COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 030/CENIPA/2019

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PT-HPG**
MODEL:	**206B**
DATE:	**11FEB2019**

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 11FEB2019 accident with the 206B aircraft model, registration PT-HPG. The accident was classified as “[SCF-PP] System/Component Failure or Malfunction Powerplant – Engine Failure in Flight”.

During a passenger transport flight between the Royal Palm Plaza Helipad (SSQW), Campinas - SP, to the Bandeirantes Helipad (SDBH), São Paulo - SP, the aircraft had an engine failure in flight and an unsuccessful attempt to landing was made between the Anhanguera (SP-330) and the SP-021 (Rodoanel Mário Covas) Highways.

Close to the ground, a truck-type vehicle that traveled on the Highway access lane hit the aircraft.

The truck had substantial damage to the cabin.

The aircraft was destroyed.

The truck driver left unharmed. The pilot and passenger of the helicopter died on the spot.

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

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AMR	DCTA Material Division
ANAC	Brazil National Civil Aviation Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
BH06	Bell 206 aircraft Type Rating
CA	Airworthiness Certificate
CBA	Aeronautics Brazilian Code
CENIPA	Aeronautical Accident Investigation and Prevention Center
CIV	Pilot's Flight Logbook
CMA	Aeronautical Medical Certificate
COA	Air Operator Certificate
COM	Maintenance Organization Certificate
CSO	Cycles Since Overhaul
CTP	Main Gearbox
DCTA	Department of Science and Airspace Technology
EDS	X-Ray Spectroscopy
EO	Operating Specifications
FAA	Federal Aviation Administration
FCU	Fuel Control Unit
FOD	Foreign Object Damage
GSO	Safety Manager
HMNT	Single Turbo Helicopter Rating
IAE	Aeronautics Space Institute
IS	Supplementary Instruction
METAR	Aviation Routine Weather Report
MEV	Scanning Electron Microscope
NM	Nautical Miles
NSCA	Aeronautics Command System Standard
NTSB	National Transportation Safety Board (USA)
OM	Maintenance Organization
PCH	Commercial Pilot License – Helicopter
PMA	Parts Manufacturer Approval
PN	Part Number
PTG	Power Turbine Governor
QAv	Aviation Kerosene
RBAC	Brazilian Civil Aviation Regulation
RNC	Non-Conformities Summary
RPM	Rotations Per Minute

RS	Safety Recommendation
SAE	Aircraft Registration Category of Public Specialized Air Service
SBMT	ICAO Location Designator - Campo de Marte Aerodrome, São Paulo - SP
SBKP	ICAO Location Designator - Viracopos Aerodrome, Campinas - SP
SDAM	ICAO Location Designator - Campos dos Amarais State Aerodrome, Prefeito Francisco Amaral, Campinas - SP
SDBH	ICAO Location Designator – Bandeirantes Helipad, São Paulo - SP
SSQW	ICAO Location Designator – Royal Palm Plaza Helipad, Campinas - SP
SIPAER	Aeronautical Accident Investigation and Prevention System
SN	Serial Number
TBO	Time Between Overhaul
TC	Computed Tomography
TPX	Aircraft Registration Category of Non-Regular Public Air Transport
TSO	Time Since Overhaul
UTC	Universal Time Coordinated
VTE	Special Technical Inspection
W/O	Work Order
XRF	X-Ray Fluorescence

1. FACTUAL INFORMATION.

Aircraft	**Model:** 206B **Registration:** PT-HPG **Manufacturer:** Bell Helicopter	**Operator:** RQ *Serviços Aéreos Especializados* Ltd.
Occurrence	**Date/time:** 11FEB2019 - 1405 UTC **Location:** Intersection between SP-330 and SP-021 Highways **Lat.** 23°27'08"S **Long.** 046°47'12"W **Municipality – State:** São Paulo – SP	**Type(s):** [SCF-PP] System/Component Failure or Malfunction Powerplant **Subtype(s):** Engine Failure in Flight

1.1 History of the flight.

The aircraft took off from the Royal Palm Plaza Helipad (SSQW), Campinas - SP, to the Bandeirantes Helipad (SDBH), São Paulo - SP, at about 1345 (UTC), in order to transport personnel, with a pilot and a passenger on board.

With about twenty minutes of flight, the aircraft made an emergency landing attempt at an intersection between the Anhanguera Highway and Rodoanel Mário Covas.

Security cameras from the concessionaire that managed the highway, captured images indicating that the aircraft performed a self-rotation, possibly aiming to land on the grassy area between the two upper lanes of the Rodoanel.

As the maneuver was unsuccessful, the aircraft passed between the two viaducts and was hit, still in flight, by a truck traveling on the access road to the Highway.

The truck had substantial damage to the cabin and the driver left unharmed.

The aircraft was destroyed.

The helicopter crewmember and the passenger died on the spot.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The main Gearbox (CTP), the blades, the engine and the fuselage were severely damaged by the impact and the action of fire (Figure 1).

Figure 1 - Wreckage of the main Gearbox (CTP), the blades, the engine and the fuselage.

The tail boom was sectioned due to the impact and did not suffer the action of fire (Figure 2).

Figure 2 - Sectioned tail boom.

1.4 Other damage.

A truck-type vehicle had substantial damage to the cabin, specifically in the upper front portion, front grille and windshield (Figure 3).

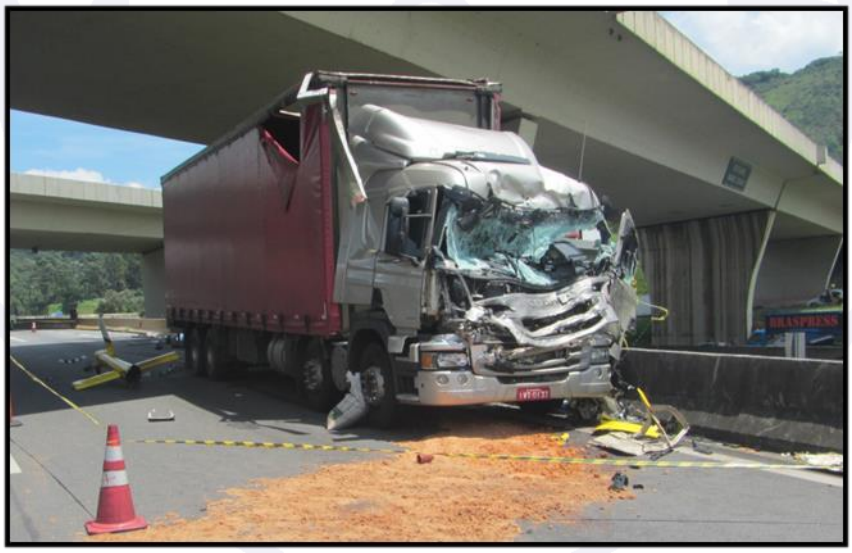


Figure 3 - View of the damaged vehicle after the collision with the aircraft.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	Pilot
Total	Unknown
Total in the last 30 days	Unknown
Total in the last 24 hours	Unknown
In this type of aircraft	Unknown
In this type in the last 30 days	Unknown
In this type in the last 24 hours	Unknown

N.B.: The Pilot's Flight Logbook was not found. The partial data, related to the flown hours, were obtained through the records contained in the ANAC's CIV - Digital system.

The last information launched at the CIV - Digital system was dated 12JUN2018.

It was also found that the information contained in the CIV - Digital system did not correspond to the movements of the aircraft registered at the Campo de Marte Aerodrome (SBMT), São Paulo - SP, where the aircraft was based. According to the information collected, the pilot had more total flight hours than those mentioned in the system, including in that aircraft model.

1.5.2 Personnel training.

The pilot took the PPH course at the São Paulo Aeroclub, in 1999.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PCH License and had valid HMNT Rating.

1.5.4 Qualification and flight experience.

The pilot was performing a non-scheduled public air transport flight in the air taxi mode, which could only be performed by an operator subject to operational certification under the terms of the RBAC 135.

In order to operate in accordance with this RBAC, it would be necessary that, in addition to the Air Operator Certificate (COA), issued on behalf of the certificate holder, and the authorization to provide remunerated public air transport services for passengers or cargo, the operator had submitted a training program approved by the ANAC that would ensure adequate training for the performance of each crewmember's duties.

The RQ *Serviços Aéreos Especializados* Ltd. did not have an approved operational training program and was not certified by the ANAC, according to RBAC 135, and did not have authorization to provide remunerated public air transport services for passengers or cargo.

That considered, it was concluded that the pilot was not qualified in the type of flight (air taxi), being unable to get his experience in the type of operation that was being performed.

1.5.5 Validity of medical certificate.

The pilot had valid CMA.

1.6 Aircraft information.

The aircraft, 206B model, serial number 1705, was manufactured by Bell Helicopter, in 1975 and was registered in the SAE Category.

The Airworthiness Certificate (CA) was valid.

The aircraft had flown 8 hours and 20 minutes after the last inspections carried out by the Maintenance Organization (OM) WM Helicopters, Maintenance Organization Certificate (COM) nº 0304-05/ANAC), on 06DEC2018.

The inspections were of the following types:

- "400 hours/12 months" of the battery;

- “100 hours/12 months” of the battery installation kit;

- “24 months” of the aircraft;

- “100 hours/90 days” for aircraft corrosion control;

- “weekly” of the aircraft;

- "1.200 hours/24 months" of the aircraft components;

- “transponder recertification”;

- “balancing of the main rotor”; and

- “flight test”.

It was equipped with an M250 engine, which in terms of maintenance, was originally developed to allow modular overhaul. The major components of the engine were the compressor, the Gearbox and the turbine (Figure 4).

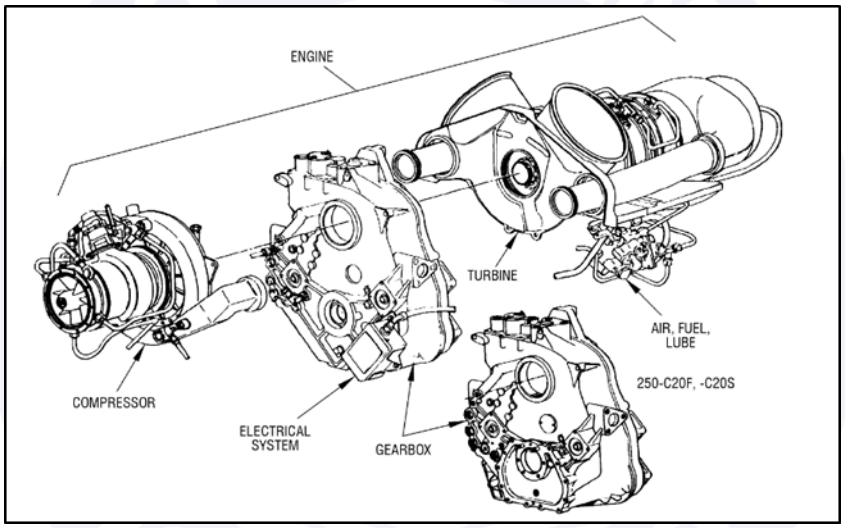


Figure 4 - Overview of the modules.

A premature removal of any of these components did not cause the removal of the others, unless a secondary damage had occurred.

For operators using Modular Overhaul, the Rolls-Royce recommended an interval between overhauls - Time Between Overhaul (TBO) as listed in Figure 5 below:

Modular Overhaul–Components Recommended Time Between Overhauls

Component	Recommended TBO (Hours)	Recommended Heavy Maintenance Inspection (HMI) by Authorized Maintenance Center
Compressor	3500(1)	None
Gearbox	On condition	None
Turbine	3500(1)	1750 hr. (1)
Turbine–Non–Product Improved(2)	1000(1)	None

(1) Refer to Airworthiness Limitations, Section 05–10–00, for life limits on certain rotating parts. It is the responsibility of the operator to assure that life limits are never exceeded.

(2) Identified by turbine P/N 6853329.

Figure 5 - Recommended Time Between General Overhauls in the M250-C20 Series Overhaul Manual.

There was the possibility that the permitted operating life limit of certain parts specified in the Airworthiness Limitations, Section 05-10-00 (Maintenance and Operation Manual), was exceeded before the recommended TBO. Therefore, it was the operator's responsibility to ensure that neither the total time nor the operating life limit of any of these components were exceeded.

The M250-C20 Series Overhaul Manual described, among other things, that one of these components, bearing nº 2, which was the back support part of the compressor rotor, should be inspected and subjected to acceptance criteria during the overhaul of the compressor module.

During the investigation, despite requests made to the operator, it was not possible to locate and access the entire maintenance records of the PT-HPG aircraft.

The Investigation Team had access to the following maintenance records and service reports performed:

- Helicopter Airframe Logbook nº 05, branded PT-HPG, with opening term dated 01DEC2012, handed out by the Maintenance Organization WM *Helicópteros*.

- The Rolls Royce Engine Logbook, model 250-C20, Serial Number (SN) CAE-821758. It was not possible to specify the logbook number, due to the erasure in the identification of the number in the opening term. It was also observed that some pages were identified with the number 02, others with the number 03 and some without identification. The OM WM Helicópteros handed out the material.

- Service Order nº 3408 dated 18OCT2017, issued by the OM WM *Helicópteros*, with 18 copies of maintenance records.

- Service Order nº 3469 dated 16MAY2018 and its annexes, issued by the OM WM *Helicópteros*.

- Service Order nº 3540 and its annexes, dated 06DEC2018, issued by the OM WM *Helicópteros*.

- Components Control and Airframe Inspections of the helicopter branded PT-HPG, issued by the OM WM *Helicópteros*, dated 06DEC2018.

- Components Control and Rolls Royce Engine Inspections, model 250-C20, SN CAE-821758, issued by the OM WM *Helicópteros*, dated 06DEC2018.

- Airframe Airworthiness Guidelines Controls for the PT-HPG helicopter and the Rolls Royce engine, model 250-C20, SN CAE-821758 issued by the OM WM *Helicópteros*.

- Copy of Airframe Logbook nº 02 of the Rolls Royce engine, model 250-C20, SN CAE-821758, with opening term dated 15MAR2003, handed out by the OM HBR *Aviação SA*.

- Copy of Airframe Logbook nº 02 of the helicopter branded PT-HPG, with opening term dated 15MAR2003, handed out by the OM HBR *Aviação SA*.

- Copy of Airframe Logbook nº 05 of the helicopter branded PT-HPG, with opening term dated 01DEC2012, handed out by the OM HBR *Aviação SA*.

- Copy of Service Order nº 0677/2017 and its annexes, dated 20JUL2017, issued and handed out by the OM HBR *Aviação SA*.

- Copy of Service Order nº 0481/2015 and its annexes, dated 20JUL2017, issued and handed out by the HBR *Aviação SA* Maintenance Organization.

- Copy of Service Order nº 0778/2016 and its annexes, dated 20JUL2017, issued and handed out by the OM HBR *Aviação SA*.

