COMMAND OF AERONAUTICS

AERONAUTICAL ACCIDENT INVESTIGATION AND PREVENTION CENTER

FINAL REPORT
A - 623/CENIPA/2014

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-HBC**
MODEL:	**AS 355N**
DATE:	**18 October 2011**

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 item 3.1, 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.

CONTENTS

SYNOPSIS

This is the Final Report of the 18 October 2011 accident with the AS-355N aircraft, registration PR-HBC. The accident was classified as “in ground loss of control”.

After the start-up of engine number 2, the aircraft began to vibrate, and its skids started impacting the concrete pavement on which the aircraft had been resting.

The pilot decided to attempt a takeoff, but did not succeed. The aircraft yawed to the right and then tumbled to the left, with the main rotor blades colliding with the ground.

The aircraft occupants (the pilot and two passengers) got out uninjured.

The aircraft sustained substantial damage.

An accredited representative of the French *Bureau d’Enquête et d’Analyses pour la Sécurité de L’Aviation Civile* (BEA) was designated for participation in the investigation.

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	National Civil Aviation Agency
CA	Airworthiness Certificate
CCF	Aeronautical Medical Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CHT	Technical Qualification Certificate
METAR	Aerodrome Routine Weather Report
MGB	Main Gear Box
NR	Rotor Speed
OAT	Outside Air Temperature
PPH	Private Pilot (helicopter category)
PCH	Commercial Pilot (helicopter category)
RBHA	Brazilian Aeronautical Homologation Regulation
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
TPX	Non-Regular Public Air Transport
UTC	Coordinated Universal Time
VFR	Visual Flight Rules

AIRCRAFT	**Model:** AS 355N **Registration:** PR-HBC **Manufacturer:** EUROCOPTER FRANCE	**Operator:** *Helibarra Táxi Aéreo*
OCCURRENCE	**Date/time:** 18OUT2011 / 19:50 UTC **Location:** *Sepé Tiarajú* Estate **Lat.** 03º06'32"S – **Long.** 058º27'17"W **Municipality – State:** Itacoatiara – Amazonas	**Type:** In ground loss of control

1 FACTUAL INFORMATION

1.1 History of the occurrence

At 21:00 UTC, the aircraft was beginning the engine start-up procedure in a locality known as *Estância Sepé Tiarajú,* a resort in the municipality of Itacoatiara, State of Amazonas, with a pilot and two passengers on board, for a test.

According to information provided by the pilot, the aircraft, after the start-up of engine number 2, and during the stabilization of the parameters, began to behave in a way consistent with a ground resonance effect, with its skids impacting the concrete surface.

The pilot attempted to take off, but did not succeed. The aircraft yawed to the right and then tumbled to the left, with the main rotor blades colliding with the ground.

1.2 Injuries to persons

Injuries	Crew	Passengers	Third parties
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
Uninjured	1	2	-

1.3 Damage to the aircraft

The aircraft sustained damage to its structure, breakage of the main rotor blades, abrupt stop of the engine number 2 and main transmission, and had its tail boom severed at its middle section.

1.4 Other damage

Nil.

1.5 Information on the personnel involved

1.5.1 Information on the crew

HOURS FLOWN	
	PILOT
Total	3,000:00
Total in the last 30 days	80:00
Total in the last 24 hours	06:25
In this type of aircraft	100:00
In this type in the last 30 days	80:00
In this type in the last 24 hours	06:25

N.B.: Data provided by the operator.

1.5.1.1 Professional formation

The pilot did his Private Pilot course (helicopter category) at the flying school known as *Escola Prática de Pilotagem*, in Rio de Janeiro, Brazil, in 1982.

1.5.1.2 Validity and category of licenses and certificates

The pilot had a commercial pilot license (helicopter category), and a valid AS355 type aircraft technical qualification certificate.

1.5.1.3 Qualification and flight experience

The pilot was qualified, and had 100 hours of flight in the aircraft model.

1.5.1.4 Validity of medical certificate

The pilot had a valid aeronautical medical certificate (CCF).

1.6 Aircraft information

The aircraft (SN 5694) was manufactured by Eurocopter France in 2001, and was registered in the Non-Regular Public Air Transport category.

The Airworthiness Certificate (CA) of the aircraft was valid.

The airframe, engine, and rotor logbook records were up-to-date.

The last inspection of the aircraft ("10-hour" type) was done on 16 October 2011 by the company itself. The aircraft flew 8 hours 30 minutes after this inspection.

1.7 Meteorological information

The weather conditions were VMC. The temperature was 26°C, with a surface wind of 4kt.

1.8 Aids to navigation

Nil.

1.9 Communications

Nil.

