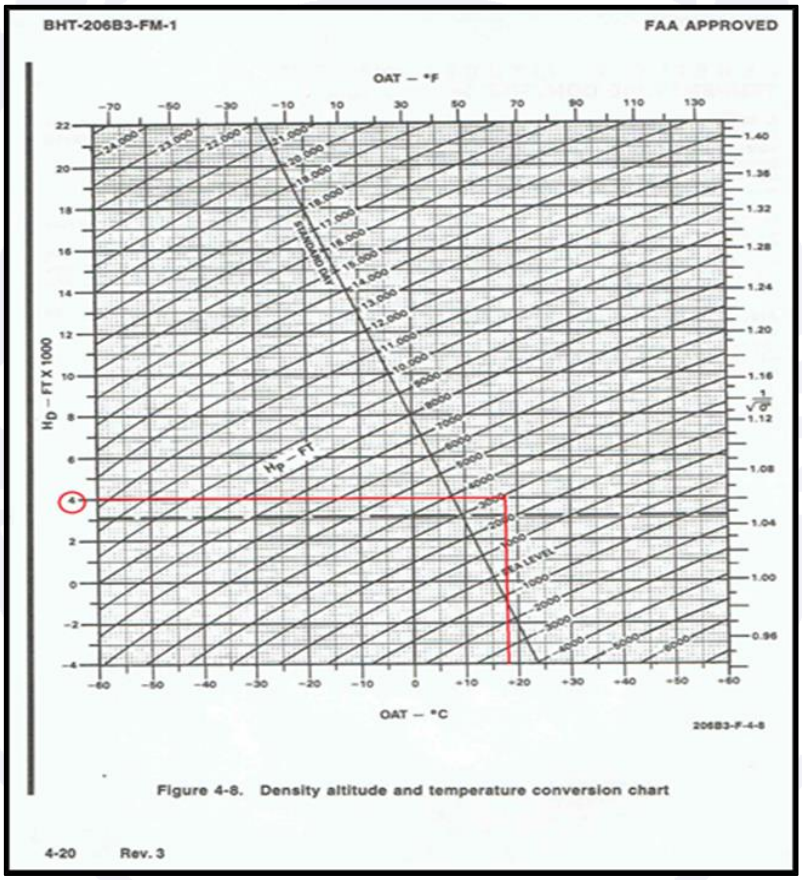


Figure 7 – Density Altitude.

Considering that the weight of the aircraft at the time of the loss of power was of 1.456,86 kg and that the calculated density altitude was of 4.000ft, it was concluded that the aircraft did not meet the performance requirements in the graph of Figure 8, since the maximum weight for these conditions would be approximately of 1.320kg.