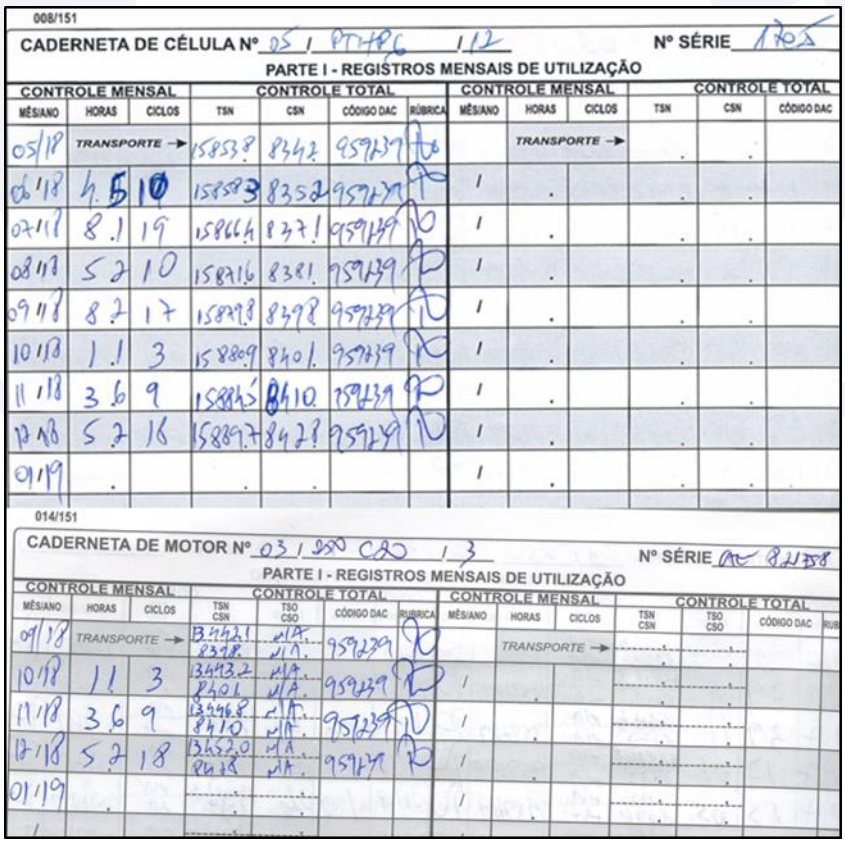
- Copy of part of the item history sheets (Log Cards) of the PT-HPG aircraft airframe handed out by the OM HBR *Aviação SA*.

- Copy of part of the Log Cards of the Rolls Royce engine, model 250-C20, SN CAE-821758 handed out by the OM HBR *Aviação SA*.

- Copy of the monthly report of services performed by the *Aeronaves Turbinas e Componentes* Ltd. Company (ATC) referring to December 2011.

- Copy of the SEGVOO 003 nº ATC 00414/2011 and the SEGVOO 003 nº ATC 00417/2011.

The analyzed airframe and engine logbooks did not have updated records (Part I). The last registration in both logbooks had been made in December 2018 (Figure 6).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CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12 Nº SÉRIE 1705

PARTE I - REGISTROS MENSAIS DE UTILIZAÇÃO

CONTROLE MENSAL			CONTROLE TOTAL				CONTROLE MENSAL			CONTROLE TOTAL			
MÊS/ANO	HORAS	CICLOS	TSN	CSN	CÓDIGO DAC	RÚBRICA	MÊS/ANO	HORAS	CICLOS	TSN	CSN	CÓDIGO DAC	
05/18	TRANSPORTE →		15853.8	8342.	959439			TRANSPORTE →					
06/18	4.5	10	15858.3	8352.	959439		/	.		.	.		
07/18	8.1	19	15866.4	8371.	959439		/	.		.	.		
08/18	5.2	10	15871.6	8381.	959439		/	.		.	.		
09/18	8.2	17	15879.8	8398.	959439		/	.		.	.		
10/18	1.1	3	15880.9	8401.	959439		/	.		.	.		
11/18	3.6	9	15884.5	8410.	959439		/	.		.	.		
12/18	5.2	16	15889.7	8421.	959439		/	.		.	.		
01/19	.		.	.			/	.		.	.		

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CADERNETA DE MOTOR Nº 03 / 250 C20 / 3 Nº SÉRIE CAE 821758

PARTE I - REGISTROS MENSAIS DE UTILIZAÇÃO

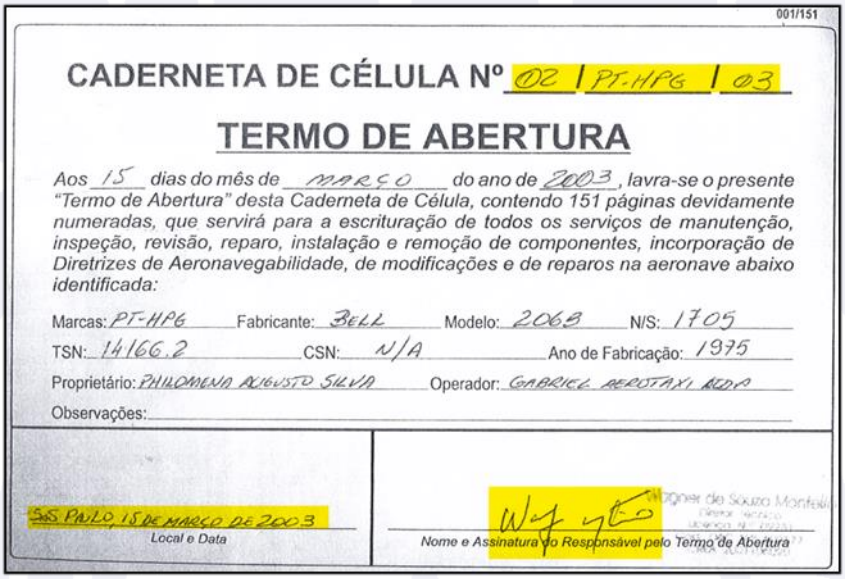
CONTROLE MENSAL			CONTROLE TOTAL				CONTROLE MENSAL			CONTROLE TOTAL			
MÊS/ANO	HORAS	CICLOS	TSN CSN	TSO CSO	CÓDIGO DAC	RÚBRICA	MÊS/ANO	HORAS	CICLOS	TSN CSN	TSO CSO	CÓDIGO DAC	
09/18	TRANSPORTE →		8398.	N/A.	959439			TRANSPORTE →					
10/18	1.1	3	8401.	N/A.	959439		/	.		.	.		
11/18	3.6	9	8410.	N/A.	959439		/	.		.	.		
12/18	5.2	18	8429.	N/A.	959439		/	.		.	.		
01/19	.		.	.			/	.		.	.		

Figure 6 - Last monthly usage record in Part I of airframe logbook number 05/PT-HPG/12 and engine logbook number 03.

In accordance with item 5.6.2 of Supplementary Instruction (IS) nº 43.9-003, Revision A, of ANAC, the updating of Part I of the airframe and engine logbooks should have been done by the fifth day of the subsequent month and, in case of an aircraft, engine or propeller operates after an inactive period longer than one month, this inactivity should be mentioned in a single line in the Monthly Control of Parts I field of the respective logbooks.

Airframe Logbook 02/PT-HPG/03 had its opening term registered on 15MAR2003 and closing on 01DEC2012 (Figures 7 and 8). Afterwards, it was found that the opening term of Airframe Logbook 05/PT-HPG/12 was dated 01DEC2012 (Figure 9), the same day of the closing of logbook 02/PT-HPG/03 (Figure 8).

Airframe logbooks numbers 03 and 04 of the PT-HPG aircraft were not found and/or presented.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CADERNETA DE CÉLULA Nº 02 / PT-HPG / 03

TERMO DE ABERTURA

Aos 15 dias do mês de MARÇO do ano de 2003, lavra-se o presente "Termo de Abertura" desta Caderneta de Célula, contendo 151 páginas devidamente numeradas, que servirá para a escrituração de todos os serviços de manutenção, inspeção, revisão, reparo, instalação e remoção de componentes, incorporação de Diretrizes de Aeronavegabilidade, de modificações e de reparos na aeronave abaixo identificada:

Marcas: PT-HPG Fabricante: BELL Modelo: 206B N/S: 1705

TSN: 14166.2 CSN: N/A Ano de Fabricação: 1975

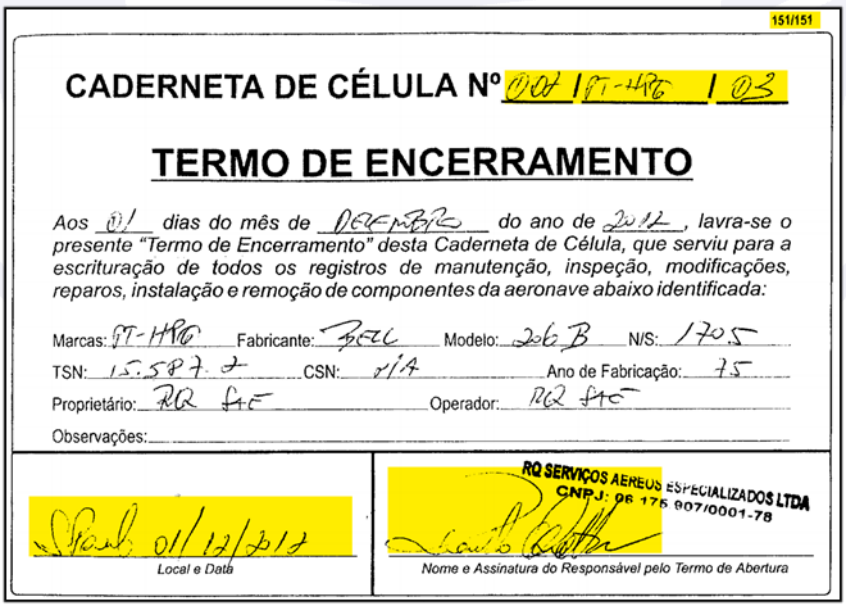
Proprietário: PHILOMENA AUGUSTO SILVA Operador: GABRIEL AEROTAXI ADDA

Observações:

SÃO PAULO, 15 DE MARÇO DE 2003
Local e Data

Nome e Assinatura do Responsável pelo Termo de Abertura

Figure 7 – Opening Term for Airframe logbook nº 02 / PT-HPG / 03.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CADERNETA DE CÉLULA Nº 02 / PT-HPG / 03

TERMO DE ENCERRAMENTO

Aos 01 dias do mês de DEZEMBRO do ano de 2012, lavra-se o presente "Termo de Encerramento" desta Caderneta de Célula, que serviu para a escrituração de todos os registros de manutenção, inspeção, modificações, reparos, instalação e remoção de componentes da aeronave abaixo identificada:

Marcas: PT-HPG Fabricante: BELL Modelo: 206B N/S: 1705

TSN: 15.587.2 CSN: N/A Ano de Fabricação: 75

Proprietário: RQ Operador: RQ

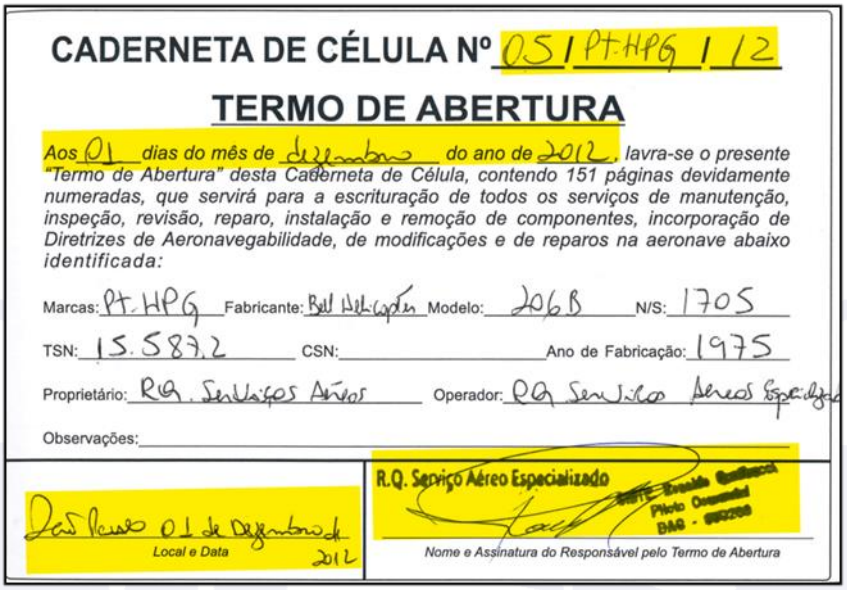
Observações:

01/12/2012
Local e Data

RQ SERVIÇOS AEREOS ESPECIALIZADOS LTDA
CNPJ: 06 175 907/0001-78

Nome e Assinatura do Responsável pelo Termo de Abertura

Figure 8 - Closing Term for Airframe logbook nº 02 / PT-HPG / 03.



CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12

TERMO DE ABERTURA

Aos 01 dias do mês de dezembro do ano de 2012, lavra-se o presente "Termo de Abertura" desta Caderneta de Célula, contendo 151 páginas devidamente numeradas, que servirá para a escrituração de todos os serviços de manutenção, inspeção, revisão, reparo, instalação e remoção de componentes, incorporação de Diretrizes de Aeronavegabilidade, de modificações e de reparos na aeronave abaixo identificada:

Marcas: PT-HPG Fabricante: Bell Helicopter Modelo: 206B N/S: 1705

TSN: 15.587,2 CSN: Ano de Fabricação: 1975

Proprietário: RQ. Serviços Aéreos Operador: RQ Serviços Aéreos Especializado

Observações:

Rio Preto 01 de Dezembro de 2012
Local e Data

R.Q. Serviço Aéreo Especializado
Piloto
Nome e Assinatura do Responsável pelo Termo de Abertura

Figure 9 - Opening Term for Airframe logbook nº 05 / PT-HPG / 12

In addition, there were signs of erasures on the inside pages of both logbooks and pages without identification and/or with their identification in disagreement with the opening term, according to Figures 10, 11, 12, 13, 14 and 15.