1.10 Aerodrome information

The accident occurred outside of aerodrome area.

1.11 Flight recorders

The aircraft was equipped with an SN365 (REC-V E5-42 model) Monitair Recorder manufactured by ECT INDUSTRIES (France) in September 2003.

The recorder was sent to the CENIPA's Flight Data Analysis Laboratory in Brasilia for the read-out of the engine data.

The recorder manufacturer participated in the readout. The engine operation data and parameters retrieved referred to the last 41 flights of the aircraft, including the one of the occurrence.

1.12 Impact and wreckage information

When the accident occurred, the aircraft was on a hard surface, namely, a helipad. There were no signs of prior impact.

Before the impact, the aircraft left skid hit the ground a few times, then the aircraft yawed to the right, and increased its incline to the left, causing the main rotor blades to strike the ground, damaging the helicopter tail boom and main structure.

The distribution of the wreckage was concentrated.

Figure 1 – Final resting place of the aircraft.

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

The investigators went to the crash site accompanied by a HELIBRAS technical representative, knowledgeable about the crashed aircraft model.

The investigation work focused on verifying the flatness of the occurrence location, on the analysis of the marks left on the ground, and on a detailed examination of the various items and components of the helicopter.

The examination of the ground surface on which the rotor spin-up was performed showed that the pavement was rigid, flat, and that there were no marks on the ground indicative of lateral movement of the helicopter skids on the helipad.

The marks observed on the pavement were made by the impact of the helicopter left skid when the aircraft rolled to the left.

The collective control was in the unlocked position.

The aircraft landing gear assembly was of the high type, and consisted of front and rear cross tubes with skids and steps.

The front and rear cross tubes, and the right skid did not present any abnormalities.

The left skid struck the ground in the accident, and broke near the junction with the front cross tube.

The right skid had no damage, but the left one was dented due to impact with the ground.

The elastomers of the cross tubes had no apparent defects; the hydraulic dampers were in normal condition, showing no signs of leakage, and could be moved firmly and freely.

The cabin resonators (masses that are located below the pilots' seats) were in normal working order and properly secured to the aircraft structure.

The anti-vibrating assembly with springs of the main rotor head was intact.

The investigation commission confirmed that the damage to the main rotor blades and rotor head were caused by the impact of the blades with the ground after the aircraft tumbled to the left.

The aircraft was equipped with a Monitair Recorder, which was removed at the post-accident field investigation and sent to the CENIPA's Labdata for read-out. Data relative to the start-up of the engine number 2 (moment of occurrence) and other data relative to earlier flights were retrieved.

On the occurrence flight (flight 208), there was no stabilization of the engine number 2. There was an increase of the torque and NR, until the torque reached a value of 86.5%. On average, the time for the NR to reach 170 RPM is 30 seconds after the beginning of the start-up.

On the flight previous to the one of the occurrence (flight 207), the torque had increased gradually up to 50%, diminishing after the NR increased, and stabilized at 27%. After the start-up of the second engine, the torque stabilized at 11% for each engine.

1.17 Organizational and management information

Since August 1999, the operational headquarters of the company was in Rio de Janeiro. Of the eight helicopters composing the company fleet, five (including the accident aircraft) were AS-355N's. The accident helicopter had been operating in the company for five months.

The company's board of pilots consisted of 17 professionals, eight of whom were pilots of AS-355N aircraft, the model which got involved in the occurrence.

The company had an Aircraft Maintenance Unit (a.k.a. ROTORTRANS) certified by the ANAC under the RBHA 145. The workshop provided services and repairs to a variety of entities (privately-owned and government companies, civil and military public organizations). The maintenance of the entire Helibarra aircraft fleet was provided by ROTORTRANS.

In 2010, the Helibarra Taxi-Air and Heliportugal underwent a commercial merge, increasing the number of aircraft, and diversifying the services provided by the new company as a whole.

1.18 Operational information

The aircraft was within the weight and center of gravity (CG) limits specified by the manufacturer.

On the day of the occurrence, the aircraft was refueled with 173kg of AV-1, with a total take-off weight of about 1,993 kg, for a MTOW of 2,600kg.

After the final landing of the aircraft, the pilot, along with an assistant mechanic and a member of the company's ground crew, performed a start-up of the engine number 2, in order to do a maintenance check prescribed in the Service Bulletin - no. 05.00.51, issued by Eurocopter on 06 July 2007 and applicable to AS355N aircraft.

