COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-125/CENIPA/2021

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-HHH**
MODEL:	**R44 II**
DATE:	**08NOV2021**

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 considering the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

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

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

This Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree 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. Considering the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This Final Report pertains to the November 8, 2021 accident involving the model R44-II aircraft of registration marks PR-HHH. The occurrence was typified as "[SCF-PP] Powerplant failure or malfunction."

During a local aerial reporting flight, the aircraft experienced a power loss, and the pilot performed an emergency landing in a soccer field.

The aircraft sustained substantial damage.

The occupants were uninjured.

Being the United States of America the State of Design of the aircraft, an Accredited Representative of the NTSB (National Transportation Safety Board) was designated for participation in the investigation of the accident.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AGL	Above Ground Level
ANAC	Brazil’s National Civil Aviation Agency
CENIPA	Brazil’s Center for the Investigation and Prevention of Aeronautical Accidents
CMA	Aeronautical Medical Certificate
CVA	Certificate of Airworthiness
DECEA	Department of Airspace Control
EO	Operating Specifications
HMNC	Conventional Single-Engine Helicopter Class Rating
HMNT	Turbine Single-Engine Helicopter Class Rating
OM	Maintenance Organization
PCH	Commercial Pilot License - Helicopter
PIC	Pilot in Command
SAE	Specialized Air Service Aircraft Registry Category
SIPAER	Aeronautical Accidents Investigation and Prevention System
SIVB	ICAO location designator – *Helicentro Zona Sul*, *Belo Horizonte*, MG
UTC	Coordinated Universal Time

1. FACTUAL INFORMATION.

Aircraft	**Model:** R44 II **Registration:** PR-HHH **Manufacturer:** *Robinson Helicopter*	**Operator:** *Helinews Serviços de Aerocinematografia e Aeroreportagem Ltda*.
Occurrence	**Date/time**: 08NOV2021 - 14:50 (UTC) **Location:** Urban Area. **Lat.** 19°59’30”S **Long.** 044°00’55”W **Municipality – State:** *Belo Horizonte – Minas Gerais*.	**Type(s):** [SCF-PP] Powerplant failure or malfunction

1.1. History of the flight.

The aircraft took off from SIVB (*Helicentro Zona Sul*), *Belo Horizonte*, MG, at about 10:45 UTC, for a local aerial reporting flight, with one pilot and two passengers on board.

Approximately 10 minutes into the flight, the aircraft’s engine lost power, and the pilot carried out an emergency landing in a nearby soccer field.

Figure 1 – Rear view of the aircraft after coming to a complete stop.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	1	2	-

1.3. Damage to the aircraft.

The main rotor blades struck the aircraft’s tail cone, causing it to separate.

1.4. Other damage.

NIL.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Hours Flown	
	PIC
Total	2,554:00
Total in the last 30 days	45:30
Total in the last 24 hours	00:00
In this type of aircraft	2,380:00
In this type in the last 30 days	45:30
In this type in the last 24 hours	00:00

Note - Flight time data provided by the very pilot.

1.5.2. Personnel training.

The Pilot in Command (PIC) completed his PPH course (Private Pilot – Helicopter) in 2010, at NEP – *Nacional Escola de Pilotagem*, *Rio de Janeiro*, State of *Rio de Janeiro*.

1.5.3. Category of licenses and validity of certificates.

The PIC held a PCH License (Commercial Pilot – Helicopter) and had valid class ratings for HMNC (Single-Engine Piston Helicopter) and HMNT (Single-Engine Turbine Helicopter).

1.5.4. Qualification and flight experience.

The PIC had logged over 2,500 flight hours in rotary-wing aircraft, having flown the R22, R44, and R66 models. He had been operating the occurrence aircraft since January 2021. The PIC was qualified and experienced in the type of flight.

1.5.5. Validity of medical certificate.

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

1.6. Aircraft information.

The aircraft (serial number 12161) was manufactured by Robinson Helicopter in 2008. It was registered under the Public Specialized Air Service (SAE) – Multiple Category (S00).

The aircraft had a valid CVA (Certificate of Airworthiness). Both the airframe and engine logbooks were up to date, and the aircraft was operating within weight and balance limits.