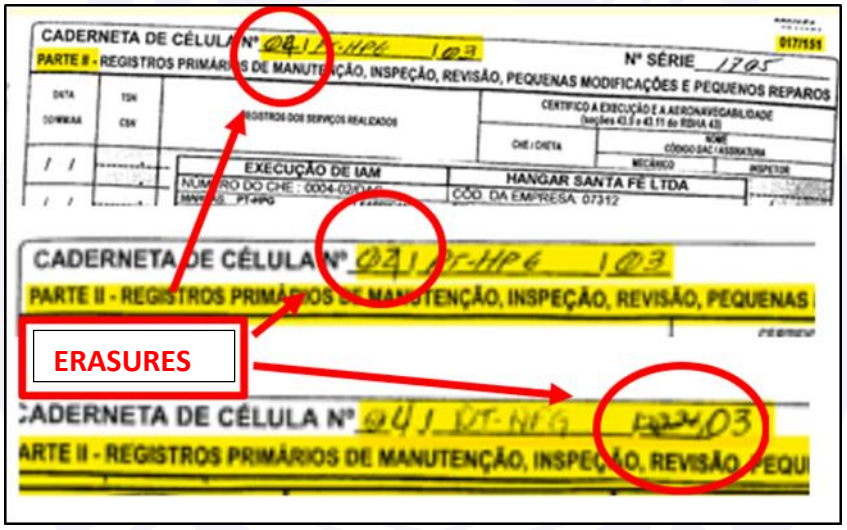
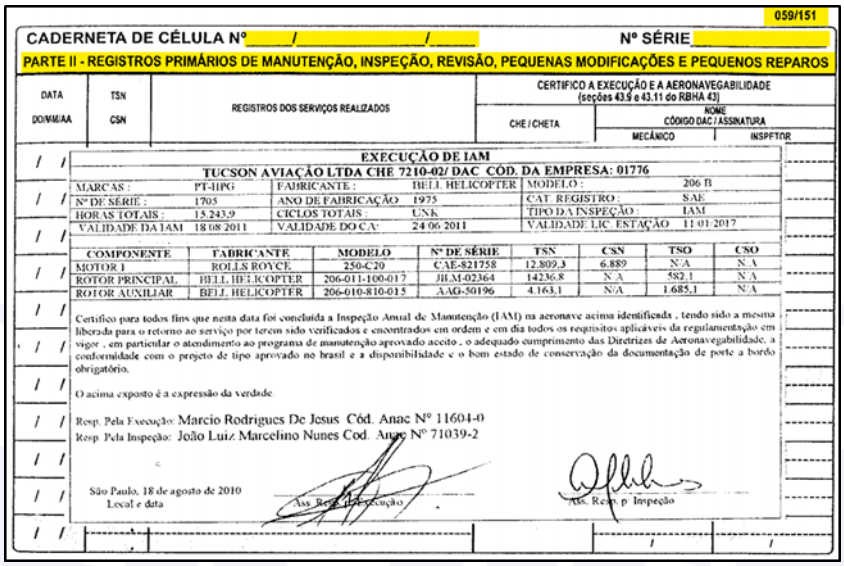


Figure 10 - Discrepancies verified in Part II of Airframe Logbook 02 / PTHPG / 03 (erasures).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CADERNETA DE CÉLULA Nº ____ / ____ / ____ Nº SÉRIE ____

PARTE II - REGISTROS PRIMÁRIOS DE MANUTENÇÃO, INSPEÇÃO, REVISÃO, PEQUENAS MODIFICAÇÕES E PEQUENOS REPAROS

DATA DD/MM/AA	TSN CSN	REGISTROS DOS SERVIÇOS REALIZADOS	CERTIFICO A EXECUÇÃO E A AERONAVEGABILIDADE (seções 43.9 e 43.11 do RBHA 43) CHE / CHETA	NOME CÓDIGO DAC / ASSINATURA MECÂNICO	INSPETOR
/ /		EXECUÇÃO DE IAM TUCSON AVIAÇÃO LTDA CHE 7210-02/ DAC CÓD. DA EMPRESA: 01776 MARCAS : PT-HPG FABRICANTE : BELL HELICOPTER MODELO : 206 B Nº DE SÉRIE : 1705 ANO DE FABRICAÇÃO : 1975 CAT. REGISTRO : SAE HORAS TOTAIS : 15.243,9 CICLOS TOTAIS : UNK TIPO DA INSPEÇÃO : IAM VALIDADE DA IAM 18/08/2011 VALIDADE DO CA: 24/06/2011 VALIDADE LIC. ESTAÇÃO 11/01/2017			

COMPONENTE	FABRICANTE	MODELO	Nº DE SÉRIE	TSN	CSN	TSO	CSO
MOTOR 1	ROLLS ROYCE	250-C20	CAE-821758	12.809,3	6.889	N/A	N/A
ROTOR PRINCIPAL	BELL HELICOPTER	206-011-100-017	JILM-02364	14236.8	N/A	582,1	N/A
ROTOR AUXILIAR	BELL HELICOPTER	206-010-810-015	AAG-50196	4.163,1	N/A	1.685,1	N/A

Certifico para todos fins que nesta data foi concluída a Inspeção Anual de Manutenção (IAM) na aeronave acima identificada , tendo sido a mesma liberada para o retorno ao serviço por terem sido verificados e encontrados em ordem e em dia todos os requisitos aplicáveis da regulamentação em vigor , em particular o atendimento ao programa de manutenção aprovado aceito , o adequado cumprimento das Diretrizes de Aeronavegabilidade, a conformidade com o projeto de tipo aprovado no brasil e a disponibilidade e o bom estado de conservação da documentação de porte a bordo obrigatório.

O acima exposto é a expressão da verdade.

Resp. Pela Execução: Marcio Rodrigues De Jesus Cód. Anac Nº 11604-0
Resp. Pela Inspeção: João Luiz Marcelino Nunes Cod. Anac Nº 71039-2

São Paulo, 18 de agosto de 2010
Local e data

Ass. Resp. p/ Execução

Ass. Resp. p/ Inspeção

Figure 11 - Discrepancies verified in Part II of Airframe Logbook 02 / PTHPG / 03 (no identification).

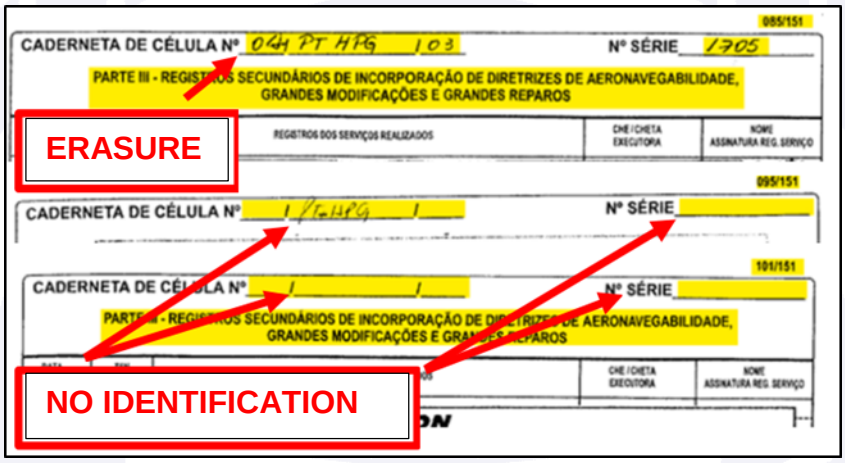


Figure 12 - Discrepancies verified in Part III of Airframe Logbook 02 / PTHPG / 03 (erasure or page without identification).

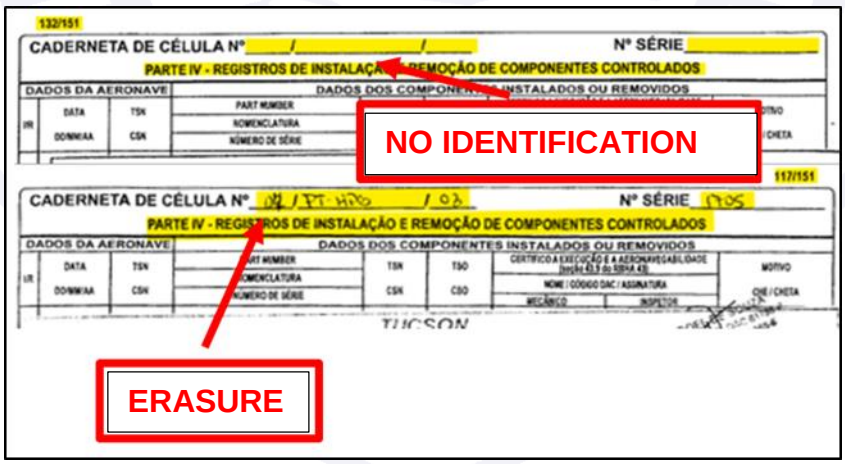
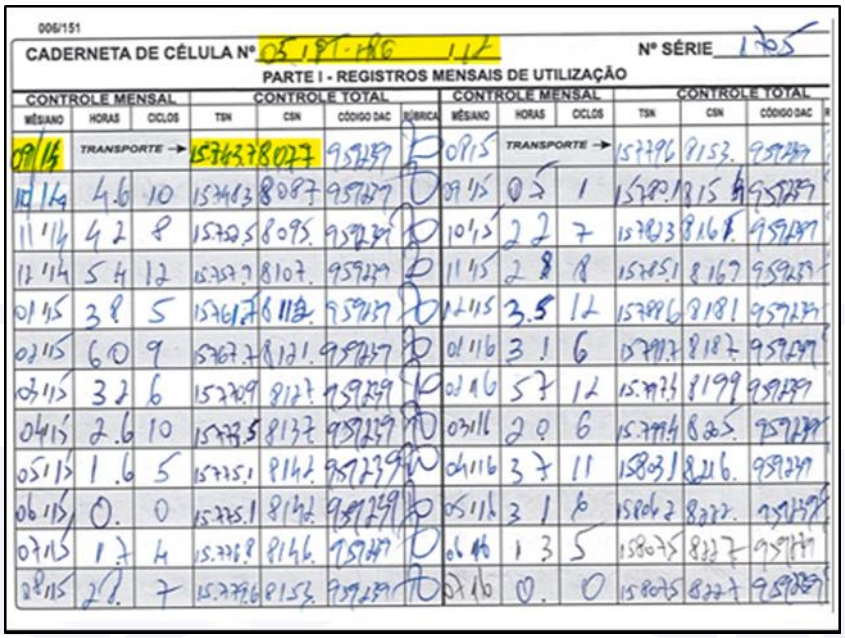


Figure 13 - Discrepancies verified in Part IV of Airframe Logbook 02 / PTHPG / 03 (erasure or page without identification).


006/151

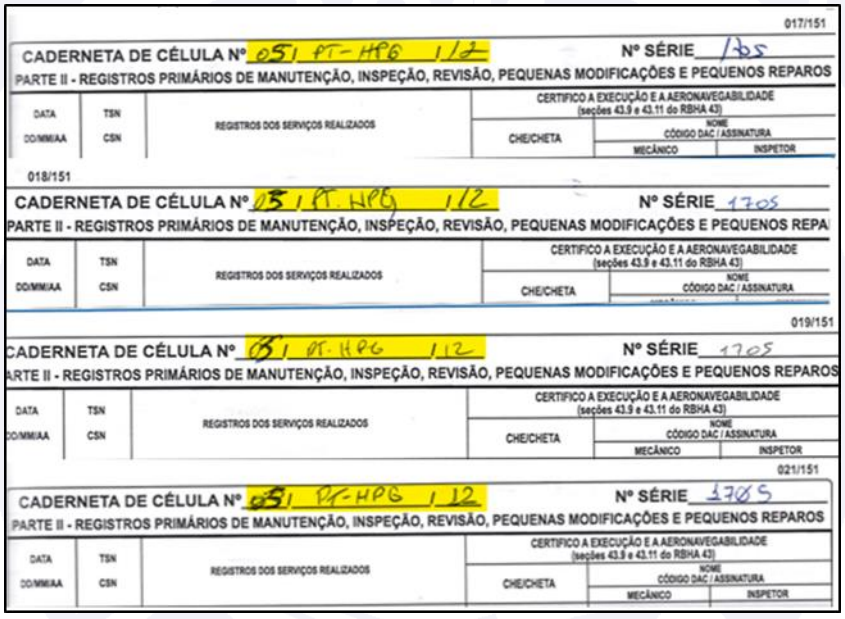
CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12 Nº SÉRIE 1705

PARTE I - REGISTROS MENSAIS DE UTILIZAÇÃO

CONTROLE MENSAL MÊS/ANO	HORAS	CICLOS	CONTROLE TOTAL TSN	CSN	CÓDIGO DAC	RUBRICA
09/14	TRANSPORTE →		15762	7807 7	959287	
10/14	46	10	15746	8087	959287	
11/14	42	8	15792	8095	959287	
12/14	54	12	15837	8107	959287	
01/15	38	5	15761	8112	959287	
02/15	60	9	15767	8121	959287	
03/15	32	6	15770	8127	959287	
04/15	26	10	15773	8137	959287	
05/15	16	5	15775	8142	959287	
06/15	0.	0	15775	8142	959287	
07/15	17	4	15778	8146	959287	
08/15	28	7	15778	8153	959287	

CONTROLE MENSAL MÊS/ANO	HORAS	CICLOS	CONTROLE TOTAL TSN	CSN	CÓDIGO DAC
08/15	TRANSPORTE →		157796	8153	959287
09/15	07	1	15780	8160	959287
10/15	22	7	15803	8167	959287
11/15	28	8	15831	8175	959287
12/15	35	12	15866	8181	959287
01/16	31	6	15897	8187	959287
02/16	57	12	15954	8199	959287
03/16	20	6	15974	8205	959287
04/16	37	11	16011	8216	959287
05/16	31	6	16042	8222	959287
06/16	13	5	16055	8227	959287
07/16	0.	0	16055	8227	959287

Figure 14 - Erasure in Part I of Airframe Logbook 05 / PTHPG / 12.


017/151

CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12 Nº SÉRIE 1705

PARTE II - REGISTROS PRIMÁRIOS DE MANUTENÇÃO, INSPEÇÃO, REVISÃO, PEQUENAS MODIFICAÇÕES E PEQUENOS REPAROS

DATA DD/MM/AA	TSN CSN	REGISTROS DOS SERVIÇOS REALIZADOS	CERTIFICO A EXECUÇÃO E A AERONAVEGABILIDADE (seções 43.9 e 43.11 do RBHA 43) CHE/CHETA	NOME CÓDIGO DAC / ASSINATURA MECÂNICO	INSPETOR

018/151

CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12 Nº SÉRIE 1705

PARTE II - REGISTROS PRIMÁRIOS DE MANUTENÇÃO, INSPEÇÃO, REVISÃO, PEQUENAS MODIFICAÇÕES E PEQUENOS REPA

DATA DD/MM/AA	TSN CSN	REGISTROS DOS SERVIÇOS REALIZADOS	CERTIFICO A EXECUÇÃO E A AERONAVEGABILIDADE (seções 43.9 e 43.11 do RBHA 43) CHE/CHETA	NOME CÓDIGO DAC / ASSINATURA

019/151

CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12 Nº SÉRIE 1705

ARTE II - REGISTROS PRIMÁRIOS DE MANUTENÇÃO, INSPEÇÃO, REVISÃO, PEQUENAS MODIFICAÇÕES E PEQUENOS REPAROS

DATA DD/MM/AA	TSN CSN	REGISTROS DOS SERVIÇOS REALIZADOS	CERTIFICO A EXECUÇÃO E A AERONAVEGABILIDADE (seções 43.9 e 43.11 do RBHA 43) CHE/CHETA	NOME CÓDIGO DAC / ASSINATURA MECÂNICO	INSPETOR

021/151

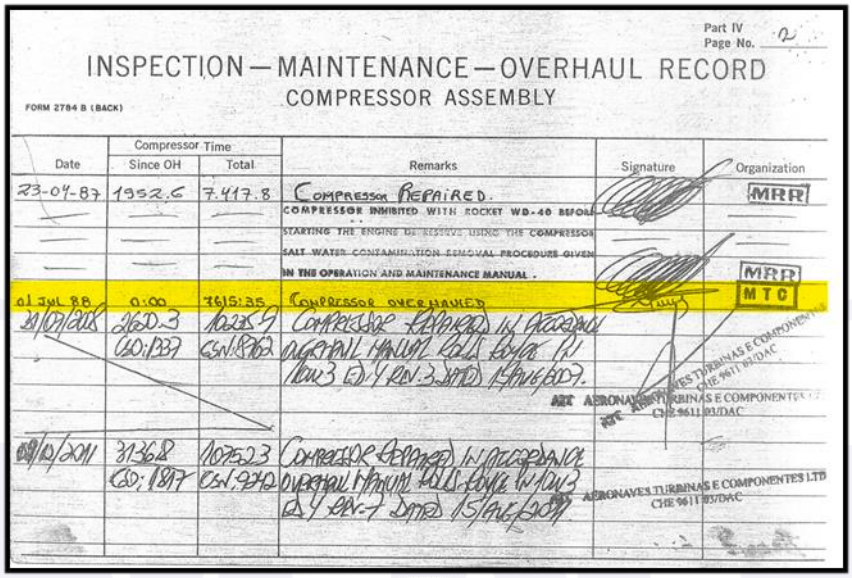
CADERNETA DE CÉLULA Nº 05 / PT-HPG / 12 Nº SÉRIE 1705

PARTE II - REGISTROS PRIMÁRIOS DE MANUTENÇÃO, INSPEÇÃO, REVISÃO, PEQUENAS MODIFICAÇÕES E PEQUENOS REPAROS

DATA DD/MM/AA	TSN CSN	REGISTROS DOS SERVIÇOS REALIZADOS	CERTIFICO A EXECUÇÃO E A AERONAVEGABILIDADE (seções 43.9 e 43.11 do RBHA 43) CHE/CHETA	NOME CÓDIGO DAC / ASSINATURA MECÂNICO	INSPETOR

Figure 15 - Discrepancies verified in Part II of Airframe Logbook 05/PTHPG/12 (erasures on the Logbook identification).

