

COMMAND OF AERONAUTICS
AERONAUTICAL ACCIDENT INVESTIGATION AND
PREVENTION CENTER



FINAL REPORT
A - 127/CENIPA/2013

<u>OCCURRENCE:</u>	ACCIDENT
<u>AIRCRAFT:</u>	PT-HCH
<u>MODEL:</u>	BELL 206B
<u>DATE:</u>	07 JULY 2013



NOTICE

According to the Law n° 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.

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

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

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

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with item 3.1, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree n° 21713, dated 27 August 1946.

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

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

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Taking into account the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

CONTENTS

SYNOPSIS	4
GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS.....	5
1 FACTUAL INFORMATION	6
1.1 History of the occurrence.....	6
1.2 Injuries to persons	6
1.3 Damage to the aircraft	6
1.4 Other damage.....	6
1.5 Personnel information.....	6
1.5.1 Information on the crew	6
1.6 Aircraft information.....	7
1.7 Meteorological information.....	7
1.8 Navigational aids	7
1.9 Communications.....	7
1.10 Aerodrome information	7
1.11 Flight recorders.....	7
1.12 Wreckage and impact information	7
1.13 Medical and pathological information.....	8
1.13.1 Medical aspects.....	8
1.13.2 Ergonomic information.....	8
1.13.3 Psychological aspects	8
1.14 Fire	8
1.15 Survival aspects	8
1.16 Tests and research.....	9
1.17 Organizational and management information	9
1.18 Operational information	9
1.19 Additional information	11
1.20 Utilization of other investigation techniques.....	11
2 ANALYSIS.....	12
3 CONCLUSIONS	12
3.1 Facts.....	12
3.2 Contributing factors.....	13
3.2.1 Human Factor	13
3.2.2 Operational Factor	13
3.2.3 Material Factor.....	14
4 SAFETY RECOMMENDATION.....	14
5 CORRECTIVE/PREVENTATIVE ACTION ALREADY TAKEN.....	15
6 DISSEMINATION	15
7 APPENDICES	15

SYNOPSIS

This is the Final Report of the accident involving the Bell 206B aircraft, registration PT-HCH, on 7 July 2013. The accident was classified as fuel exhaustion.

During an autorotation procedure on unprepared terrain, the helicopter collided with the ground in an abrupt fashion.

One of the passengers was seriously injured, the pilot and a female passenger suffered minor injuries, and another passenger was not injured.

The aircraft sustained substantial damage.

An accredited representative from the Transportation Safety Board of Canada was designated for participation in the investigation.

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ABRAPHE	Brazilian Helicopter Pilots Association
AFM	Aircraft Flight Manual
ANAC	(Brazil's) National Civil Aviation Agency
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CHT	Technical Qualification Certificate
CMA	Aeronautical Medical Certificate
FCU	Fuel Control Unit
IAM	Annual Maintenance Inspection
INVH	Flight Instructor Qualification (Helicopter category)
Lat	Latitude
Long	Longitude
PPH	Private Pilot (Helicopter category)
PCH	Commercial Pilot (Helicopter category)
SBSR	ICAO Location designator – São José do Rio Preto, State of São Paulo
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
US Gal	American gallon
UTC	Coordinated Universal Time
VFR	Visual Flight Rules

AIRCRAFT	Model: 206B Registration: PT-HCH Manufacturer: <i>Bell Helicopter</i>	Operator: Private
OCCURRENCE	Date/time: 07 JULY 2013 / 15:30 UTC Location: Fazenda Santa Marta Lat. 20°22'58"S – Long. 049°13'14"W Municipality– State: Icém – São Paulo	Type: Fuel Starvation

1 Factual information

1.1 History of the occurrence

At 17:35 UTC, the aircraft departed from the *Enseada Azul* Residential Condominium in the city of Fronteira, State of Minas Gerais, with a pilot and three passengers on board, destined for SBSR.

While the aircraft was cruising, the pilot noticed that the Fuel Pump illuminated and the engine flamed out. He started an autorotation procedure over a pasture area right away.