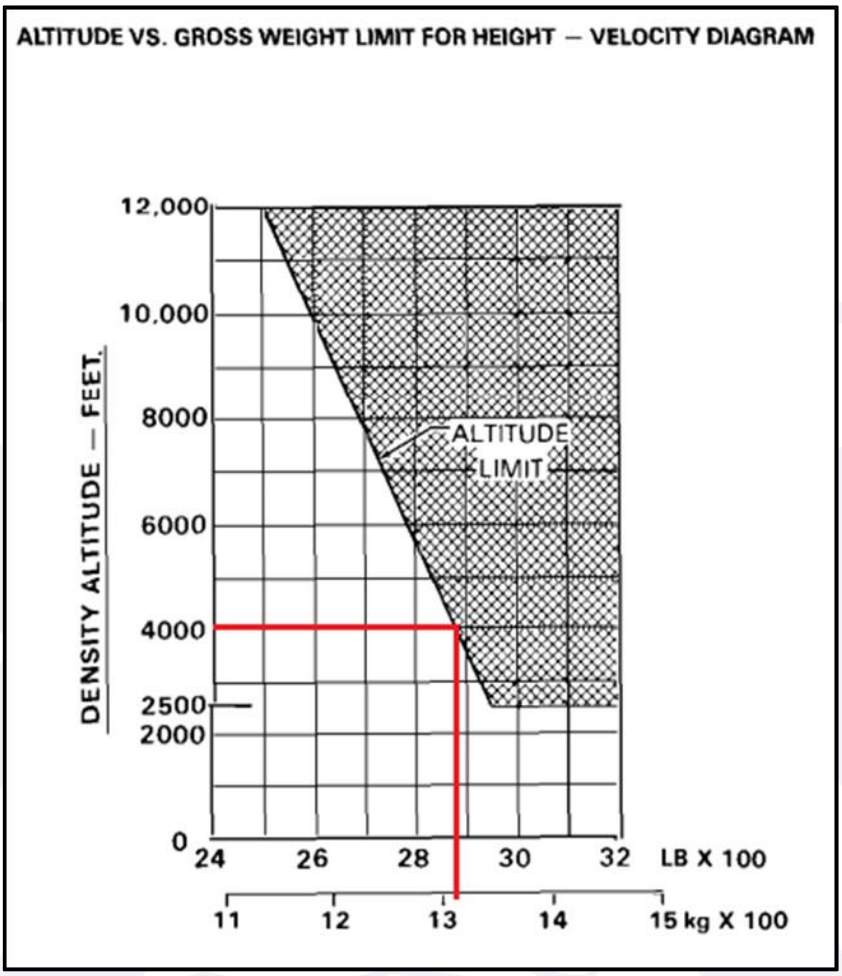


Figure 8 - Graph Altitude vs. Gross weight limit for Height - Velocity Diagram.

It is inferred in this way that the flight planning did not take into account the altitude density that is calculated as a function of the altitude pressure x temperature.

The power check procedures were also provided in the performance section of the manufacturer's manual. The check consisted of indicating the minimum percentage of torque that should be available in the engine, according to the factory specification.

This verification could be performed in hover, leveled or climbing flight with 52kt, the most accurate finding being normally achieved above 5.000ft, in order to avoid exceeding the torque limit.

1.19 Additional information.

The company had already gone through another fuel-related aviation accident with the same aircraft model PT-YBB. It was a transfer flight from Araucária - PR, to Porto Alegre - RS, with an intermediate landing, in order to carry out the refueling of the aircraft. The helicopter crashed into the ground and the pilot suffered minor injuries.

At that time, the fuel was transported on board in plastic containers. It was pointed out that the transportation of fuel and its due precautions should have followed the one recommended in the IAC 153-1001 / 2005, in force at the time, regarding the transportation of dangerous materials on board of civil aircraft.

There was no ground support to assist the refueling procedure.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a local flight, from the Jihad Dehaini Heliport (SSSE), in Araucária - PR, in order to perform a power check, to perform a service contract with a pilot and three passengers on board.

The aircraft had all current inspections, valid CA and updated airframe and engine logbooks records. There were no on-board flight recorders nor were they required.

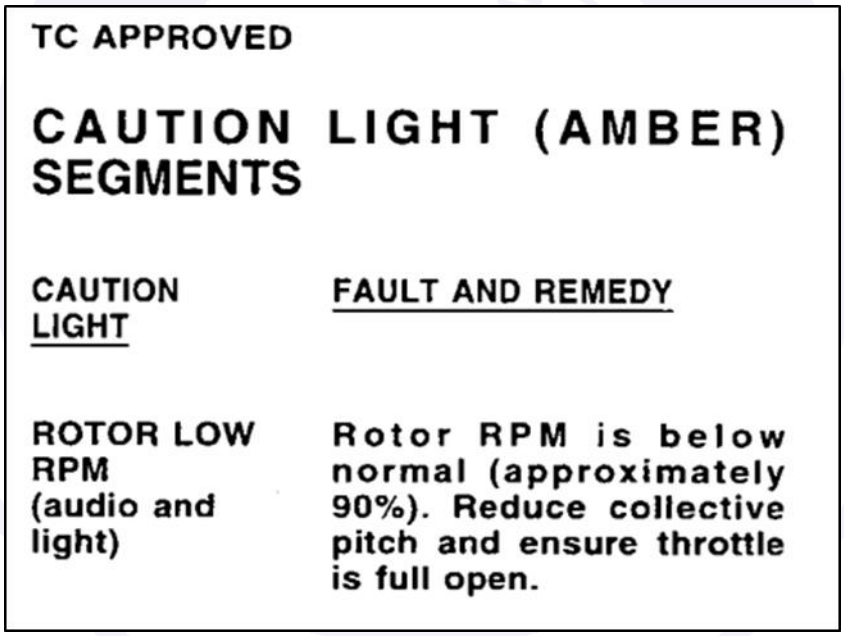
The weather conditions were favorable for the helicopter visual flight.