Its most recent inspection ("50-hour" type) took place on October 18, 2021, on the premises of the Maintenance Organization (OM) *Helicentro Zona Sul* (COM 1903-31/ANAC), in *Belo Horizonte*, MG. At the time of the accident, the aircraft had flown 30 hours and 5 minutes after the referred inspection.

The most recent comprehensive inspection, performed for CVA renewal, was conducted on October 29, 2021, on the premises of the Maintenance Organization *Helinews Serviços de Aerocinematografia e Aeroreportagem Ltda.* (COM 1705-32/ANAC), in *Rio de Janeiro*, RJ. At the time of the accident, the aircraft completed 10 hours and 45 minutes after the said inspection.

1.7. Meteorological information.

The weather conditions were above the minimums required for the flight.

1.8. Aids to navigation.

NIL.

1.9. Communications.

NIL.

1.10. Aerodrome information.

Not applicable.

1.11. Flight recorders.

Not required and not installed.

1.12. Wreckage and impact information.

The wreckage remained concentrated in the soccer field where the helicopter made an emergency landing.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

NIL.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

NIL.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

NIL.

1.16. Tests and research.

Samples of engine oil and fuel were sent to laboratories for verification of their compliance with specifications and the presence of contaminants. The results of the physical and chemical tests indicated that the samples were in accordance with specifications and showed no signs of contamination.

In addition, the engine of the helicopter underwent examination by the Investigation Committee. During the static compression test of the cylinders, cylinders 2 and 4 were found to have low compression, with 22 and 58 PSI, respectively. These values were not consistent with proper engine operation.

During the engine analysis, the Investigation Committee applied air pressure into the cylinders to move the intake and exhaust valves. The leakage was suppressed, and the compression levels of those cylinders returned to normal.

This condition was consistent with the presence of carbon deposit fragments detached from inside the combustion chamber, which may have remained trapped between the valve and its seat.

During the examination of the cylinders and the combustion chamber, one observed that there was a significant amount of carbon buildup on the cylinder heads (Figure 2), as well as clear evidence of pre-ignition and detonation in all six cylinders.