At the moment of landing, there was a strong impact of the helicopter against the ground, followed by a collision with a wire fence, resulting in the severing of the tail boom. The aircraft tumbled on its right side, and skidded for about ten meters until coming to a rest.

1.2 Injuries to persons

Injuries	Crew	Passengers	Third parties
Fatal	-	-	-
Serious	-	01	-
Minor	01	01	-
Unhurt	-	01	-

1.3 Damage to the aircraft

There was substantial damage to the aircraft fuselage, rotors, landing gear and passenger cabin.

1.4 Other damage

Nil.

1.5 Personnel information

1.5.1 Information on the crew

HOURS FLOWN	
	PILOT
Total	1,300:00
Total in the last 30 days	18:50
Total in the last 24 hours	04:30
In this type of aircraft	12:00
In this type in the last 30 days	04:30
In this type in the last 24 hours	04:30

NB.: Data provided by the pilot.

1.5.1.1 Professional formation

The pilot did his Private Pilot Course (Helicopter category) in the *Aeroclube de São Paulo*, State of São Paulo, in 2011.

1.5.1.2 Validity and category of licenses and certificates

The pilot had a Commercial Pilot license (Helicopter category). His technical qualifications regarding the BH06 type aircraft (Bell 206) and his Helicopter Flight Instructor (INVH) rating were valid.

1.5.1.3 Qualification and flight experience

The pilot was qualified, however had little more than 10 flight hours in the aircraft.

1.5.1.4 Validity of the medical certificate

The pilot had a valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information

The aircraft (serial number 509) was manufactured by Bell Helicopter in 1970.

The aircraft had a valid airworthiness certificate (CA).

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

The last inspection of the aircraft (type “Annual Maintenance Inspection” was done on 25 January 2013 by the HELITEC workshop of Campinas, State of São Paulo. The aircraft flew a total of 50 hours after the inspection.

The last overhaul of the aircraft (type “1,200 hours) was done by the *Claro Aviação* workshop in Belo Horizonte, State of Minas Gerais, on 23 January 2012. The aircraft had 77 hours of flight after the overhaul.

1.7 Meteorological information

The prevailing weather conditions were VMC.

1.8 Navigational aids

Nil.

1.9 Communications

Nil.

1.10 Aerodrome information

The accident occurred outside of aerodrome area.

1.11 Flight recorders

Neither required nor installed.

1.12 Wreckage and impact information

At the moment of landing, during the autorotation maneuver, the aircraft collided with irregular terrain covered with low vegetation (pasture).

The first impact occurred at a high rate of descent, followed by a spin and collision of aircraft parts with a wire fence. The extremity of the tail boom was cut, with the aircraft tumbling on its right side. The main rotor blades and the aircraft skis were broken. There was extensive damage to the cabin and fuselage.

There was no fuel leak. The wreckage remained concentrated, with the exception of the tail, which collided with the fence.



Figure 1 – Situation of the wreckage.

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.

1.13.3.1 Individual information

Nil.

1.13.3.2 Psychosocial information

Nil.

1.13.3.3 Organizational information

Nil.

1.14 Fire

There was no fire.

1.15 Survival aspects

Nil.

1.16 Tests and research

Due to the suspicion of fuel exhaustion, all the residual fuel in the tanks of the aircraft was drained (approximately 33 liters of aviation kerosene were obtained).

On 19 July 2013, with the helicopter stored in a deposit, the following procedures were performed in order to attest the aircraft operating condition:

a) Verification of the quantity of residual fuel between the output lines of the Fuel Control Unit (FCU) and the fuel injector (2ml of fuel were obtained);

b) Verification of the electric cabling integrity between the battery and the Fuel Quantity Indicator, together with its functioning (normal operation was confirmed);

c) Verification of the correct equalization between the quantity of fuel showed by the Indicator and the real quantity present in the tank;

d) 12 gallons of fuel were put in the tanks, and the fuel indicator functioned normally, indicating the correspondent quantity of fuel;

e) Verification of the functioning of the two electric fuel pumps, by means of the following procedures: through activation of the correspondent *circuit breakers*, each fuel pump was switched on individually.