In the maintenance records, it was possible, through the Log Cards, to identify that the compressor installed on the aircraft, SN CAC-30992F, had passed through Overhaul on 01JUL1988 (Figure 16).



Part IV Page No. 2

INSPECTION — MAINTENANCE — OVERHAUL RECORD

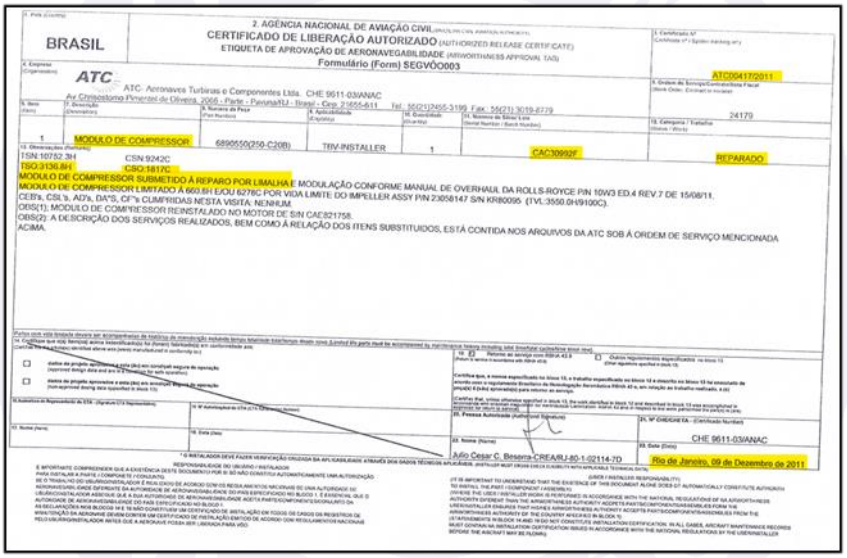
COMPRESSOR ASSEMBLY

FORM 2784 B (BACK)

Date	Compressor Time Since OH	Compressor Time Total	Remarks	Signature	Organization
23-04-87	1952.6	7.417.8	COMPRESSOR REPAIRED. COMPRESSOR INHIBITED WITH ROCKET WD-40 BEFOR STARTING THE ENGINE OF RESERVE, USING THE COMPRESSOR SALT WATER CONTAMINATION REMOVAL PROCEDURE GIVEN IN THE OPERATION AND MAINTENANCE MANUAL.		MRR
01 JUL 88	0:00	7615:35	COMPRESSOR OVERHAULED		MRR MTC
31/07/2008	2620.3 (40:133?)	10225.9 CSN:8962	COMPRESSOR REPAIRED IN ACCORDANCE OVERHAUL MANUAL ROLLS ROYCE PN 10W3 ED:4 REV:3 DATED 15/AUG/2007.		AERONAVES TURBINAS E COMPONENTES LTD CHE 9611 03/DAC
09/12/2011	31368 (ED:1897)	107523 CSN:9742	COMPRESSOR REPAIRED IN ACCORDANCE OVERHAUL MANUAL ROLLS ROYCE PN 10W3 ED:4 REV:7 DATED 15/AUG/2007.		AERONAVES TURBINAS E COMPONENTES LTD CHE 9611 03/DAC

Figure 16 - Log Card with Overhaul information on 01JUL1988.

The compressor module, SN CAC-30992F, had also been repaired due to filling, and remained, after that maintenance with 3,136.8 hours of Time Since Overhaul (TSO) and 1,817 Cycles Since Overhaul (CSO), as SEGVOO 003 nº ATC 00417/2011, dated 09DEC2011 (Figure 17).



BRASIL

2. AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL

CERTIFICADO DE LIBERAÇÃO AUTORIZADO (AUTHORIZED RELEASE CERTIFICATE)

ETIQUETA DE APROVAÇÃO DE AERONAVEGABILIDADE (AIRWORTHINESS APPROVAL TAG)

Formulário (Form) SEGVÔO003

ATC00417/2011

ATC

ATC Aeronaves Turbinas e Componentes Ltda. CHE 9611-03/ANAC

Av Cmte Sistoma Pimentel de Oliveira, 2066 - Parte - Paruna/RJ - Brasil - Cep: 21655-611 Tel.: 55(21)2456-3199 Fax: 55(21) 3019-8779

24179

1	MODULO DE COMPRESSOR	6890550(250-C20B)	TRV-INSTALLER	1	CAC30992F		REPARADO

TSN:10752.3H CSN:9242C

TSO:3136.8H CSO:1817C

MODULO DE COMPRESSOR SUBMETIDO À REPARO POR LIMALHA E MODULAÇÃO CONFORME MANUAL DE OVERHAUL DA ROLLS-ROYCE P/N 10W3 ED.4 REV.7 DE 15/08/11.

MODULO DE COMPRESSOR LIBERADO À 660.8H E/OU 627&C POR VIDA LIMITE DO IMPELLER ASSY P/N 23058147 S/N KR80095 (TVL:3550.0+91/100C).

CEB's, CSL's, AD's, DA*S, CF's CUMPRIDAS NESTA VISITA: NENHUM.

OBS(1): MODULO DE COMPRESSOR REINSTALADO NO MOTOR DE S/N CAE321758.

OBS(2): A DESCRIÇÃO DOS SERVIÇOS REALIZADOS, BEM COMO A RELAÇÃO DOS ITENS SUBSTITUIDOS, ESTÁ CONTIDA NOS ARQUIVOS DA ATC SOB A ORDEM DE SERVIÇO MENCIONADA ACIMA.

Julio Cesar C. Besarra-CREA/RJ-80-1-02114-7D

CHE 9611-03/ANAC

Rio de Janeiro, 09 de Dezembro de 2011

Figure 17 - SEGVOO 003 nº ATC 00417/2011.

The SEGVOO 003 form should be used as a primary maintenance record and for the control and traceability of aeronautical parts. Its basic purpose was to certify the airworthiness of aircraft engines, propellers and articles[1]. The uses foreseen by the form, sometimes called "label", were:

- approve the aircraft engine, propeller, or article for return to service after maintenance;
- certify the airworthiness of aircraft engines, propellers, and articles, after manufacture;

[1] According to the definition of RBAC nº. 43, Emd 04, 07AUG2019, article means an aircraft, airframe, engine, propeller, accessory, component or its parts. For the purposes of this regulation, an article has the same meaning as an aeronautical product.

- approve airworthiness for the export of aircraft engines, propellers, and articles, when required by the importing country; and

- attest to the conformity of the aircraft engine, propeller, or prototype article.

The SEGVOO 003 ATC 417/11 was listed in the monthly report of services performed by the company ATC, referring to December 2011, making it clear that the service performed by that maintenance organization was a repair on the compressor module, started on 30NOV2011 and completed on 09DEC2011 (Figure 18).

ATC

Aeronaves Turbinas e Componentes Ltda.
CHE9611-03/ANAC
SERVIÇO DE MANUTENÇÃO EXECUTADO (DEZEMBRO/2011)

DESCRIÇÃO	MODELO/PN	Nº DE SÉRIE	CLIENTE	SERVIÇO EXECUTADO	O.S.	Nº DO SEGVÔO	DATA INÍCIO	DATA TÉRMINO
MOTOR	6887190	CAE870122	NORTE JET	REPARADO	24171	ATC405/11	21/11/11	03/12/11
MOD. DE TURBINA	2303824	CAT36848	NORTE JET	REPARADO	24171	ATC406/11	21/11/11	03/12/11
MOD. DE GEARBOX	6894171	CAG36955	NORTE JET	REPARADO	24181	ATC407/11	01/12/11	03/12/11
CAP ASSY	206-040-437-001	A13-03407	ANCORATEK	[illegible]	[illegible]	[illegible]	29/11/11	06/12/11
BEARING, BALL	6874525	MP21630	NORTE JET	[illegible]	[illegible]	[illegible]	18/07/11	08/12/11
BEARING, BALL	6874525	MP35466	NORTE JET	INSPECIONADO	24092	ATC410/11	18/07/11	08/12/11
GEARSHAFT	6896481	19640	FLYONE	INSPECIONADO	24051	ATC411/11	18/05/11	08/12/11
C.T. DISK	3013411	A3020	NHR	INSPECIONADO	[illegible]	ATC412/11	12/05/05	08/12/11
BEARING, BALL #2	6889093AL	TA360510769	FLYONE	INSPECIONADO	24055	ATC413/11	19/05/11	09/12/11
MOTOR	6853341	CAE821758	RQ	REPARADO	24177	ATC414/11	30/11/11	09/12/11
MOD. DE GEARBOX	6894171	CAG31765F	RQ	REPARADO	24178	ATC415/11	30/11/11	09/12/11
MOD. DE TURBINA	23038241	CAT32808P	RQ	REPARADO	24180	ATC416/11	30/11/11	09/12/11
MOD. DE COMPRESSOR	6890550	CAC30992F	RQ	REPARADO	24179	ATC417/11	30/11/11	09/12/11
CAP ASSY	206040268001	N/A	ANCORATEK	INSPECIONADO	24183	ATC418/11	09/12/11	12/12/11
AFT HOUSING	206040241001	N/A	ANCORATEK	INSPECIONADO	24183	ATC419/11	09/12/11	12/12/11
OUTER RACE	206040221003	A-FS670	ANCORATEK	INSPECIONADO	24183	ATC420/11	09/12/11	12/12/11
INNER RACE	20604222005	A-3653	ANCORATEK	INSPECIONADO	24183	ATC421/11	09/12/11	12/12/11
ADAPTER	206040203003	A-594	ANCORATEK	INSPECIONADO	24183	ATC422/11	09/12/11	12/12/11
SUPPORT ASSY	206010452113	RE6217	ANCORATEK	[illegible]	[illegible]	[illegible]	09/12/11	12/12/11
SLEEVE ASSY	206010454109	RE4765	ANCORATEK	[illegible]	[illegible]	[illegible]	09/12/11	12/12/11
LEVER ASSY	20601046001	RE6234	ANCORATEK	INSPECIONADO	24183	ATC425/11	09/12/11	12/12/11
LINK ASSY	206010407001	REFS767	ANCORATEK	INSPECIONADO	24183	ATC426/11	09/12/11	12/12/11
INNER RING	206010451005	REFS252	ANCORATEK	INSPECIONADO	24183	ATC427/11	09/12/11	12/12/11
OUTER RING	206010453009	RE3913	ANCORATEK	INSPECIONADO	24183	ATC428/11	09/12/11	12/12/11
OUTER CAP	206010444001	N/C	ANCORATEK	INSPECIONADO	24183	ATC429/11	09/12/11	12/12/11
IDLER LEVER	206010335001	N/C	ANCORATEK	INSPECIONADO	24183	ATC430/11	09/12/11	12/12/11
IDLER LINK	206010336001	N/C	ANCORATEK	INSPECIONADO	24183	ATC431/11	09/12/11	12/12/11
PIN PIVOT	206010408001	MWFS3386	ANCORATEK	INSPECIONADO	24183	ATC432/11	09/12/11	12/12/11
PIN PIVOT	206010408001	MWFS3360	ANCORATEK	INSPECIONADO	24183	ATC433/11	09/12/11	12/12/11
GRIP	206010132113	HB362	ANCORATEK	INSPECIONADO	24183	ATC434/11	09/12/11	13/12/11
GRIP	206010132113	HB375	ANCORATEK	INSPECIONADO	24183	ATC435/11	09/12/11	13/12/11
PITCH HORN	206011104009	HB514	ANCORATEK	INSPECIONADO	24183	ATC436/11	09/12/11	13/12/11

SEGVOO ATC 414/11

SEGVOO ATC 417/11

ATC-Aeronaves Turbinas e Componentes Ltda. CHE9611-03/ANAC
Chrisostomo Pimentel de Oliveira, 2066 - Pavuna - Rio de Janeiro/RJ

E-mail: engenhariaatc@yahoo.com
Tel./Fax: (021) 55 2455-3199/3019-8779

Figure 18 – Report of the ATC Maintenance Service Executed (December/2011).

It can also be seen from Figure 18 that the company ATC performed a repair service on the Gear Box and Turbine modules. The SEGVOO 003 ATC 415/11 (Figure 19) was issued for the Gear Box module, being considered the last maintenance intervention record found in the available documentation, according to inspection control in FORM 2784C (Figure 20).

It should be noted that the Gear Box module was considered a maintenance item on condition (OC).