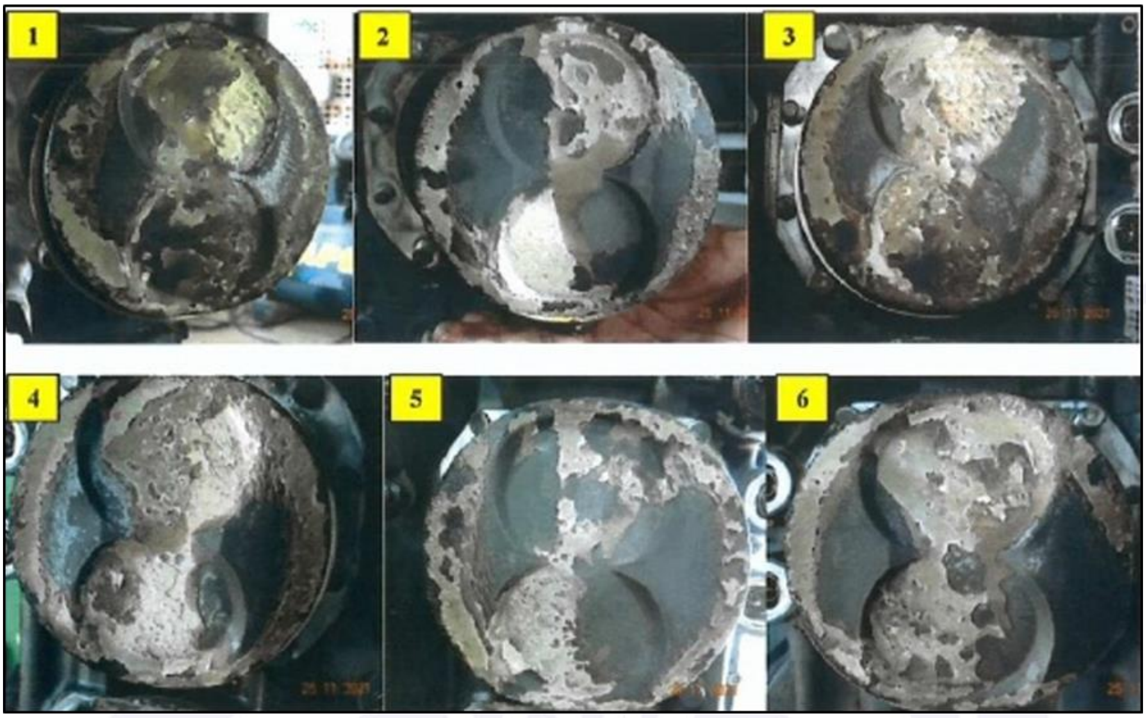

Figure 2 – View of the heads of the six engine pistons, numbered, showing the significant amount of carbon deposits accumulated on them.

The engine analysis considered that part of the carbon deposits found on the piston heads had detached and subsequently settled on the upper surfaces of the intake valves, preventing proper sealing and disrupting the combustion cycle, leading to abnormal engine operation (Figure 3).

The images in Figure 3 show scoring marks that may indicate the cylinders were in an early stage of detonation.

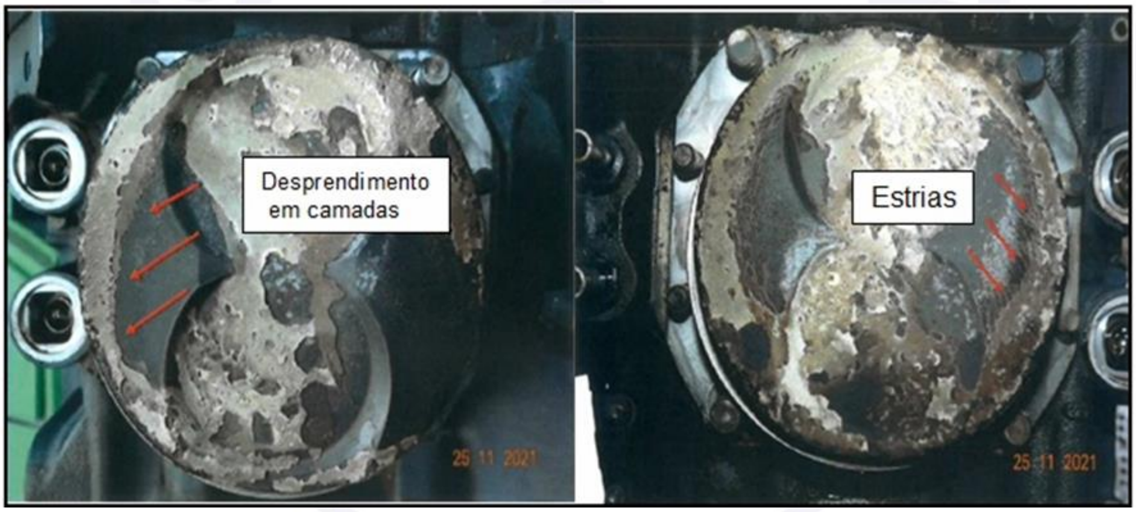

Figure 3 – View of the heads of two pistons, showing evidence of detached combustion residues.

The analysis also found that the spark plug electrode gaps were outside the limits specified by the manufacturer (Figure 4). According to the manufacturer, the gap between the center and ground electrodes of the spark plugs should range from 0.016 inches (minimum) to 0.021 inches (maximum). Moreover, all spark plugs analyzed showed gaps between the center and ground electrodes that exceeded the maximum recommended tolerance.

	Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4	Cylinder 5	Cylinder 6
Top spark-plug	.025	.022	.022	.024	.025	.024
Bottom spark-plug	.023	.025	.022	.024	.024	.025

Figure 4 – Dimensions of the gaps between the center and ground electrodes in each of the cylinders (measured in inches).

This spark plug condition could result in improper engine operation regimes, such as increased burn time of the air/fuel mixture, development of hot spots inside the combustion chamber, pre-ignition, and vibration beyond normal levels.

Excessive vibration would initially result in the removal of combustion residue deposits from inside the chamber, when present. These suspended residues in the gas mass could settle on valve seats and prevent proper sealing.