The SBCT METAR at 1800 (UTC) indicated a ceiling of 1.300ft, not compromising the operation. The manufacturer's manual, however, recommended that the power check to be performed above 5.000ft of pressure altitude for a more accurate result and to prevent the torque limit being exceeded.

Soon after takeoff, when crossing 300ft AGL, the pilot turned left to continue the climb up to 500ft AGL, when he saw a drop of approximately 5% RPM of the rotor. It then reduced the collective pitch and regained RPM.

However, when pulling the collective again, both the "R" (RPM) and the "T" (N2) of the turbine fell rapidly, triggering the LOW RPM sound and visual alarm when crossing 90% of NR. From there, the helicopter lost altitude and collided against the ground.

According to the situation described by the pilot, the emergency procedure prevised in the BHT-206B3-FM-1 would be to reduce the collective pitch and ensure that the throttle remained fully open (Figure 9).



TC APPROVED

CAUTION LIGHT (AMBER) SEGMENTS

CAUTION LIGHT	FAULT AND REMEDY
ROTOR LOW RPM (audio and light)	Rotor RPM is below normal (approximately 90%). Reduce collective pitch and ensure throttle is full open.

Figure 9 - Emergency procedure prevised at ROTOR LOW RPM (Audio and Light).

In the case in question, it was imperative that the procedures for an autorotation flight to be adopted. The delay in reacting immediately to a low RPM (audio and light) condition with NR indication below 90% resulted in the loss of control that led to the collision of the aircraft against the ground.

The pilot also claimed that he had not carried out the planned procedure because he thought he did not have enough height to do an autorotation.

Thus, the pilot chose to apply power in the collective in an attempt to keep the flight stabilized, which caused a new loss of rotation that, on this occasion, made the accident irreversible.

The pilot was validly qualified, with periodic training updated, and there were no reports on flight logs regarding difficulties in autorotation training. He was qualified and had made similar flights.

However, the previously training received by the commander may not have been sufficient, quantitatively and/or qualitatively, to develop the necessary conditioning to perform procedures relevant to this type of emergency.

This difficulty in identifying, analyzing and reacting adequately demonstrated that his judgement capacity was compromised by the valorization of aspects not pertinent to solve the emergency, which reinforces the suspicion about the effectiveness of the training received.

A security camera filmed the moment the aircraft hit the ground. In the image (Figure 3) it was observed the presence of electric poles and a truck that had passed by moments before the collision.

The pilot, however, said he "got into the automatic", not observing the obstacles in the approach to the emergency landing. Although there was no collision in the approach, such behaviors suggested that the pilot's situational awareness was affected by the tension of landing in an emergency.

Considering that the SBCT temperature was of 18ºC and that the altitude of the heliport was of 2.972ft, the density altitude of 4.000ft was obtained, as shown in Figure 7.

Thus, although the total weight (1.456,86 kg) is less than the maximum takeoff weight (1.519,5 kg), the density altitude of 4.000ft exceeded the maximum density altitude of 2.500ft, previsted in the Chart Height - Velocity Diagram (Figure 8), for the configuration of the aircraft at takeoff.

This inadequacy was translated by a take-off performed with the aircraft above the maximum weight allowed for those conditions (1.320 kg), evidencing the non-observance of aspects related to flight planning.

Regarding organizational and management information, the fuel reservoirs located on the Jihad Dehaini Heliport (SSSE), which served to supply the aircraft were not in the ROTAER.

These reservoirs, with storage capacity of 15,000 liters and 4,000 liters respectively, were not registered with the ANP, which may indicate a lack of compliance with the requirements of the regulatory standards, evidencing inadequate oversight, by the organization's management, of planning and execution activities in the administrative, technical and operational areas.