1. País (Country): BRASIL

2. AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL
CERTIFICADO DE LIBERAÇÃO AUTORIZADO (AUTHORIZED RELEASE CERTIFICATE)
ETIQUETA DE APROVAÇÃO DE AERONAVEGABILIDADE (AIRWORTHINESS APPROVAL TAG)
Formulário (Form) SEGVÔO003

3. Certificado Nº: ATC00415/2011

4. Empresa (Organization): ATC
ATC- Aeronaves Turbinas e Componentes Ltda. CHE 9611-03/ANAC
Av Chrisostomo Pimentel de Oliveira, 2066 - Parte - Pavuna/RJ - Brasil - Cep: 21055-611 Tel.: 55(21)2455-3199 Fax: 55(21) 3019-8779

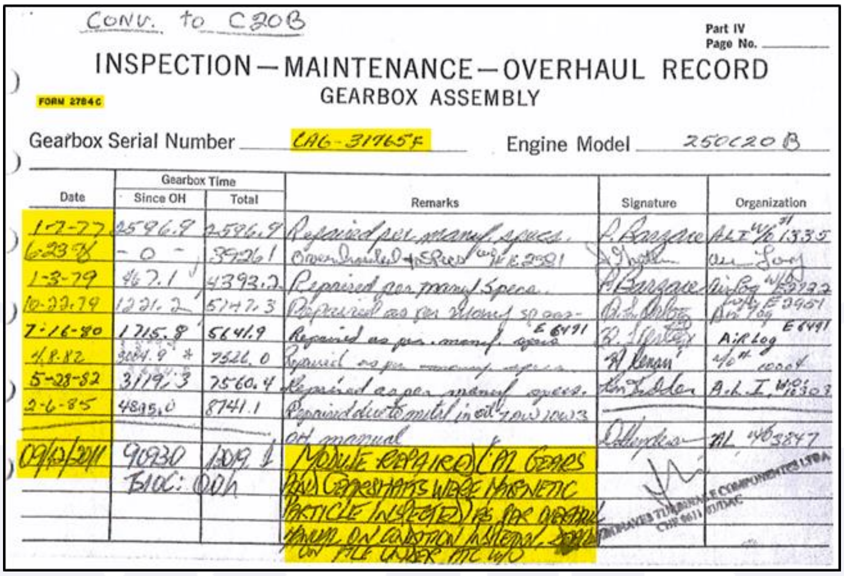
5. Ordem de Serviço/Contrato/Nota Fiscal (Work Order, Contract or Invoice): 24178

6. Item	7. Descrição (Description)	8. Número da Peça (Part Number)	9. Aplicabilidade (Eligibility)	10. Quantidade (Quantity)	11. Número de Série/Lote (Serial Number / Batch Number)	12. Categoria / Trabalho (Status / Work)
1	MODULO DE GEARBOX	6894171 (250-C20B)	TBV-INSTALLER	1	CAG31765F	REPARADO

13. Observações (Remarks)
TSN:13019.61H CSN:N/A
TSO:9093.0H CSO:N/A
TSIOC:0.0H CSOIC:N/A
MODULO DE GEARBOX SUBMETIDO Á REPARO (INSPECTION ON CONDITION) CONFORME ESPECIFICAÇÕES DO MANUAL DE OVERHAUL DA ROLLS-ROYCE P/N 10W3 ED.4 REV.7 DE 15/08/2011.
CEB's, CSL's, AD's, DA"S, CF"s CUMPRIDAS NESTA VISITA:NENHUMA.
OBS(1); MODULO DE GEARBOX REINSTALADO NO MOTOR DE S/N CAE821758.
OBS(2): A DESCRIÇÃO DOS SERVIÇOS REALIZADOS, BEM COMO Á RELAÇÃO DOS ITENS SUBSTITUIDOS, ESTÁ CONTIDA NOS ARQUIVOS DA ATC SOB Á ORDEM DE SERVIÇO MENCIONADA ACIMA.

20. Pessoa Autorizada (Authorized Signature)
21. Nº CHE/CHETA - (Certificado Number): CHE 9611-03/ANAC
22. Nome (Name): Julio Cesar C. Beserra-CREA/RJ-80-1-02114-7D
23. Data (Date): Rio de Janeiro, 09 de Dezembro de 2011

Figure 19 - SEGVOO 003 ATC 415/11.



CONV. to C20B

Part IV
Page No.

INSPECTION—MAINTENANCE—OVERHAUL RECORD
GEARBOX ASSEMBLY

FORM 2784C

Gearbox Serial Number CAC-31765F Engine Model 250C20B

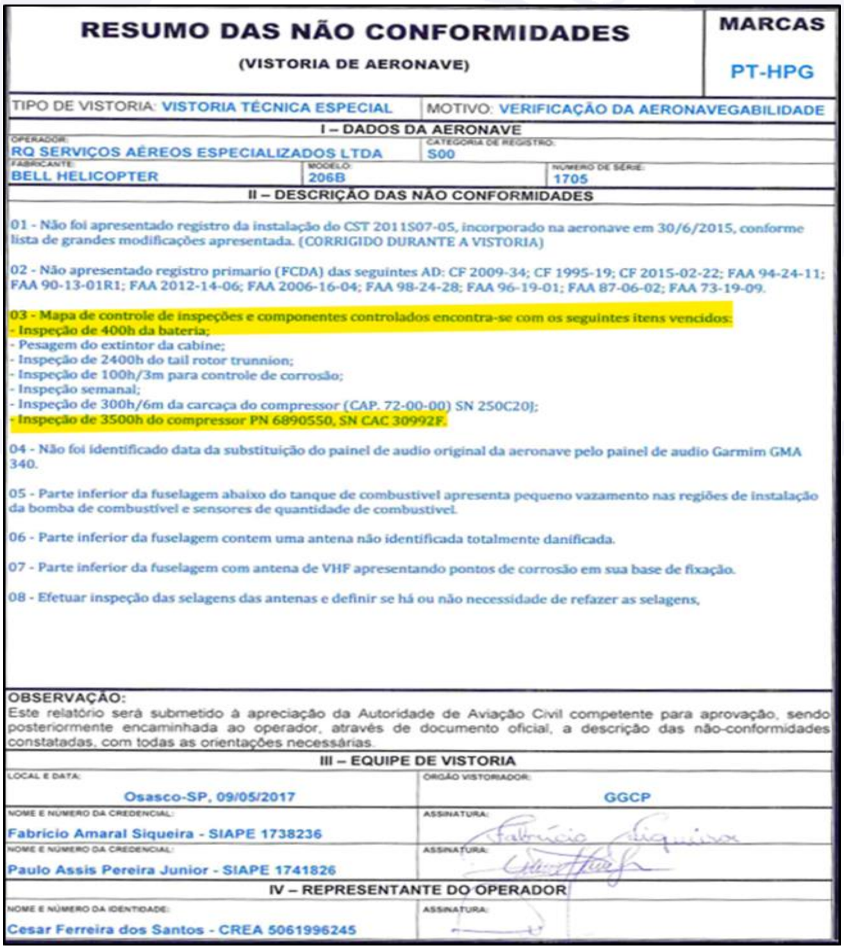
Date	Gearbox Time Since OH	Gearbox Time Total	Remarks	Signature	Organization
1-7-77	2596.9	2596.9	Repaired per manuf. specs.		ALT W/O 1335
6-23-78	- 0 -	3926.1	Overhauled + specs W/O E2381		
1-3-79	467.1	4393.2	Repaired per manuf. specs.		
10-22-79	1221.2	5147.3	Repaired as per manuf. specs.		
7-16-80	1715.8	5641.9	Repaired as per manuf. specs E6491		Air Log E6491
4-8-82	3004.9	7526.0	Repaired as per manuf. specs		
5-28-82	3119.3	7560.4	Repaired as per manuf. specs.		A.L.I.
2-6-85	4815.0	8741.1	Repaired due to metal in oil per OH manual		
09/12/2011	9093.0 BIOC: 00h	1209.1	MODULE REPAIRED (PM GEARS AND GEARSHAFTS WERE MAGNETIC PARTICLE INSPECTED) AS PER OVERHAUL MANUAL ON CONDITION INSPECTION. ON FILE UNDER ATC W/O		

Figure 20 - FORM 2784C.

On May 8 and 9, 2017, the PT-HPG aircraft underwent a Special Technical Inspection (VTE), carried out by the ANAC, and the aircraft was considered “non-airworthy”.

Together with the Inspection Report, a document called Non-Conformities Summary (RNC) was issued, describing the “non-conformities” found in the survey that led to the result of “non-airworthy” for the aircraft (Figure 21).

Among the non-conformities reported in the RNC, the last line of item nº. 03 described that the 3,500-hour inspection of the SN CAC 30992F compressor was overdue.



RESUMO DAS NÃO CONFORMIDADES
(VISTORIA DE AERONAVE)

MARCAS: PT-HPG

TIPO DE VISTORIA: VISTORIA TÉCNICA ESPECIAL — MOTIVO: VERIFICAÇÃO DA AERONAVEGABILIDADE

I – DADOS DA AERONAVE

OPERADOR: RQ SERVIÇOS AÉREOS ESPECIALIZADOS LTDA — CATEGORIA DE REGISTRO: S00
FABRICANTE: BELL HELICOPTER — MODELO: 206B — NÚMERO DE SÉRIE: 1705

II – DESCRIÇÃO DAS NÃO CONFORMIDADES

01 - Não foi apresentado registro da instalação do CST 2011S07-05, incorporado na aeronave em 30/6/2015, conforme lista de grandes modificações apresentada. (CORRIGIDO DURANTE A VISTORIA)

02 - Não apresentado registro primario (FCDA) das seguintes AD: CF 2009-34; CF 1995-19; CF 2015-02-22; FAA 94-24-11; FAA 90-13-01R1; FAA 2012-14-06; FAA 2006-16-04; FAA 98-24-28; FAA 96-19-01; FAA 87-06-02; FAA 73-19-09.

03 - Mapa de controle de inspeções e componentes controlados encontra-se com os seguintes itens vencidos:
- Inspeção de 400h da bateria;
- Pesagem do extintor da cabine;
- Inspeção de 2400h do tail rotor trunnion;
- Inspeção de 100h/3m para controle de corrosão;
- Inspeção semanal;
- Inspeção de 300h/6m da carcaça do compressor (CAP. 72-00-00) SN 250C20J;
- Inspeção de 3500h do compressor PN 6890550, SN CAC 30992F.

04 - Não foi identificado data da substituição do painel de audio original da aeronave pelo painel de audio Garmim GMA 340.

05 - Parte inferior da fuselagem abaixo do tanque de combustivel apresenta pequeno vazamento nas regiões de instalação da bomba de combustível e sensores de quantidade de combustivel.

06 - Parte inferior da fuselagem contem uma antena não identificada totalmente danificada.

07 - Parte inferior da fuselagem com antena de VHF apresentando pontos de corrosão em sua base de fixação.

08 - Efetuar inspeção das selagens das antenas e definir se há ou não necessidade de refazer as selagens,

OBSERVAÇÃO:
Este relatório será submetido à apreciação da Autoridade de Aviação Civil competente para aprovação, sendo posteriormente encaminhada ao operador, através de documento oficial, a descrição das não-conformidades constatadas, com todas as orientações necessárias.

III – EQUIPE DE VISTORIA

LOCAL E DATA:	ÓRGÃO VISTORIADOR:
Osasco-SP, 09/05/2017	GGCP
NOME E NÚMERO DA CREDENCIAL: Fabrício Amaral Siqueira - SIAPE 1738236	ASSINATURA: Fabrício Siqueira
NOME E NÚMERO DA CREDENCIAL: Paulo Assis Pereira Junior - SIAPE 1741826	ASSINATURA:

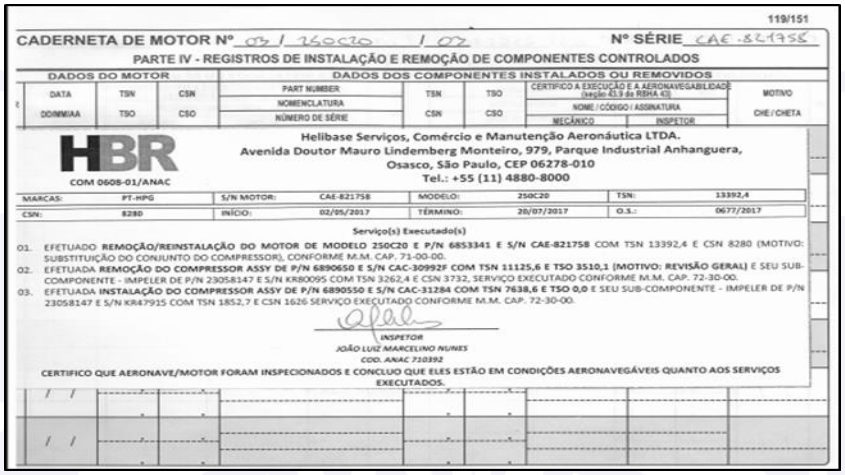
IV – REPRESENTANTE DO OPERADOR

NOME E NÚMERO DA IDENTIDADE:	ASSINATURA:
Cesar Ferreira dos Santos - CREA 5061996245	

Figure 21 - Summary of “non-conformities” found in the survey.

According to the record in the Engine Logbook, Part IV - Controlled Components Installation and Removal Records, the SN CAC 30992F compressor was removed for the reason “General Overhaul”, as it had reached 3,510.1 hours of TSO (Figure 22).

Also according to this record in the Engine Logbook, the SN CAC 31284 compressor was installed on the aircraft and had not operated after the last Overhaul (TSO 0, 0 hours).


119/151

CADERNETA DE MOTOR Nº 03 / 250C20 / 02 Nº SÉRIE CAE-821758

PARTE IV - REGISTROS DE INSTALAÇÃO E REMOÇÃO DE COMPONENTES CONTROLADOS

DADOS DO MOTOR | DADOS DOS COMPONENTES INSTALADOS OU REMOVIDOS

HBR COM 0608-01/ANAC

Helibase Serviços, Comércio e Manutenção Aeronáutica LTDA.
Avenida Doutor Mauro Lindemberg Monteiro, 979, Parque Industrial Anhanguera,
Osasco, São Paulo, CEP 06278-010
Tel.: +55 (11) 4880-8000

MARCAS: PT-HPG | S/N MOTOR: CAE-821758 | MODELO: 250C20 | TSN: 13392,4
CSN: 8280 | INÍCIO: 02/05/2017 | TÉRMINO: 20/07/2017 | O.S.: 0677/2017

Serviço(s) Executado(s)

01. EFETUADO **REMOÇÃO/REINSTALAÇÃO DO MOTOR DE MODELO 250C20 E P/N 6853341 E S/N CAE-821758** COM TSN 13392,4 E CSN 8280 (MOTIVO: SUBSTITUIÇÃO DO CONJUNTO DO COMPRESSOR), CONFORME M.M. CAP. 71-00-00.
02. EFETUADA **REMOÇÃO DO COMPRESSOR ASSY DE P/N 6890650 E S/N CAC-30992F COM TSN 11125,6 E TSO 3510,1 (MOTIVO: REVISÃO GERAL)** E SEU SUB-COMPONENTE - IMPELER DE P/N 23058147 E S/N KR80095 COM TSN 3262,4 E CSN 3732, SERVIÇO EXECUTADO CONFORME M.M. CAP. 72-30-00.
03. EFETUADA **INSTALAÇÃO DO COMPRESSOR ASSY DE P/N 6890550 E S/N CAC-31284 COM TSN 7638,6 E TSO 0,0** E SEU SUB-COMPONENTE - IMPELER DE P/N 23058147 E S/N KR47915 COM TSN 1852,7 E CSN 1626 SERVIÇO EXECUTADO CONFORME M.M. CAP. 72-30-00.

INSPETOR
JOÃO LUIZ MARCELINO NUNES
COD. ANAC 710392

CERTIFICO QUE AERONAVE/MOTOR FORAM INSPECIONADOS E CONCLUO QUE ELES ESTÃO EM CONDIÇÕES AERONAVEGÁVEIS QUANTO AOS SERVIÇOS EXECUTADOS.