Spark plug inspection was scheduled and considered completed during the 50-, 100-, and 300-hour maintenance checks, concluded on September 2, 2021, according to the entries in the engine logbooks; and during the renewal of the CVA (Certificate of Airworhiness) carried out on October 29, 2021, as recorded in the airframe logbook.

According to the technical analysis conducted by the Investigation Committee, the aforementioned failure condition could have led to intermittent spark plug firing, which in turn could have caused engine flameout.

1.17. Organizational and management information.

The operator (*Helinews Serviços de Aerocinematografia e Aeroreportagem Ltda.*) was also a Maintenance Organization (OM) certified by ANAC to perform maintenance services on R44 II aircraft. There was a person designated as the Accountable Manager for the OM, and that individual simultaneously held the same position under the operator's Operations Specifications (EO).

According to reports, during the inspection for renewal of the CVA (Certificate of Airworthiness), the maintenance team verbally informed the Accountable Manager that the spark plugs had exceeded their operational limit, as specified in the technical manuals, and replacement was recommended.

However, the decision taken at the management level was not to perform the maintenance action at that time, stating that the spark plugs would be replaced sometime in the future. The aircraft was then authorized to return to normal operation with the same spark plugs, without any objection from the company's personnel.

1.18. Operational information.

The aircraft took off from SIVB for a routine local aerial reporting flight over the city of *Belo Horizonte*, carrying a news crew composed of a reporter and a cameraman.

Up until the time of the occurrence, the flight was proceeding normally, and no signs of malfunction were observed in any of the aircraft systems, including during previous flights.

The PIC's initial intention was to make a right turn after takeoff and proceed toward the city center to report on a pedestrian accident. However, shortly after engine start, the news crew was informed about another accident involving a car and a motorcycle at a different location, which then became the reporting priority. Thus, the flight was initiated above the site of the traffic accident, following a circular flight path while maintaining an altitude between 500 and 600 ft. and a speed between 25 and 30 kt.

Ten minutes after takeoff, the pilot reported noticing a reduction in engine performance. Subsequently, the main rotor low RPM horn (NR) sounded, and the associated low rotor RPM warning light illuminated.

In response, the PIC initiated an autorotation maneuver, directing the aircraft toward a soccer field located to the left of his field of view. He stated that, as soon as the maneuver began, the horn ceased, the warning light extinguished, and he observed a decrease in the engine's Manifold Pressure (MP).

Based on this information, the Investigation Committee analyzed the Height vs. Airspeed diagram from the R44 II Pilot's Operating Handbook, Section 5 – Performance, commonly referred to as the "dead man's curve" (Figure 5).