The above mentioned Service Bulletin had instructions concerning the verification of the status of the Main Gearbox oil pressure light (which was supposed to be out). The procedure comprised the following steps:

1) Shut down both engines;

2) Write down the outside air temperature (OAT) in °C or °F;

3) Start up at least one of the engines;

4) Write down the NR RPM at which the indicative red light of the MGB oil pressure went out;

5) Transfer the NR and OAT numbers to the specific graphs of the Bulletin; and

6) The results obtained might be an indication of the need to do the tests again, at intervals varying from 110 hours of flight (zone 1 of the graph) to 25 hours of flight (zone 2 of the graph) or, even, the removal and replacement of the oil pump (zone 3 of the graph).

According to a report of the company's maintenance sector, the aircraft was being subjected to checks every 25 hours of flight, notwithstanding the fact that the previous results indicated the need of a new procedure only with 110 hours of flight.

The pilot reported that shortly after the start-up of engine number 2, he felt a strong vibration of the aircraft as if it had entered into ground resonance. He applied collective control and maximum power immediately, aiming at making the helicopter take off, but after getting airborne, it yawed to the right and tumbled to the left, resulting in collision of the main rotor blades with the ground.

The Flight Manual -AS355- Eurocopter does not contemplate takeoffs with only one engine in operation.

The total time from the start-up to the collision of the aircraft with the ground was 49 seconds.

The support team provided emergency assistance, making use of chemical-powder extinguishers for preventing the onset of fire.

1.19 Additional information

According to the manufacturer, the limit for the aircraft to reach 170 RPM is 30 seconds after start-up is initiated, and this value (170 rpm) is the operational limit for application of the rotor brake.

1.20 Utilization of other investigation techniques

Nil.

2 ANALYSIS

On the day of the occurrence, the aircraft was within the weight and balance limits prescribed in the manual. The conditions of ambient temperature, surface wind, and altitude of the aerodrome were consistent with completion of the engine start-up procedure.

The pilot chose to perform the start-up of engine number 2, in compliance with an operational prescription of the very aircraft manufacturer. This procedure would serve the purpose of carrying out a maintenance check prescribed in a Service Bulletin issued by Eurocopter.

The need to conduct a check of the MGB every 25 hours of flight was an initiative of the aircraft operator, since, according to a maintenance report, the results obtained in previous tests justified the procedure to be performed only every 110 hours of flight.

The pilot told the Investigation Commission that after the engine number 2 start-up, the aircraft sustained ground resonance, and ended up colliding with the ground after a takeoff attempt.

During the investigation, it was observed that the marks made on the ground resulted from the impact of the left skid with the surface, with no indication of a contingent ground resonance event, which would otherwise result in marks made by both skids.

Several aircraft items were checked during the post-accident field investigation. No abnormalities were observed in the aircraft landing gear and main rotor. These items could have caused the phenomenon reported by the pilot if they had had a problem prior to the occurrence.

Another factor that rules out the idea of ground resonance has to do with the type of surface on which the aircraft was. Ground resonance phenomena are very unlikely to occur on hard surfaces, without a previous abrupt landing, main rotor unbalance, or failure of the dampers. No evidence of such situations was found during the investigation.

The pilot reported that the signs of ground resonance started shortly after the stabilization of the engine number 2. However, the comparison of the data of the accident flight (number 208) with the data of the previous flight (number 207), after the read-out performed by the CENIPA, showed that the engine did not stabilize. The engine parameters evolved rapidly without stabilization on the nominal regime. The torque, which normally rises and then decreases, stabilized at a lower value without dropping, and then rose,

simultaneously with the NR, up to 86.5%. It is unlikely that such a situation could have occurred with a locked collective control.

A curve corresponding to the values recorded during the flight (number 207) prior to the one of the occurrence was drawn and compared with the curve of the accident flight (number 208). On the former flight, it was possible to observe a normal start-up, in which the torque of the first engine progressively increased up to 50%, and then decreased while the NR increased, stabilizing at 27%. After the start-up of the second engine, the torque stabilized at 11% for each engine, denoting normal operation of the aircraft without application of the collective.

One of the factors capable of causing ground resonance is vibrations in the rotor head due to imbalance of the blades, incorrect tracking, or problems with the lead-lag dampers. These sources were ruled out, since the aircraft had just landed after a flight, there were no mechanical problems registered in the logbook, and both the pilot and the interviewed mechanics were emphatic in stating that the aircraft had not presented any discrepancies.

Other factors that could have caused ground resonance, such as abrupt landing, landing with one skid, and run-landing on uneven ground (situations that are capable of quickly altering the center of gravity of the rotor head, causing a change in the angle between the main rotor blades) were also ruled out, since the aircraft had landed uneventfully, and the accident occurred during the start-up procedure.

Another source of ground resonance, namely, wrong tire-pressure, was not applicable to the occurrence, because the helicopter was not equipped with tires.