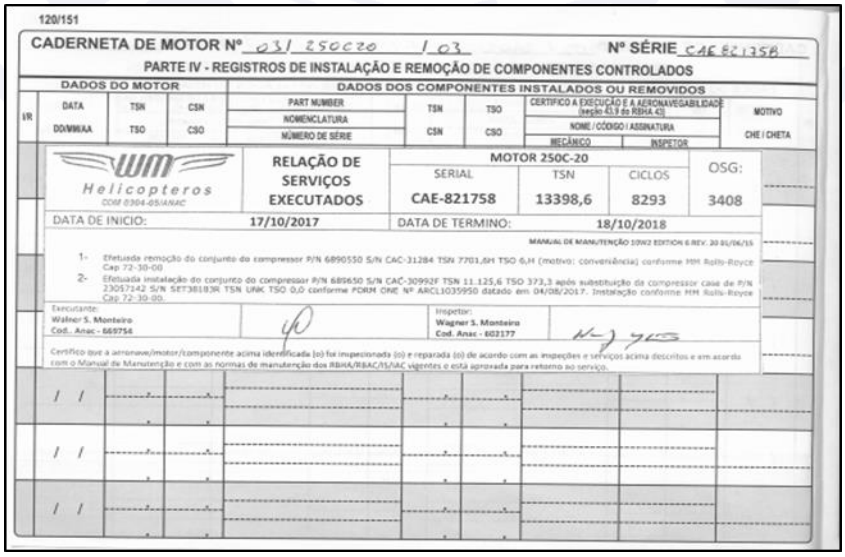
Figure 22 - Records of the CAC-30992F compressor removal for General Overhaul and installation of the CAC-31284 compressor, with TSO 0,0 hours, described on page 119/151 of the Engine Logbook made by OM HBR *Aviação SA*.

With the replacement of the compressor and proof of corrections for non-conformities, the ANAC released the aircraft on 09AUG2017, according to Official Letter nº128 (SEI)/2017/GTAI-SAR/GGCP/SAR-ANAC, dated 10AUG2017.

After the removal of the compressor by the HBR company, no record was found and/or presented that proves that the SN CAC 30992F compressor had been submitted to general review (Overhaul) after 01JUL1988.

Seventy days after the approval of the aircraft under inspection by the ANAC, the compressor set SN CAC-31284 was removed and the OM WM *Helicópteros* reinstalled the compressor set SN CAC-30992F in the engine of the PT-HPG aircraft.

According to the record made on page 120/151 of the Engine Logbook, the SN CAC-30992F compressor would have 373.3 hours of TSO (Figure 23).


120/151

CADERNETA DE MOTOR Nº 03 / 250C20 / 03 Nº SÉRIE CAE-821758

PARTE IV - REGISTROS DE INSTALAÇÃO E REMOÇÃO DE COMPONENTES CONTROLADOS

DADOS DO MOTOR | DADOS DOS COMPONENTES INSTALADOS OU REMOVIDOS

WM Helicopteros COM 0364-05/ANAC

RELAÇÃO DE SERVIÇOS EXECUTADOS

MOTOR 250C-20			OSG:
SERIAL	TSN	CICLOS	
CAE-821758	13398,6	8293	3408

DATA DE INICIO: 17/10/2017 DATA DE TERMINO: 18/10/2018

MANUAL DE MANUTENÇÃO 109W2 EDITION 6 REV. 20 01/06/15

1- Efetuada remoção do conjunto do compressor P/N 6890550 S/N CAC-31284 TSN 7701,6H TSO 6,H (motivo: conveniência) conforme MM Rolls-Royce Cap 72-30-00.
2- Efetuada instalação do conjunto do compressor P/N 689650 S/N CAC-30992F TSN 11.125,6 TSO 373,3 após substituição do compressor case de P/N 23057142 S/N SET38183R TSN UNK TSO 0,0 conforme FORM ONE Nº ARCL1035950 datado em 04/08/2017. Instalação conforme MM Rolls-Royce Cap 72-30-00.

Executante: Wálner S. Monteiro Cod. Anac - 669754

Inspetor: Wagner S. Monteiro Cod. Anac - 602177

Certifico que a aeronave/motor/componente acima identificada (o) foi inspecionada (o) e reparada (o) de acordo com as inspeções e serviços acima descritos e em acordo com o Manual de Manutenção e com as normas de manutenção dos RBHA/RBAC/IS/IAC vigentes e está aprovada para retorno ao serviço.

Figure 23 - Maintenance records described on page 120/151 of the Engine Logbook made by the OM WM *Helicópteros*.

The TSO hours information was also repeated in the Service Order nº 3408, issued by the maintenance organization WM *Helicópteros*, on 18OCT2017 (Figure 24).

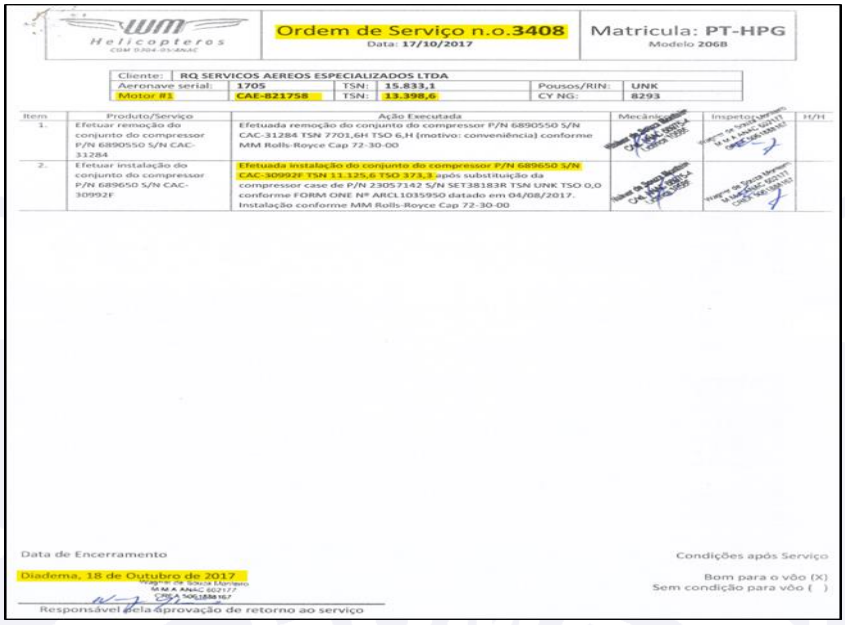

Ordem de Serviço n.o.3408
Data: 17/10/2017
Matricula: PT-HPG
Modelo 2068
Cliente: RQ SERVICOS AEREOS ESPECIALIZADOS LTDA
Aeronave serial: 1705 TSN: 15.833,1 Pousos/RIN: UNK
Motor #1 CAE-821758 TSN: 13.398,6 CY NG: 8293
Item | Produto/Serviço | Ação Executada | Mecânico | Inspetor | H/H
1. Efetuar remoção do conjunto do compressor P/N 6890550 S/N CAC-31284 | Efetuada remoção do conjunto do compressor P/N 6890550 S/N CAC-31284 TSN 7701,6H TSO 6,H (motivo: conveniência) conforme MM Rolls-Royce Cap 72-30-00
2. Efetuar instalação do conjunto do compressor P/N 689650 S/N CAC-30992F | Efetuada instalação do conjunto do compressor P/N 689650 S/N CAC-30992F TSN 11.125,6 TSO 373,3 após substituição da compressor case de P/N 2305742 S/N SET38183R TSN UNK TSO 0,0 conforme FORM ONE Nº ARCL1035950 datado em 04/08/2017. Instalação conforme MM Rolls-Royce Cap 72-30-00
Data de Encerramento
Diadema, 18 de Outubro de 2017
Responsável pela aprovação de retorno ao serviço
Condições após Serviço
Bom para o vôo (X)
Sem condição para vôo ( )

Figure 24 - Service Order nº 3408.

Attached to the Service Order nº 3408, issued by the maintenance organization WM *Helicópteros*, there was a copy of the Card Part IV, page nº 3, of OM ATC-*Aeronaves Turbinas e Componentes* Ltd., with certification nº 9611-03, issued by the ANAC, which would have supported the installation of the SN CAC-30992F compressor set on the engine and, consequently, the release for return to service the engine and the aircraft on 18OCT2017 (Figure 25).

As described in the registration of this Card Part IV, page nº 3, the OM ATC-*Aeronaves Turbinas e Componentes* Ltd. it would have performed Overhaul on the SN CAC-30992F compressor on 08DEC2011, with the compressor having 10,752.3 total hours of operation and 9,424 cycles and, from that date, its TSO would start counting a new cycle, that is, considering the maintenance program manufacturer, it would have 3,500 hours until the next overhaul.

This document also mentions, in the Remarks area, the Work Order (W/O) nº 24177 for details of the work performed.

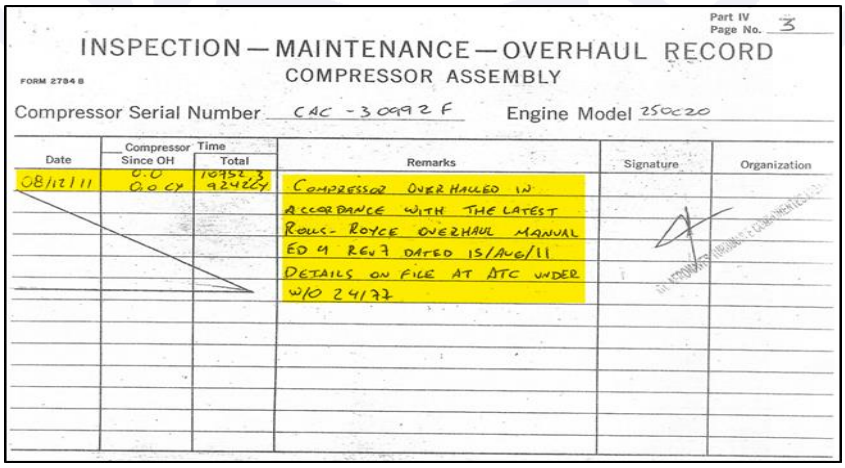

Part IV Page No. 3
INSPECTION — MAINTENANCE — OVERHAUL RECORD
COMPRESSOR ASSEMBLY
FORM 2784 B
Compressor Serial Number CAC-30992F Engine Model 250C20
Date | Compressor Time Since OH | Compressor Time Total | Remarks | Signature | Organization
08/12/11 | 0.0 0.0 CY | 10752.3 9424 CY | COMPRESSOR OVERHAULED IN ACCORDANCE WITH THE LATEST ROLLS-ROYCE OVERHAUL MANUAL ED 4 REV 7 DATED 15/AUG/11 DETAILS ON FILE AT ATC UNDER W/O 24177

Figure 25 - Card Part IV, page nº 3 of the compressor set (document attached to service order nº 3408, of 18OCT2017, issued by the maintenance organization WM *Helicópteros*).

Due to the OM ATC-*Aeronaves Turbinas e Componentes* Ltd., issuer of the Service Order, having its OM Certificate suspended by the ANAC since 16JAN2015, it was not possible to recover of the W/O at the company and no records were found in the documentation delivered by the operator's responsible.

However, when consulting the monthly report of services performed by the ATC company for December 2011, it was possible to identify that the W/O 24177 referred to the SEGVOO 003 ATC 414/11, which attested the return to service, after maintenance, of the complete engine and not for the compressor module (Figure 26). In addition, the monthly report still contained the following information in the “service performed” area: REPAIRED (Figure 18).

BRASIL

2. AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL
CERTIFICADO DE LIBERAÇÃO AUTORIZADO (AUTHORIZED RELEASE CERTIFICATE)
ETIQUETA DE APROVAÇÃO DE AERONAVEGABILIDADE (AIRWORTHINESS APPROVAL TAG)
Formulário (Form) SEGVÔO003

ATC00414/2011

ATC - ATC- Aeronaves Turbinas e Componentes Ltda. CHE 9611-03/ANAC
Av. Chrisostomo Pimentel de Oliveira, 2066 - Parte - Pavuna/RJ - Brasil - Cep: 21655-611 Tel.: 55(21)2455-3199 Fax: 55(21) 3019-8779

24177

Item	Descrição	Número da Peça	Aplicabilidade	Quantidade	Número de Série/Lote	Categoria / Trabalho
1	MOTOR	250-C20B	TBV-INSTALLER	1	CAE821758	REPARADO

Observações (Remarks)
SN:13019.1H CSN:6960C
SO:NOVO CSO:NOVO
OTOR SUBMETIDO À REPARO NO MODULO DE COMPRESSOR, GEARBOX (INSPECTION ON CONDITION), TURBINA (DESCONTAMIÇÃO E BALANCEAMENTO DOS CONJUNTOS DE N1 E N2), EFE-JADO MODULAÇÃO E TESTE FUNCIONAL EM BANCO DE PROVAS CONFORME O MANUAL DE OVERHAUL DA ROLLS-ROYCE P/N 10W3 ED.4 REV.7 DE 15/08/2011.
EB's, CSL's, AD's, DA'S, CF's CUMPRIDAS NESTA VISITA: NENHUM.
BS(1): MOTOR SAIU COM A SEGUINTE CONFIGURAÇÃO MODULAR: CAG31765F, CAC30992F E CAT32808P.
BS(2): MOTOR PARA APROVAÇÃO PARA RETORNO AO SERVIÇO (APRS). DEVERÁ SER ATESTADO PELO OPERADOR E/OU EMPRESA DE MANUTENÇÃO HOMOLOGADA, PADRÃO D3,APÓS XECUÇÃO DO CHECK-RUN, CONFORME PREVISTO NO MANUAL DE OPERAÇÃO E MANUTENÇÃO, CAPÍTULO 72-00-00 PÁGINA 501.
BS(3): A DESCRIÇÃO DOS SERVIÇOS REALIZADOS, BEM COMO A RELAÇÃO DOS ITENS SUBSTITUIDOS, ESTÁ CONTIDA NOS ARQUIVOS DA ATC SOB A ORDEM DE SERVIÇO MENCIONADA CIMA.

CHE 9611-03/ANAC
Julio Cesar C. Besserra-CREA/RJ-80-1-02114-7D
Rio de Janeiro, 09 de Dezembro de 2011

Figure 26 - SEGVOO 003 nº ATC 00414/2011.

No record was found in the copies of SEGVOO 003 nº ATC 00417/2011 (Figure 17) and nº ATC 00414/2011 (Figure 26) that mentioned any Overhaul service performed on the compressor CAC-30992F by the OM *Aeronaves Turbinas e Componentes* Ltd.

When consulting the entry and exit control of items (Figure 27), dated 09DEC2011, from the ATC Maintenance Organization, it was possible to observe that the compressor module entered and left the company with 3,136.8 hours of TSO. This corroborated the information that the last Overhaul performed on the compressor module occurred on 01JUL1988.