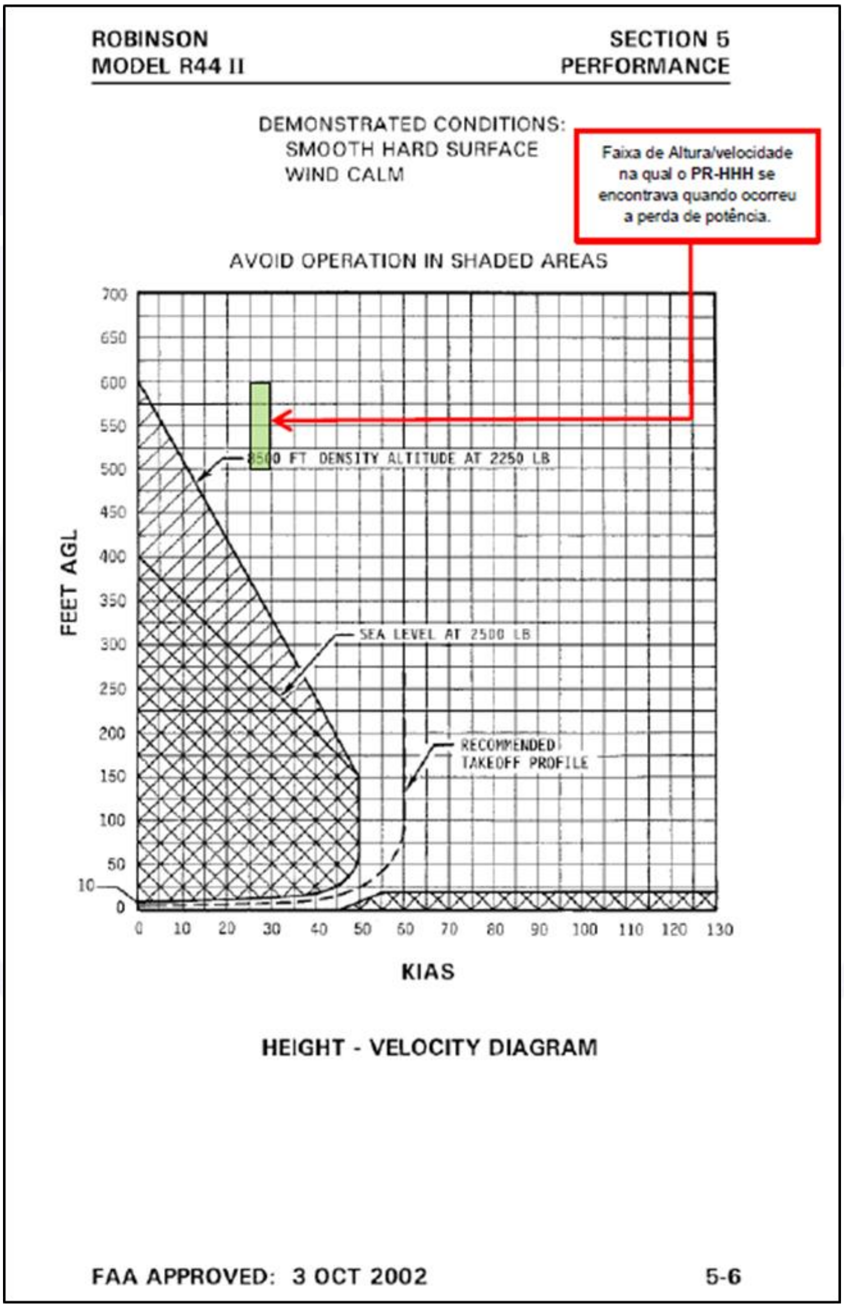

Figure 5 – Height vs. Airspeed diagram, highlighting the height and speed range of the PR-HHH aircraft at the moment of the power loss.
Source: adapted from the R44 II Pilot's Operating Handbook.

This diagram, an important performance reference for the safe operation of the aircraft, defined an envelope of airspeed and height above the ground beyond which the manufacturer did not guarantee a safe landing in the event of engine failure. Engine failures occurring within the shaded area represented a risk of severe damage to the helicopter and serious injury to its occupants.

For power loss situations, the emergency procedures described in Section 3 of the R44 II Pilot's Operating Handbook had been categorized based on the aircraft's height above ground level. There were specific procedures to be followed when flying above 500 ft. Above Ground Level, as well as procedures for altitudes between 8 and 500 ft. AGL (Figure 6).

ROBINSON
MODEL R44 II

SECTION 3
EMERGENCY PROCEDURES

POWER FAILURE ABOVE 500 FEET AGL

1. Lower collective immediately to maintain rotor RPM.
2. Establish a steady glide at approximately 70 KIAS. (For maximum glide distance or minimum rate of descent, see page 3-3.)
3. Adjust collective to keep RPM between 97 and 108% or apply full down collective if light weight prevents attaining above 97%.
4. Select landing spot and, if altitude permits, maneuver so landing will be into wind.
5. A restart may be attempted at pilot's discretion if sufficient time is available (see "Air Restart Procedure", page 3-3).
6. If unable to restart, turn unnecessary switches and fuel valve off.
7. At about 40 feet AGL, begin cyclic flare to reduce rate of descent and forward speed.
8. At about 8 feet AGL, apply forward cyclic to level ship and raise collective just before touchdown to cushion landing. Touch down in level attitude with nose straight ahead.

POWER FAILURE BETWEEN 8 FEET AND 500 FEET AGL

1. Lower collective immediately to maintain rotor RPM.
2. Adjust collective to keep RPM between 97 and 108% or apply full down collective if light weight prevents attaining above 97%.
3. Maintain airspeed until ground is approached, then begin cyclic flare to reduce rate of descent and forward speed.
4. At about 8 feet AGL, apply forward cyclic to level ship and raise collective just before touchdown to cushion landing. Touch down in level attitude and nose straight ahead.