As a matter of fact, no evidence was found relating this accident to ground resonance.

It is possible that the pilot performed the start-up of engine number 2 with the collective control unlocked. This is justified by the increase in torque along with an increase of NR, with no stabilization of the parameters. Upon realizing the situation, the pilot instinctively decided to pull the collective control. The aircraft, however, did not have performance capability for single-engine takeoff, and the application of the collective in this situation would have aggravated the aircraft roll tendency.

There was no attempt on the part of the pilot to perform the rotor brake procedure. According to an analysis of the engine start-up data, there were approximately 30 seconds available for the procedure before the NR reached the 170 RPM limit.

It is also possible that the little experience of the pilot in this type of aircraft contributed to his inappropriate judgment with regard to an unfeasible single-engine takeoff or a hasty identification of ground resonance, leading him to a situation that culminated in the accident.

3 CONCLUSIONS

3.1 Facts

a) The pilot had a valid aeronautical medical certificate (CCF);

b) The pilot had a valid technical qualification certificate (CHT);

c) The pilot had qualification, and had flown 100 hours in the aircraft model;

d) The aircraft had a valid airworthiness certificate (CA);

e) The airframe, engine, and rotor logbook records were up-to-date;

f) The aircraft was within the prescribed weight and balance limits;

g) The pilot and an assistant mechanic were performing a maintenance check in accordance with a Service Bulletin issued by the aircraft manufacturer;

h) The pilot performed a start-up of the engine number 2;

i) The pilot judged that the aircraft was sustaining ground resonance;

j) There was no stabilization of the engine parameters;

k) The marks on the ground were made by the impact of the left skid with the hard surface of the pavement;

l) The aircraft yawed to the right, and increased its incline to the left;

m) The main rotor collided with the ground;

n) No evidence was found of malfunctioning of the landing gear, main rotor or hydraulic damper assemblies;

o) The helicopter collective was found unlocked in the post-accident field investigation;

p) The aircraft sustained substantial damage; and

q) The pilot and passengers got out uninjured.

3.2 Contributing factors

3.2.1 Human Factor

Medical aspect

Not a contributor.

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 possible that an inadequate application of the pedals, an ineffective control of the aircraft roll, and a sudden input on the collective control in order to make the aircraft take off caused loss of control and the subsequent collision of the helicopter main rotor blades with the ground.

b) Pilot's forgetfulness – undetermined

It is possible that the pilot did not do the proper checks prior to engine start-up, performing the procedure without realizing that the collective lever was not locked in the down position.

c) Training – undetermined

It is possible that the pilot did not receive proper training with regard to ground resonance as for the procedures to be adopted in this helicopter model.

It is also possible that he was not properly instructed on the impossibility of a single-engine takeoff with this type of aircraft.

d) Piloting judgment – a contributor

The pilot, upon believing that he had entered a ground resonance condition, decided to make the aircraft take off with only one engine, unaware of the performance limits contained in the Aircraft Manual.

e) Pilot's little experience – undetermined

It is possible that the pilot, who was not highly experienced in the equipment, identified prematurely a possible ground resonance phenomenon, and wrongfully decided to make the aircraft take off, disregarding the alternative of rotor brake application.

3.2.1.3.2 Concerning the ATS units

Not a contributor.

3.2.3 Material Factor

Concerning the aircraft

Not a contributor.

3.2.2.2 Concerning ATS equipment and technology systems

Not a contributor.

4 SAFETY RECOMMENDATIONS

Safety Recommendation is a measure of preventative or corrective nature issued by the SIPAER Investigation Authority (or by a SIPAER-link) within their respective area of responsibility, aiming at suppressing a hazard or mitigating a risk generated by a latent condition, or an active failure.

From the SIPAER standpoint, a safety recommendation is essential for Operational Safety, refers to a specific hazard, and has to be complied with within a certain deadline.

Safety Recommendations made by the CENIPA:

To the National Civil Aviation Agency:

A - 623/CENIPA/2014 – 01 Issued on 03/06/2016

Carry out administrative negotiations with the Helibarra Táxi-Aéreo Ltda. company, in order to ensure that its pilots are properly instructed in relation to the performance of the aircraft utilized.

A - 623/CENIPA/2014 – 02 Issued on 03/06/2016

Provide guidance to the training section of the *Helibarra Táxi-Aéreo Ltda.* company, aiming at the delivering of periodical instructions on the recommended procedures applicable to

ground resonance events, so that their crews receive subsidies for a quick and effective recognition of the problem, and, as necessary, application of immediate corrective actions.

5 CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

Nil.

On June 3th 2016.