Then, both fuel pumps were operated in conjunction. During these procedures, the fuel pressure indicator was observed, and special attention was paid to the characteristic noise associated with the functioning of each pump.

Afterwards, a flush of the fuel tank was performed by means of pressure from the pumps. The fuel collected was stored in a 50-liter transparent container for verification of the outflow (which proved normal) until the residual quantity of 5 US Gal in the tank was reached, moment at which the outflow diminished considerably and stopped when there were 4 US Gal in the tank. During the entire procedure, it was observed that the fuel pressure indicator was inoperative.

1.17 Organizational and management information

Although the Helicopter was in fact a property of the operator for several months, its documentation in the ANAC records at the time of the accident was still in the name of the *Paraopeba Participações Ltda.* company.

A purchase and sale agreement was presented, in which the PT-HCH aircraft had been purchased by the *Itamaraty Terraplenagem Ltda.* company, which authorized its direct transference to the private operator.

1.18 Operational information

The pilot had been hired for a few flights only during the weekend at which the accident occurred. And, thus, did not have an employment bonds with the aircraft operator.

The objective of the flights was to transport guests to a private party organized by a friend of the operator's in the region of São José do Rio Preto, State of São Paulo.

The pilot, despite having qualification for the type aircraft, had less than 10 hours of experience before the flights of 7 July 2013.

His experience was mainly in the operation of Robinson 22 and Robinson 44 helicopters, and had worked as flight instructor in these aircraft.

The aircraft, while on the ground in the *Campo de Marte* Aerodrome (SBMT), was fully refueled on 6 July 2013. At 13:30 local time of the same day, it departed for São José do Rio Preto, on a positioning flight of little more than two hours.

On average, the Bell 206B aircraft fuel consumption varied between 95 and 100 liters per hour according to the type of operation (total time of hovering flight, higher use of power, altitude flown, etc.).

After landing at the destination, the aircraft was fully refueled again, and departed for the *Enseada Azul* Farm located in the region of *Fronteira* (State of Minas Gerais), at a distance of 35NM from São José do Rio Preto.

According to witnesses, the aircraft flew over the landing spot for a few minutes upon arrival.

At the end of the day, at about 17:00 local time, the aircraft flew approximately 47 NM toward the region of Bebedouro, State of São Paulo, where the pilot and the aircraft spent the overnight.

The investigation calculated that the aircraft flew approximately one hour and five minutes after the last refueling (estimated average speed of 90kt).

The pilot informed that he went to bed after 22:30 and had some difficulty sleeping, in addition to not having eaten well on that day

On 7 July 2013, at about 06:30, the aircraft departed for the locality of Colina, in the region of Olímpia, at a distance of 10NM from Bebedouro.

Approximately at 07:00, the aircraft returned to Enseada Azul after deviating from the normal route to pass near São José do Rio Preto so that the pilot could find his reference (a road connecting the city to Fronteira, this latter already in the State of Minas Gerais).

Therefore, it is estimated that the trip lasted between 50 minutes and one hour, with the helicopter covering a distance of approximately 85NM.

At about 10:00, the aircraft departed for another flight, this time from Enseada Azul to Colina and back to Enseada Azul, flying a total of 114NM in approximately one hour and 25 minutes.

The last departure from Enseada Azul was destined for São José do Rio Preto, but the aircraft had a flameout when it was less than ten minutes into the flight.

Since the pilot did not write in the logbook the time spent in each of the legs, it was necessary to estimate it, after considering the distances flown at an average speed of 90kt.

According to the investigation, approximately 3 hours and 30 minutes were flown up to the moment of the flameout. The monitoring of the fuel consumption was made solely by means of observation of the fuel gauge.

By examining the aircraft logbook, it was observed that, on the occasions that the pilots entered the amount of fuel consumed on the legs flown, the average fuel consumption was approximately 100 liters per hour. This would be the value considered for purposes of planning the endurance.

According to information provided by the pilot, the fuel pump light had illuminated at some point of the preceding flight leg, but he was not able to inform precisely when this had occurred.