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Figure 6 – Emergency procedures for power loss, highlighted in red.
Source: adapted from the R44 II Pilot's Operating Handbook.

The pilot reported that during the autorotation maneuver, he opened the fuel flow throttle, overriding the governor's action, and noticed an increase in both Manifold Pressure (MP) and engine RPM. Based on that response, he believed that "he had engine power" and that the power loss might have resulted from governor malfunction.

He stated that, for this reason, he momentarily interrupted the autorotation maneuver and applied collective pitch, attempting to return to normal flight. However, as this attempt was unsuccessful—since engine RPM and MP began to decrease again—he felt compelled to return immediately to the emergency landing profile under autorotation.

At the time he resumed the autorotation maneuver, the aircraft was at 250 ft., nearly over the selected landing site.

According to the PIC, it was necessary to increase the rate of descent to align with the optimal approach angle and reach the intended touchdown point within the selected landing area.

Near the landing, the pilot initiated the flare maneuver at an altitude approximately four times higher than ideal. As a result, the aircraft impacted the ground with the skids with significant energy, slightly tilted and misaligned with the direction of travel.

After this abrupt contact, the helicopter lifted off the ground again in a nose-down attitude, prompting the pilot to pull the cyclic aft in an attempt to counteract the aircraft's post-impact attitude.

This control input caused the main rotor disc to tilt excessively rearward, resulting in the main rotor blades striking the aircraft's tail cone, severing it and triggering the entire sequence of damage observed.

1.19. Additional information.

To better understand this occurrence, it is important to highlight certain aspects related to helicopter flight controls, as well as the specific characteristics of the autorotation procedure. Lírio (2012)[1] states the following:

> "[…] helicopters have four independent flight controls: longitudinal, lateral, vertical, and directional. The pilot operates these controls with hands and feet through specific control levers located in the cockpit. The conventional control system consists of the cyclic control, collective control, pedals, and the throttle, described below:
>
> - Cyclic control: located in front of the pilot, it is used to control the longitudinal and lateral movement of the helicopter. The pilot moves the cyclic stick in the desired flight direction (forward, sideways, or backward), cyclically changing the pitch angle of the main rotor blades. It is the primary control of airspeed in helicopters.
>
> - Collective control: located to the left of the pilot, it is used to control the vertical movement of the aircraft. The pilot raises or lowers the collective lever, collectively changing the pitch angle of all main rotor blades. It is the primary control of altitude in helicopters.
>
> - Pedals: used for directional control, they act on the collective pitch of the tail rotor or on the differential pitch variation between two contra-rotating rotors. To yaw the aircraft to the right, the pilot presses the right pedal, and vice versa.
>
> - Throttle: located on the collective grip, the center console, or overhead panel, it allows control of engine power output. In piston-engine helicopters, the pilot may have to simultaneously operate the collective and throttle to ensure that changes in collective pitch are accompanied by compatible changes in fuel flow. In turbine helicopters, the throttle is connected to an automatic regulating device called a governor, which relieves the pilot from having to manually adjust it during normal operation. However, in case of governor malfunction, the throttle must be manually operated by the pilot."

Regarding the autorotation procedure in helicopters, it is important to note that it is a critical flight technique generally employed when the engine fails and ceases to supply power to the main rotor blades. This procedure allows the helicopter to descend in a controlled manner and land safely, even without engine power.

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[1] LIRIO, T.A., Guia Técnico de Investigação de Acidentes Aeronáuticos com Helicópteros para Investigadores do SIPAER. Dissertação de Mestrado em Segurança de Aviação e Aeronavegabilidade Continuada - Instituto Tecnológico de Aeronáutica, São José dos Campos -SP, p.31, 2012.
LIRIO, T.A., Technical Guide for Helicopter Accident Investigation for SIPAER Investigators. Master's Dissertation in Aviation Safety and Continuing Airworthiness – Instituto Tecnológico de Aeronáutica, São José dos Campos - SP, p.31, 2012.

On autorotation, Lírio (2012) emphasizes that it occurs mechanically through the freewheeling unit, which allows the main rotor to continue rotating even when the engine is not running.