ATC
CHE 9611-ANAC
FABRICANTE: Allison MODELO: 250-C20B FOLHA: 1/1 2A
S/N: CAE821758 CLIENTE:TUCSON
PEÇAS ROTATIVAS COM VIDA LIMITADA DATA: 09/12/2011
FASE: CONTROLE O.S.:TA20P24177

ENTRADA

DESCRIÇÃO	P/N	S/N	TSN	LIMITE	SALDO	CSN	LIMITE	SALDO
Módulo de Compressor	6890550	30992F	10752.3	TSO:3136.8	363.2	9242	N/A	N/A
Módulo de Turbina	23038241	32808P	5794.0	TSO2328.0:	1172.0	8445	N/A	N/A
Módulo de Gearbox	6877180	31765F	13019.1	TSO:9093.0	O/C	N/A	N/A	N/A
Impeller Assy	23058147	KR80095	2889.2	3550.0	660.8	2872	9150	6278
1st Stg. Turbine Wheel	6886407	X553881	626.6	1775.0	1148.4	560	3000	2440
2nd Stg. Turbine Wheel	6898782	X510249	1315.7	1775.0	459.3	1599	3000	1401
3rdStg. Turbine Wheel	23001967	X79829	2328.0	4550.0	2222.0	3195	6000	2805
4thStg. Turbine Wheel	6853279	HX67507	2328.0	4550.0	2222.0	3195	6000	2805
TIE BOLT	23068265	NM89244	626.6	N/A	N/A	560	9000	8440

OBSERVAÇÕES:

Julio Cesar C.Beserra
Gerente de Produção
CREA/RJ 80-1-02114D

SAÍDA

DESCRIÇÃO	P/N	S/N	TSN	LIMITE	SALDO	CSN	LIMITE	SALDO
Módulo de Compressor	6890550	30992F	10752.3	TSO:3136.8	363.2	9242	N/A	N/A
Módulo de Turbina	23038241	32808P	5794.0	TSO2328.0:	1172.0	8445	N/A	N/A
Módulo de Gearbox	6877180	31765F	13019.1	TSO:9093.0	O/C	N/A	N/A	N/A
Impeller Assy	23058147	KR80095	2889.2	3550.0	660.8	2872	9150	6278
1st Stg. Turbine Wheel	6886407	X553881	626.6	1775.0	1148.4	560	3000	2440
2nd Stg. Turbine Wheel	6898782	X510249	1315.7	1775.0	459.3	1599	3000	1401
3rdStg. Turbine Wheel	23001967	X79829	2328.0	4550.0	2222.0	3195	6000	2805
4thStg. Turbine Wheel	6853279	HX67507	2328.0	4550.0	2222.0	3195	6000	2805
TIE BOLT	23068265	NM89244	626.6	N/A	N/A	560	9000	8440

OBSERVAÇÕES:

Julio Cesar C.Beserra
Gerente de Produção
CREA/RJ 80-1-02114D

Figure 27 - ATC Maintenance Organization item entry and exit control document.

1.7 Meteorological information.

The meteorological conditions at the accident site were favorable for the visual flight, as observed in the security camera of SP-021 Highway (Figure 28).

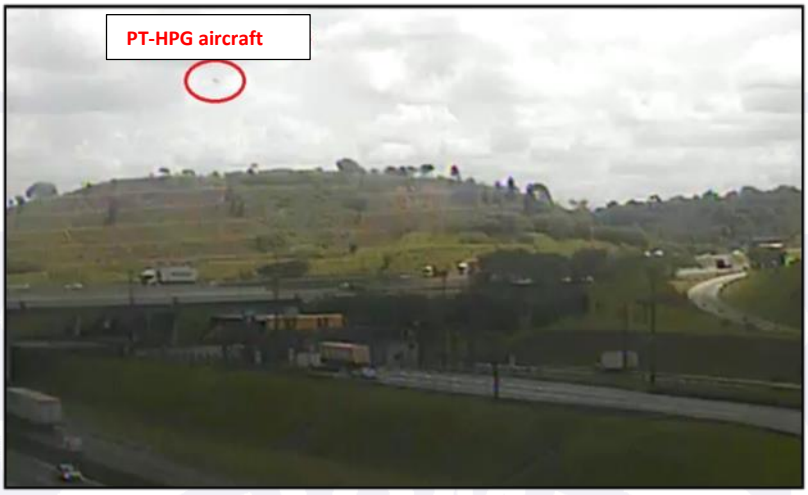


Figure 28 - Image from the security camera just before the accident.

The METAR of the Campo de Marte Aerodrome (SBMT), 11.3 NM away from the accident site, contained the following information:

METAR SBMT 111300Z 31009KT 9999 BKN033 28/19 Q1018=

METAR SBMT 111400Z 29010KT 9999 BKN036 28/19 Q1017=

METAR SBMT 111500Z 30009KT 9999 BKN040 30/20 Q1016=

METAR SBMT 111600Z 30011KT 270V340 9999 BKN040 30/19 Q1016=

The METAR of the Viracopos Aerodrome (SBKP), 9 NM away from the Amarais Aerodrome and 5.5 NM away from the Royal Palm Plaza Helipad, contained the following information:

METAR SBKP 111300Z 35012KT 9999 SCT026 BKN100 27/20 Q1018=

METAR SBKP 111400Z 33011KT 9999 SCT033 SCT100 29/20 Q1017=

METAR SBKP 111500Z 36010KT 9999 BKN036 30/19 Q1016=

METAR SBKP 111600Z 32012KT 9999 BKN040 31/19 Q1015=

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place outside the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The aircraft was hit on its left side, in flight, by a truck-type vehicle and broke into four parts: main Gearbox (CTP), blades, engine, fuselage and tail boom.

After the collision, a fire completely destroyed the fuselage and partially destroyed the main Gearbox (CTP), blades and engine.

The tail boom, after being sectioned, was not affected by the flames and had small deformations resulting from the impact.

The truck's braking marks identify where the vehicle would have hit the aircraft. It is clear that the approach of the helicopter for the attempted autorotation was very close to the highway protection wall (Figure 29).

Figure 29 - Approximate impact location.

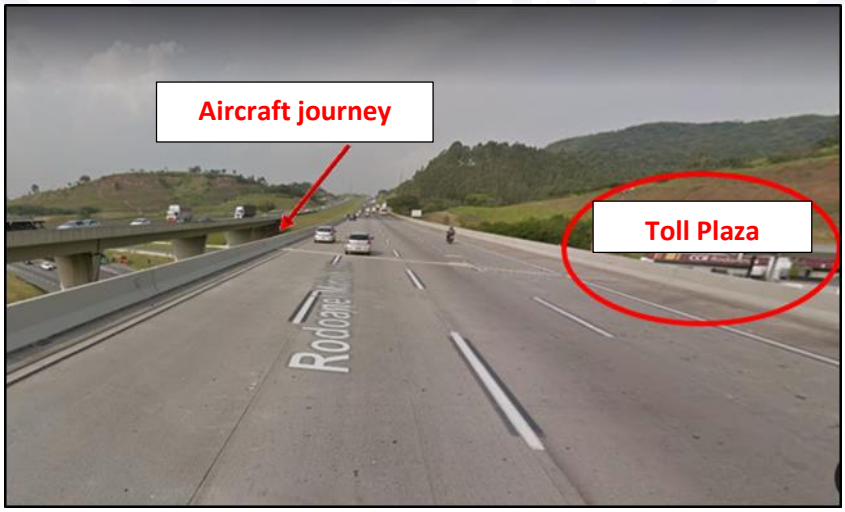


Figure 30 - Aircraft journey.

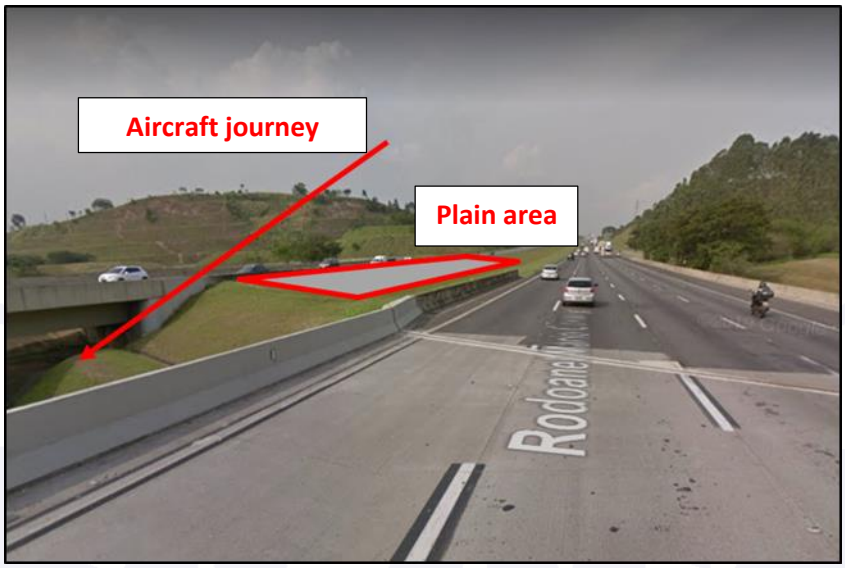


Figure 31 - Aircraft journey and probable area chosen by the pilot for autorotation.

Figure 32 - Place where the aircraft passed (between lanes).

1.13 Medical and pathological information.

1.13.1 Medical aspects.

The commander carried out his last health inspection in an accredited clinic in São Paulo - SP, on 07AUG2018 without presenting abnormalities. There was only the indication to use corrective lenses.

The analysis of the necroscopic report revealed external injuries of medical-legal interest, which indicated that the cause of death was due to head trauma, in consequence of the injuries received, with secondary carbonization.

The blood sample was negative for the use of ethyl alcohol and drugs, in addition to medicines. The measurement of carbon monoxide detected a concentration below 10% of carboxyhemoglobin in the blood, indicating that the pilot was already dead before exposure to the gas.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

According to information collected, the pilot was one of the owners of the company to which the aircraft involved in the incident belonged.

According to the reports obtained, he had personally carried out the negotiations concerning the performance of that transfer flight. The company's operational coordination became aware of this charter one week before the scheduled date. According to the interviewees, accepting jobs outside the company's operational specification was not the pilot's usual behavior.

However, people close to him reported that the acceptance of this air taxi flight might have occurred for financial reasons, as the company was in low demand for jobs at the time, flying about three and a half hours a month, which left the pilot worried.

He worked on Saturdays, Sundays and holidays to cover financial obligations. He kept the office phone transferred to his cell phone on weekends so as not to miss the opportunity to make new flights that might appear.

The pilot spent the weekend, before the day of the incident, on his farm in the countryside of São Paulo, returning on Sunday afternoon. He arrived at the Campo de Marte Aerodrome on 11FEB2019, at about 0945 (UTC), and the displacement to the passenger boarding place was scheduled to happen at 1100 (UTC).

The company's Safety Manager (GSO) was only aware of the flight with the news of the occurrence passed on by the company's coordination. In his view, the pilot mastered the aircraft, was a detailed person, careful with the equipment and piloting, and tried to keep up with updated aviation knowledge.

Other professionals in the field, close to him, defined him as an excellent pilot, systematic, careful and skilled with helicopters. He was well-liked by colleagues who also worked at Campo de Marte.

It’s been informed that he did not drink, had no addictions and kept a good professional relationship.

The GSO worked at RQ *Serviços Aéreos Especializados* Ltd. for 9 months, but he had known the pilot for 20 years. There was an open and friendly relationship between them.

1.14 Fire.

After being hit by the truck, the aircraft broke down and caught fire.

The fuselage and the tail boom were on the highway, the engine and the main Gearbox (CTP) and blades were tossed to the central reservation.

The wreckage was divided by a concrete wall (Figure 33)

Figure 33 - View of the fuselage remains and the soot marks on the concrete wall.

The fuselage was consumed by the fire and the marks left by the soot on the wall showed a random burning, compatible with fire after the impact.

The tail boom was not subjected to the action of fire, as it was removed from the rest of the aircraft structure.

1.15 Survival aspects.

There were no survivors.

1.16 Tests and research.

Due to the destruction of the aircraft and the action of the fire, it was not possible to collect samples that were in the fuel system at the time of the accident, as well as there was not enough oil in the engine to perform spectrometric analysis, since it was pulled out of its mounting, as a result of the impact, and also the system lines were open.

Thus, six samples of Aviation Kerosene (QAv) were collected from the fixed tank and from the fuel supply truck of the distributor that carried out the last refueling of the aircraft at the Campo de Marte Aerodrome.

The IAE's Aeronautical Propulsion Subdivision performed the physical-chemical tests of aspect; corrosivity to copper (100ºC/2 hours); flash point; specific mass at 20º and fuel distillation to check compliance with the values specified by the ANP Resolution.

The results obtained with the tests showed that the material of all samples were in accordance with their technical specifications and did not show any signs of contamination.

The connecting shaft of the engine accessories box to the tail rotor (Figure 34) was found sectioned and the part was sent for fracture analysis at the DCTA.

Figure 34 - Connecting shaft between the “Gearbox” and the tail rotor.

The results of the tests, carried out at the IAE’s AMR, based at the DCTA, indicated, after visual and stereoscopic examinations, rupture due to overload applied to the material.

The flexible blades had different aspects between the side referring to the tail rotor and that one of the freewheel outlet (Figure 35).

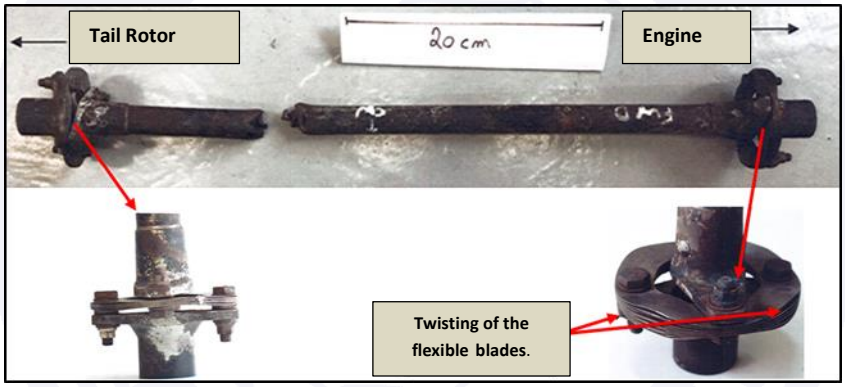


Figure 35 - Twist of the flexible coupling blades of the tail rotor/Gearbox connection shaft.

The conditions found, showed a possible locking of part of the shaft connected to the tail rotor and a continuous rotation of part of the shaft connected to the Gearbox and, consequently, to the freewheel assembly.

The fractures found in the connection shaft of the engine Gearbox to the tail rotor had different morphologies. The side referring to the tail rotor showed a morphology called fish mouth (Figure 36 - IV), while the engine side showed a spiral morphology (Figure 36 - V).