Approximately one minute before the engine flameout, the Fuel Pump light illuminated again.

In a research done in conjunction with the Australian Transport Safety Bureau (ATSB), it was possible to verify that other occurrences of similar characteristics with the same type of aircraft had been investigated in earlier times, being three in Australia (years 2002, 2004, and 2009), and one in Ireland (2004).

Among the relevant pieces of information contained in the Aircraft Flight Manual (AFM), it is worth highlighting the following:

- a) The unusable fuel for the model was 1 US Gal (3.78 liters);
- b) The AFM of the aircraft had the following warning: *Operation with both fuel boost pumps inoperative is not approved. Due to possible fuel sloshing in unusual attitude or out of trim conditions and one or both fuel boost pumps inoperative, the unusable fuel is ten gallons.* The term *sloshing* refers the motion of fuel in the tank, hindering the functioning of the pump;
- c) Still according to the manual, although the flight below an altitude of 6,000 feet was possible with one or both fuel pumps inoperative, the pilot was required to land the aircraft as soon as practicable in such cases;
- d) The Bell 206 did not have the low fuel warning light originally. For the ones that had the light installed (not the case of the PT-HCH), the referred warning would be given when the quantity of fuel reached 20 US Gal, a moment at which according to the AFM the pilot had to plan for landing.

The aircraft had a *RANGE EXTENDER*, which allowed *the capacity of the fuel tank to increase from 291.5 liters to 366 liters, of which 4 liters were unusable.*

Considering the 10 gallons (37.5 liters) referred to in the AFM as unusable, there would still be 328.5 liters, enabling a flight of 3 hours and 20 minutes (at a consumption of 100 liters per hour) without risk of a flameout due to sloshing or failure of the fuel pump(s).

The fuel gauge, in addition to not having indication of low fuel, had a red mark for the condition of empty tank, as shown in picture 2.



Figure 2: Fuel gauge installed in the aircraft.

1.19 Additional information

Nil.

1.20 Utilization of other investigation techniques

Nil.

2 ANALYSIS

The research done by aircraft maintenance specialists made it possible to determine that the fuel pump and the fuel gauge were functioning properly, thus ruling out any possibility of mechanical failure in the helicopter. The problem verified in the fuel pressure indicator had no influence on the occurrence of flameout.

During the investigation, it was possible to determine in a practical way that the quantity of fuel remaining in the aircraft tanks was less than 10 US Gal, and that there had not been any kind of damage to the tank that might have caused leaks.

The accident flight was the last of a series conducted on the weekend without refueling of the aircraft.

The AFM had information that due to the possibility of inoperability of one or both electric fuel pumps, as well as sloshing during unusual (or out of trim) flight attitudes, the unusable fuel was 10 US Gal.

The investigation commission, after learning of the legs flown by the Aircraft, estimated a total flight time of 3 hours and 20 minutes after the last aircraft refueling in São José do Rio Preto.

The previous illumination (precise moment not determined) of the Fuel Pump light reported by the pilot may have been the first evidence that the level of fuel was low and that sloshing was possibly taking place already.

The pilot had been hired for that event only, and did not have employment bonds with the owner/operator of the aircraft.

The experience of the pilot in the type of aircraft was short (less than 10 hours at the beginning of the operation) although he had the required qualification for conducting the flight.

The short experience of the pilot in the aircraft made him control the fuel just by means of the fuel gauge, without concern of the time of flight available to him on account of the fuel consumption per hour.

It is also likely that the short experience of the pilot in the aircraft contributed to inappropriate application of the controls during the autorotation, resulting in an increased rate of descent, which caused the aircraft to have a strong impact with the ground at the moment of landing.

The aircraft logbook was not updated with the flight time spent on the legs flown, an indication of poor planning on the part of the pilot in relation to the flight.