The most common reason for performing the autorotation procedure is engine failure, but other emergencies may also require its use, such as tail rotor failure and a reduction in available engine power.

In cases of sudden engine failure, the pilot's reaction time in identifying the emergency and lowering the collective control is a decisive factor in preventing a sharp drop in main rotor RPM—a structure intrinsically linked to the helicopter's lift capability.

Lírio (2012) further explains that the final 100 to 75 feet of the maneuver are critical, as this is the moment when the descent in autorotation transitions into a power-off landing. During this phase, known as the *flare*, the airflow through the main rotor is reversed, and the accumulated energy is exchanged for lift, reducing forward speed and rate of descent. Deceleration must continue until just before touchdown, reaching the lowest possible forward speed and sink rate for the given situation.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

The aircraft took off from SIVB, *Belo Horizonte*, MG, for a routine local aerial reporting flight. In addition to the PIC, the news crew—consisting of a reporter and a cameraman—was also on board.

Ten minutes into the flight, the aircraft was flying over the site of a traffic accident, in a circular flight path, at a speed between 25 and 30 kt. and an altitude between 500 and 600 ft. At that moment, the aircraft's engine began to lose performance, followed by the activation of the aural and visual low main rotor RPM warnings. The PIC then initiated the emergency autorotation procedure, steering the aircraft toward the nearest soccer field.

The engine malfunction forced the PIC to make quick decisions and operate the flight controls in search of a suitable landing site within the area being overflown, in order to carry out an emergency landing, as the aircraft no longer had sufficient power to sustain flight.

The initial procedures adopted by the PIC during the autorotation—along with the brief recovery of nominal rotor RPM, manifold pressure, and engine speed—led him to believe there was a possibility of returning to normal flight. Consequently, the PIC applied collective pitch and interrupted the autorotation procedure, even though the manufacturer's emergency procedures did not contemplate such action, especially at that altitude.

As it was not possible to maintain normal flight—due to a renewed loss of engine RPM and manifold pressure—the PIC returned to the autorotation landing profile, this time at an altitude of approximately 250 ft.

In this return to the autorotation profile, the aircraft was too high in relation to the optimal glide path for an emergency landing on the soccer field. Under those conditions, it was necessary to increase the rate of descent in order to avoid exceeding the lateral and longitudinal boundaries of the chosen landing area.

This sequence of combined events culminated in the PIC performing the flare maneuver at an altitude significantly higher than ideal. This deceleration at an improper height resulted in a hard touchdown of the skids against the ground.

In this context, it is possible that an inadequate assessment of the engine's actual operating condition led to the interruption of the autorotation procedure, which affected the flight path toward the soccer field and ultimately resulted in the flare being executed at an altitude four times higher than recommended.

The high-energy impact caused the helicopter to lift off the ground again in a nose-down attitude, prompting the pilot to pull the cyclic aft in an attempt to counteract the aircraft's acquired attitude after the initial impact.

The PIC's control input at that critical moment caused an excessive rearward tilt of the main rotor disc, which led to the rotor blades striking the aircraft's tail cone and severing it.

The damage observed on the aircraft was consistent with the high-energy impact and the subsequent collision of the main rotor blades with the tail cone.

With respect to maintenance services, it was confirmed that the inspection of the spark plugs was scheduled during the most recent engine inspections and CVA renewal. Records indicated that such inspections had been performed. Given the short interval between the inspection and the flight, it can be inferred that, at that time, the spark plugs were already showing the wear observed during the investigation.

The examinations performed on the engine and its components revealed nonconformities in the spark plugs, which, as demonstrated, exhibited electrode gaps exceeding the upper limit established by the manufacturer.

Therefore, it was possible to conclude that the power loss reported by the pilot may have been related to the excessive gap between the spark plug electrodes.

As determined during the engine analysis, the condition of the spark plugs and the wear on the electrodes were not consistent with the maintenance records that indicated recent completion of the engine inspections and CVA renewal—approximately 30 and 10 flight hours earlier, respectively. These findings indicated shortcomings in the preventive/corrective maintenance services carried out on the aircraft or a misinterpretation of technical reports, bulletins, service orders, and similar documents.