The cleaning and maintenance of these reservoirs were carried out by the air taxi company itself or by contracted service, using Aluminox or Intercap, which are descaling and acid strippers.

During the investigation, contaminating material was found inside the fuel tank at the airline's base. This material was collected and sent to the laboratory at the IAE, in order to compare with the contaminant found in the engine. Visually they were identical, but the trials showed that they had different spectra, not being able to unequivocally identify these materials.

Despite the non-identification of the contaminating materials, it could be inferred that the airline's storage and fueling processes were unreliable.

As the engine had no severe damage, it was translated for functional testing on the IAS test bench. During the tests, particles of contamination were found in the remaining QAV-1 in the fuel filter and the fuel nozzle last chance filter.

These samples were collected and taken for analysis in the IAE laboratory, but it was not possible to identify them.

Part of these contaminants were sent to the Rolls Royce laboratory in the United States where they claimed to be 78% reliable, either PAM or polyacrylamide. The main use of this substance was as a solids flocculant in liquids and could be used in the water treatment.

The company already had a history of a previous accident related to fuel supply. It was a PT-YBB transfer flight, which was refueled in an intermediate landing, from fuel transported on board in plastic containers.

Before the accident in question, the inspected company had performed two other surveys on PT-YHH. Although the surveyor repeatedly issued safety recommendations to the operator, there was a recurrence of problems related to its management processes.

The surveys regularly verified nonconformities related to the powertrain of the aircraft, which were only remedied on the eve of the audit flight.

The most recent version of the MGSO, the Standard Operational Procedures (SOP) and the Training Program dated back to 2014, just when the change of ownership took place. In these documents, there were still some pages dated from 2011, containing the name of the former owner and directors who had already left the company.

There was provision for meetings and safety surveys over the period. At these meetings, only the Safety Manager (GSO) and the pilot participated. In turn, safety surveys were never carried out, denoting that the safety organizational culture was inadequate, demonstrating low adherence to the principles of flight safety.

Regarding the pilot's CMA, even if the validity was erroneously extended, there was no evidence that his health condition contributed to the accident.

The hypothesis is that the contaminant present in the aircraft fuel comes from continued fueling from the reservoirs of the aircraft operating company. This hypothesis is reinforced by the fact that these reservoirs are not registered at the ANP, and their maintenance is carried out by the air taxi company itself or by third parties, failing to comply with the requirements established in the norms in force.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot’s CMA presented an error as to its expiration date;

b) the pilot had valid HMNC and HMNT Ratings;

c) the pilot was qualified and had experience in that kind of flight;

d) the aircraft had valid Airworthiness Certificate (CA);

e) the aircraft was above the limits of weight and balance;

f) the airframe and engine logbooks records were updated;

g) the weather conditions were favorable for the helicopter visual flight;

h) shortly after takeoff, when crossing 300ft AGL, the pilot turned to the left to continue the climb up to 500ft AGL;

i) the pilot reported a drop of approximately 5% RPM of the rotor;

j) the pilot claimed to have reduced the collective lever and recovered the RPM;

k) the pilot stated that he pulled the collective lever again, triggering the "LOW RPM" sound and visual alarm, when the NR dropped below 90%;

l) the pilot claimed that he had not carried out the planned procedure because he thought he did not have enough height to do an autorotation;

m) the pilot declared that "entered in automatic" not observing the obstacles in the approach to the emergency landing;

n) the aircraft was refueled at the air taxi's own base;

o) at the air taxi's base, located at the back of the former owner's residence, there was a heliport, a hangar and two tanks for fuel storage, one with a capacity of 4,000 liters and one for 15,000 liters;

p) the cleaning and maintenance of these fuel tanks were carried out by the air taxi company itself or by contracted service, using acid descalers and strippers;

q) during the engine tests, particles of contamination were found in the remaining QAV-1 in the fuel filter and the fuel nozzle last chance filter;

r) these samples were collected and taken for analysis in the IAE laboratory, but it was not possible to identify them;

s) part of these contaminants was sent to the Rolls Royce laboratory in the United States, where they stated, with 78% reliability, to be PAM or polyacrylamide;

t) contaminating material was found inside the fuel tank at the air taxi's base;

u) the examinations carried out at the IAE did not unequivocally identify these materials;

v) the most recent version of MGSO, Standard Operational Procedures (SOP) and Training Program dated back to 2014, and contained some pages with the name of the former owner and directors who had already left the company;

w) only the GSO and the pilot participated in the safety meetings.

x) operational safety surveys were never performed;

y) the aircraft had substantial damage; and

z) the pilot and passengers suffered serious injuries.