3 CONCLUSIONS

3.1 Facts

- a) The pilot had a valid CMA;
- b) The pilot had a valid CHT;
- c) The pilot had qualification, but only little experience in the aircraft type;
- d) The aircraft airworthiness certificate was valid;

e) The purpose of the flights was to transport guests to a private party organized by a friend of the operator's in São José do Rio Preto, State of São Paulo;

f) On average, the fuel consumption of the Bell 206B varied between 95 and 100 liters per hour;

g) The accident flight was the last one of a sequence of several flights operated during the weekend without any intermediary refueling;

h) According to the investigation, approximately 3 hours and 20 minutes were flown since the last refueling;

i) The monitoring of the fuel consumption was made only through the indication of the fuel indicator;

j) The investigation determined that the quantity of fuel remaining in the tanks after the autorotation was less than 10 US Gal;

k) The AFM detailed that on account of the non-operation of one or both electric fuel pumps, as well as of the sloshing in unusual or out-of-trim flight attitudes, the non-utilizable quantity of fuel was 10 US Gal;

l) During the cruise flight, the pilot observed that the fuel light illuminated and that the engine shut down;

m) The pilot performed the autorotation procedure over a pasture area;

n) The helicopter touched the ground with a strong impact and then hit a wire fence in the sequence;

o) The aircraft tumbled on its right side, skidding for approximately 10 meters until coming to a stop;

p) The aircraft sustained substantial damage; and

q) One of the passengers was seriously injured, the pilot and a female passenger suffered minor injuries, and another passenger suffered no injuries.

3.2 Contributing factors

3.2.1 Human Factor

3.2.1.1 Medical aspect

Nil.

3.2.1.2 Psychological aspect

3.2.1.2.1 Individual information

Nil.

3.2.1.2.2 Psychosocial information

Nil.

3.2.1.2.3 Organizational information

Nil.

3.2.2 Operational factor

3.2.2.1 Concerning the operation of the aircraft

a) Application of Controls – undetermined

It is likely that an inadequate utilization of the controls during the autorotation generated a high rate of descent, which ended up resulting in a strong impact of the aircraft against the ground at the moment of landing.

b) Piloting Judgment – a contributor

The pilot controlled the aircraft fuel only by means of the fuel indicator, without observing the parameters of hourly average consumption. He did not keep appropriate records concerning the flight time of each flight leg, either.

c) Flight Planning – a contributor

The pilot did not take into consideration the helicopter fuel consumption per hour for planning the flights, and used exclusively the fuel indicator to control fuel consumption.

d) Little Experience of the Pilot – a contributor

The pilot had only 10 hours of experience in the type of helicopter at the start of the operation, a fact that contributed to his poor planning, as well as poor judgment and (probably) inappropriate application of controls during the autorotation.

e) Managerial Oversight – a contributor

The aircraft operator did not evaluate appropriately, in conjunction with the organizer of the event, the number of legs to be flown and the possible intermediary refueling necessary for the maintenance of an adequate level of safety.

3.2.2.2 Concerning ATS units

Not a contributor.

3.2.3 Material Factor

3.2.2.1 Concerning the aircraft

Not a contributor.

3.2.2.2 Concerning ATS equipment and technology systems

Not a contributor.

4 SAFETY RECOMMENDATION

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

In accordance with the Law n°12970/2014, recommendations are made solely for the benefit of the air activity operational safety.

Compliance with a Safety Recommendation is the responsibility of the holder of the highest executive position in the organization to which the recommendation is being made. An addressee who judges to be unable to comply with a Safety Recommendation must inform the CENIPA on the reason(s) for the non-compliance.

Safety Recommendations made by the CENIPA:**To the National Civil Aviation Agency (ANAC):****A-127/CENIPA/2013 – 001****Issued on 15/06/2015**

Publicize the content of this report at seminars, lectures and similar activities targeted at owners, operators and explorers of general aviation helicopters.

5 CORRECTIVE/PREVENTATIVE ACTION ALREADY TAKEN

Nil.

6 DISSEMINATION

- (Brazil's) National Civil Aviation Agency - ANAC
- Brazilian Helicopter Pilots Association (ABRAPHE)
- SERIPA IV
- Transportation Safety Board of Canada – TSB

7 APPENDICES

Nil.

On 15/June/2015.