The maintenance actions related to the spark plugs were scheduled and recorded as completed, suggesting that the Maintenance Organization (OM) certified the aircraft's return to airworthiness, although the operator held final responsibility for the aircraft's airworthiness.

Consequently, the aircraft resumed normal operations with the same spark plugs, and this decision apparently did not elicit any objections from company personnel. The lack of questioning regarding the continued use of the spark plugs—despite the detected nonconformities—suggested the presence of an organizational culture with low adherence to procedures and flight safety principles, which may have contributed to the occurrence under analysis.

3. CONCLUSIONS.

3.1. Findings.

a) the pilot held valid HMNC and HMNT ratings;

b) the pilot held a valid Aeronautical Medical Certificate (CMA);

c) the pilot was qualified and experienced in the type of flight;

d) the aircraft held a valid Airworthiness Review Certificate (CVA);

e) the aircraft was operating within weight and balance limits;

f) the airframe and engine logbooks were up to date;

g) weather conditions were above the minimums required for flight;

h) the aircraft took off from SIVB for a routine local aerial reporting flight;

i) the aircraft was flying in a circular pattern at a speed between 25 and 30 kt and an altitude between 500 and 600 ft.;

j) ten minutes after takeoff, the aircraft experienced an engine power loss;

k) the engine performance degradation was followed by aural and visual warnings of low main rotor RPM;

l) the PIC initiated emergency autorotation procedures, steering the aircraft toward the nearest soccer field;

m) the PIC reported that he performed the flare at a significantly higher altitude than ideal;

n) the PIC executed the emergency landing with a hard touchdown;

o) the main rotor blades struck the aircraft's tail cone, severing it;

p) samples of engine oil and fuel were sent to laboratory analysis, and results indicated that both were within specification and showed no signs of contamination;

q) an engine analysis revealed that two cylinders had low compression;

r) during the inspection of the cylinders and combustion chamber, a significant amount of carbon buildup was found on the cylinder heads;

s) the engine analysis showed carbonization within all cylinders and on the piston heads, with clear evidence of pre-ignition;

t) all spark plugs analyzed exhibited electrode gaps exceeding the manufacturer's maximum recommended tolerance;

u) during the 50-, 100-, and 300-hour engine inspections completed on September 2, 2021, the spark plugs were not replaced;

v) during the CVA renewal on October 29, 2021, the spark plugs were not replaced;

w) the aircraft sustained substantial damage; and

x) the PIC and the two passengers were uninjured.

3.2. Contributing factors.

- **Organizational culture – undetermined.**

The absence of questioning from company personnel regarding the decision to continue using the spark plugs, despite the detected nonconformities, suggested an organizational culture with low adherence to procedures and flight safety principles, which may have contributed to the occurrence under analysis.

- **Piloting judgment – undetermined.**

It is possible that an inadequate assessment of the actual engine operating conditions led to the interruption of the autorotation procedure, which affected the flight path toward the soccer field and resulted in the flare being performed at an altitude four times higher than ideal.

- **Aircraft maintenance – a contributor.**

As determined during the engine analysis, the condition of the spark plugs and the wear on the electrodes were not consistent with the maintenance records indicating that engine inspections and CVA renewal had been completed approximately 30 and 10 hours earlier, respectively. These aspects indicated inadequacies in the preventive/corrective maintenance services performed on the aircraft.

- **Managerial oversight – a contributor.**

The aircraft's return to normal operation and its airworthiness status, as attested by the Maintenance Organization, pointed to inadequate oversight of the organization’s administrative and technical activities, particularly in relation to the applicable regulations. These were not effectively enforced, leading to the normalization of procedural deviations, the consequences of which became evident in this occurrence.

4. SAFETY RECOMMENDATIONS

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

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of safety, and shall be treated as established in the NSCA 3-13 “Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State”.

To Brazil’s National Civil Aviation Agency (ANAC), it is recommended:

A-125/CENIPA/2021 - 01 **Issued on 05/21/2025**

Act in coordination with *Helinews* (COM 1705-32/ANAC) in order to verify whether the company performs maintenance activities in compliance with ANAC regulations and the approved manuals for the R44 II aircraft and the Textron Lycoming IO-540-AE1A5 engine.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On May 21th, 2025.