3.2 Contributing factors.

- **Attitude – a contributor.**

The pilot did not observe the procedures provided in the manufacturer's manual for the emergency situation experienced. Such an attitude may have elapsed from the level of knowledge he had on the subject, since he also failed to consider in his planning other important parameters for performing the flight, as the maximum weight calculation, for instance.

- **Organizational culture – a contributor.**

The culture of the company was permeated by attitudes and habits that weakened flight safety and that were reflected in this occurrence, given the informality present in the context of the flight.

- **Training – undetermined.**

Although the pilot's training was updated and there were no reports of difficulties in flight records, it is suspected that there was inefficiency in the training performed, due to the pilot's performance in the emergency that occurred.

- **Piloting judgement – a contributor.**

The pilot did not perform the foreseen emergency procedure because he judged he did not have enough height to do an autorotation.

Thus, when power was applied to the collective in an attempt to keep the flight stabilized, both the "R" (RPM) and the "T" (N2) of the turbine fell rapidly, triggering the LOW RPM sound and visual alarm when crossing 90% of NR. At that moment the irreversibility of the accident occurred.

- **Flight planning – a contributor.**

The flight planning was inadequate, as the pilot did not consider the density altitude in the calculation of the maximum weight, allowing the operation of the helicopter with overweight.

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

On the occasion of the NR first fall, the pilot chose to continue the flight, demonstrating difficulty in perceiving, analyzing and choosing the best alternative for the situation.

- **Management planning – a contributor.**

There was inadequacy in the planning carried out by the organization at its managerial level, especially regarding the allocation of material resources, in what concerns the storage of fuel used in the development of operational activities, which contributed to the used fuel to present impurities.

- **Support systems – undetermined.**

The outdating of the company manuals, standards and publications may have contributed to failures in fuel storage and in-flight pilot performance.

- **Managerial oversight – a contributor.**

The supervision of the operating company was inadequate, because its processes had recurring failures, meetings and planned surveys were not performed and the fuel reservoirs used were not registered at the ANP. Such inadequacies have contributed to the inadequate use of fuel in the aircraft.

- **Other - Fuel Supply – undetermined.**

The reservoirs were cleaned and maintained by the air taxi company or a contracted service, using professional descaling agents and acid strippers. Such reservoirs because they were not registered with the ANP, did not fulfill the requirements established in the current regulations and may have contributed to a possible contamination of the fuel.

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-044/CENIPA/2017 - 01 **Issued on 05/16/2019**

Analyze the pertinence of improving the mechanisms and systems for the issuance and control of the Aeronautical Medical Certificates (CMA), in order to ensure compliance with the requirements of RBAC 67, especially in relation to the item 67.15 - Validity of the CMA.

A-044/CENIPA/2017 - 02 **Issued on 05/16/2019**

Act in conjunction with Icaraí Turismo Air Taxi Ltd., in order to reassess the adequacy and compliance of the MGSO adopted by that operator.

A-044/CENIPA/2017 - 03 **Issued on 05/16/2019**

Act in conjunction with Icaraí Turismo Air Taxi Ltd., in order for that organization to improve its flight planning and management supervision mechanisms, aiming to increase the levels of competence and safety required for the performance of the activities for which the company is certified.

A-044/CENIPA/2017 - 04 **Issued on 05/16/2019**

Act in conjunction with Icaraí Turismo Air Taxi Ltd., in order for that organization to implement an effective change in the organizational culture in force within the company, aiming to increase adherence to the principles of accident prevention by the professionals who work there, inhibiting attitudes and habits that may undermine safety.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On May 16th, 2019.