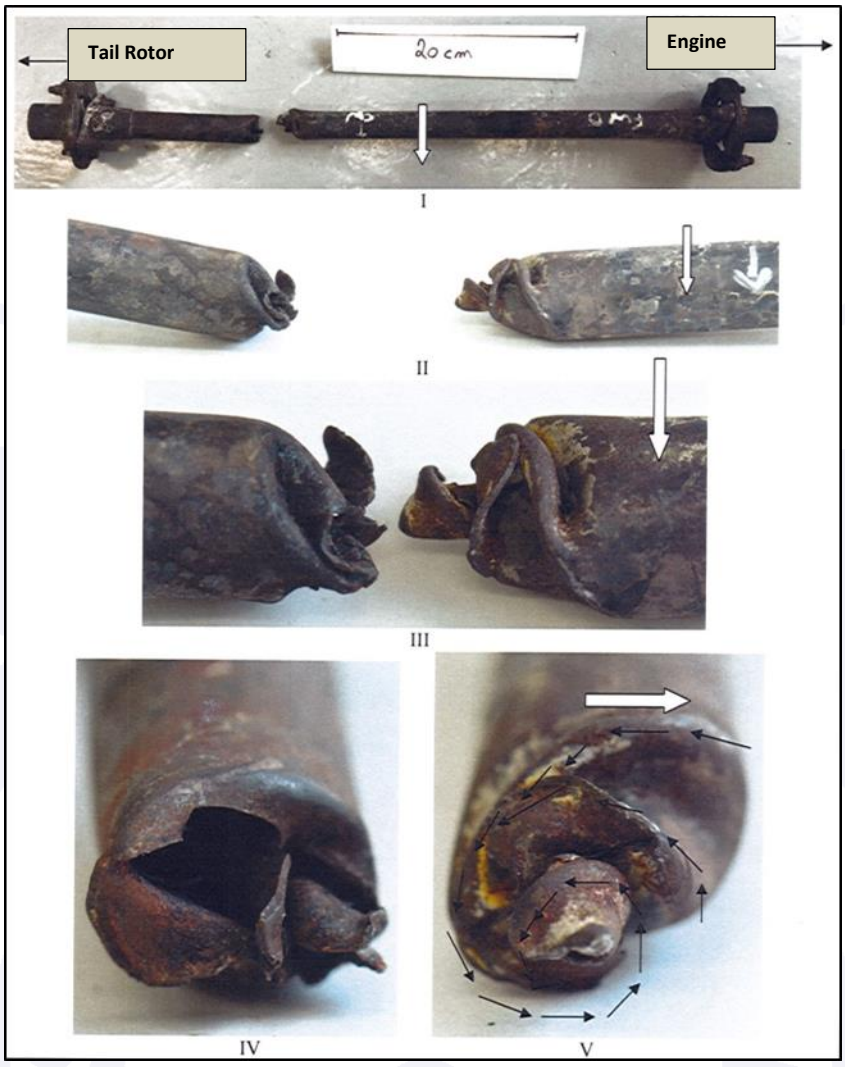


Figure 36 - Connecting shaft between the “Gearbox” and the tail rotor.

The morphology of the connection shaft fracture, with rupture without helical deformation on the connection side with the tail rotor and with deformation on the output side of the Gearbox, indicated that the shaft was rotating at the moment of the collision with the truck. The rotation of the axle did not necessarily indicate engine operation, since the freewheel system kept the rotation of the shaft while the main rotor was spinning, even with the engine inoperative.

The M250-C20 engine, serial number CAE 821758, which equipped the PT-HPG aircraft, was transported to an OM holder of a valid Maintenance Organization Certificate (COM). The Operating Specifications (EO) of the OM allowed maintenance actions on this engine.

Two Rolls Royce technical representatives and a representative of the Investigation Team accompanied the dismantling activities of the engine and its parts.

During the analysis of the general condition of the engine, it was observed that it was locked and its color showed that it was exposed to high external temperature (Figure 37).

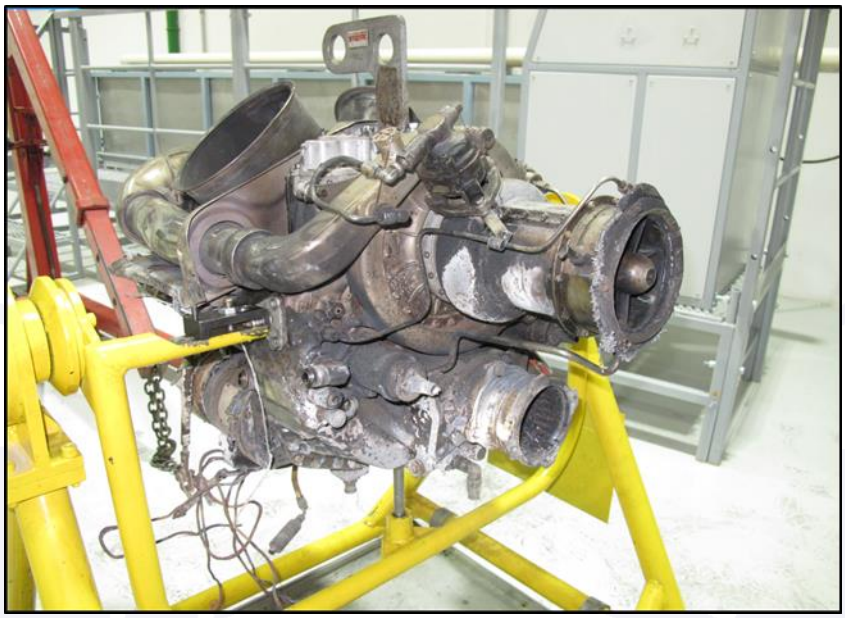


Figure 37 - External condition observed in the engine that equipped the PT-HPG aircraft.

When analyzing the fuel system, no impurities were observed in the filter elements.

The Fuel Control Unit (FCU) and the Power Turbine Governor (PTG) were damaged due to exposure to heat, but no apparent anomalies or functional discrepancies were found.

The fuel injector nozzle (Fuel Nozzle) and bleed valve (Bleed Valve) were examined externally and no blockages or damage were observed.

The fuel pump was exposed to high temperatures, as evidenced by its color, and was blocked, possibly by exposure to fire. (Figure 38).

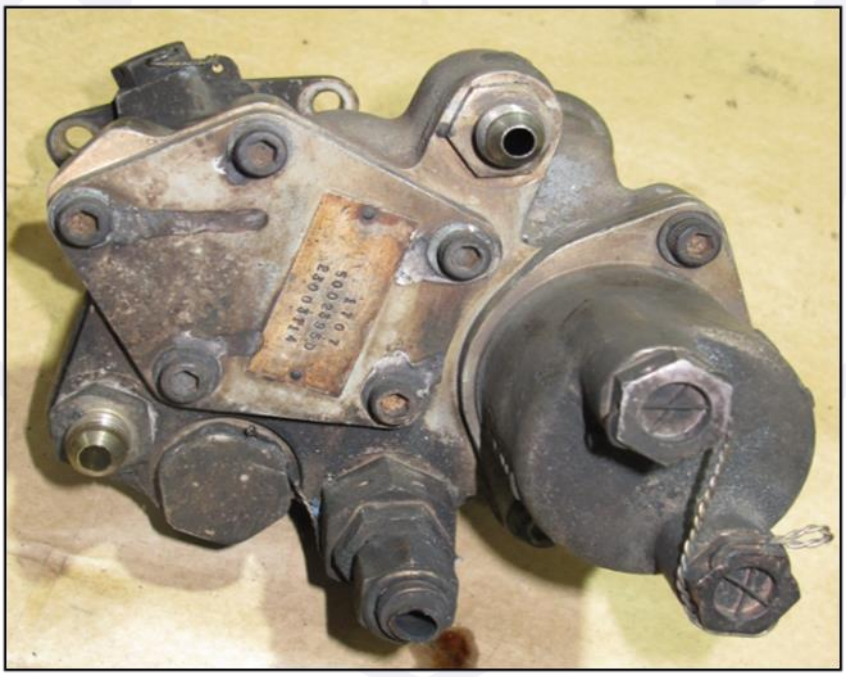


Figure 38 - Fuel Pump.

When disassembling and analyzing the compressor section, no sign of material ingestion was found and, even after separating the compressor module from the Gear Box, the compressor remained locked (Figure 39).

Figure 39 - Front view of the axial compressor air intake.

No compromise was observed for the stator and rotor blades (Figures 40 and 41).

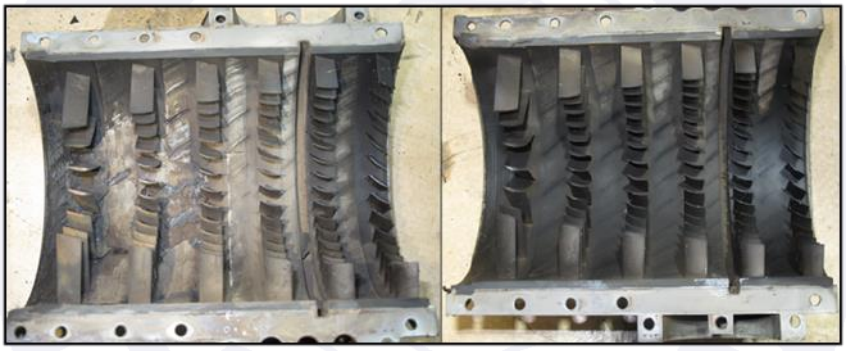


Figure 40 - Stator blades intact.

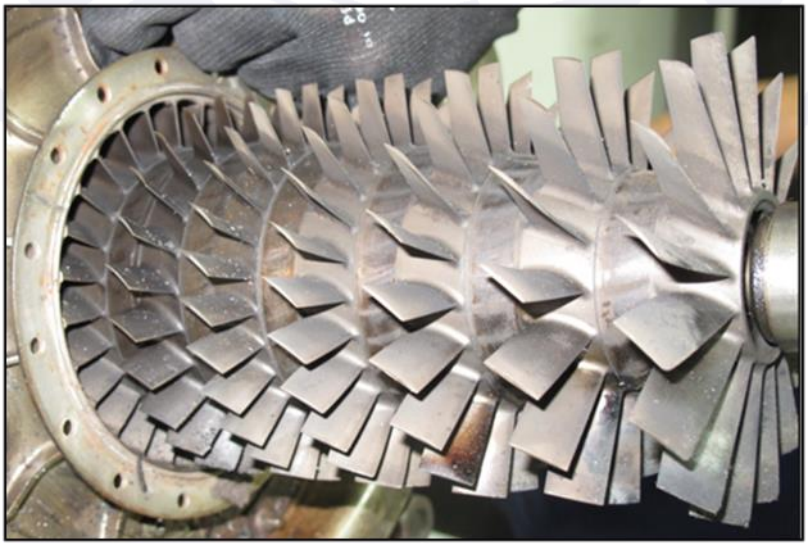


Figure 41 - Rotor blades intact (axial compressor impeller).

The impeller of the centrifugal compressor showed material loss in part of the disc diameter (Figure 42) and rubbing in part of the carcass (Shroud) that surrounded the impeller (Figure 43).

Figure 42 - Loss of material from the centrifugal compressor impeller.

Figure 43 - Scratch marks on the centrifugal compressor housing (Shroud).

During the separation of the compressor section and the Gearbox, bearing nº 2 was found locked and with the ball separator fractured in several parts (Figures 44 and 45).

It was possible, through the markings on bearing nº 2, to identify that it was a Parts Manufacturer Approval (PMA) component, with design and production approved by the (FAA), manufactured by Timken Alcor Aerospace Technologies Inc.

Figure 44 - Bearing nº 2 with the fractured ball separator.

Figure 45 - Fractured ball separator.

The balls of bearing nº 2 showed abnormal wear and were ovalized (Figure 46).

Figure 46 - Balls of bearing n° 2 worn and ovalized.

Color variation was visually observed in the ball separator of the bearing (Figure 47).

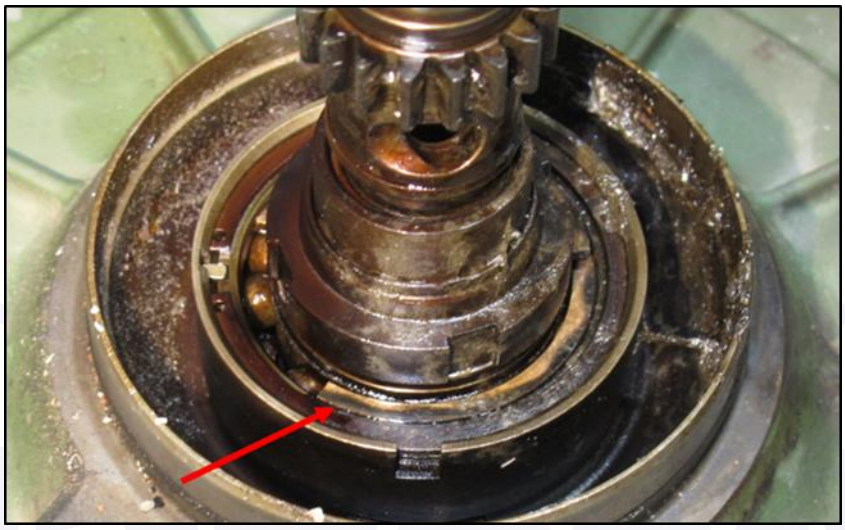


Figure 47 - Color change due to exposure to high temperatures.

Bearing nº 2 was subjected to stereoscopic examinations at the DCTA, and it was evidenced wear and loss of material in the external and internal bearing tracks (Figure 48).

Figure 48 - External and internal tracks with wear and loss of material.

In addition, the analyzes carried out on the bearing showed that the fracture occurred by an overload mechanism, without any evidence of fatigue in the material.

When analyzing the lubrication system and the Gearbox, it was found that the filter element of the low-pressure oil return filter (Scavenge Oil Filter) was dry and covered with soot and also metallic powder residues were found inside the container, however, there were not enough fragments and sizes to block the oil passage and activate the by-pass system.

The oil pressure filter was visually inspected and no dirt / wreckage or foreign material was observed. The residual oil contained in the oil pressure filter container was apparently clean, with normal color and smell (Figure 49).

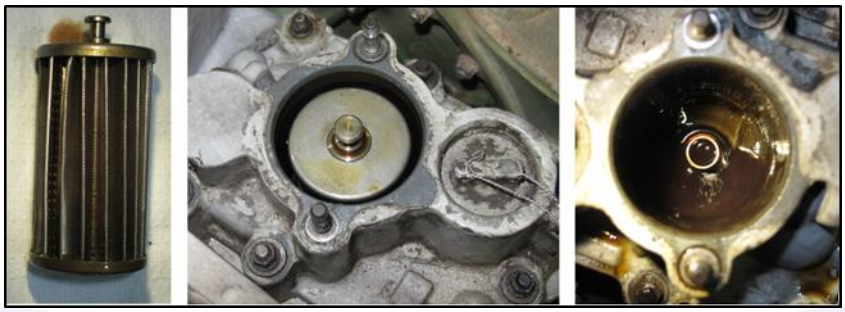


Figure 49 - Oil pressure filter and the filter container.

The upper and lower Magnetic Chip Detectors contained a significant amount of apparently ferrous material, covered by an oily substance similar to gel (Figure 50).

Figure 50 - Metallic material deposited on the Magnetic Chip Detectors.

The X-ray fluorescence analysis (XRF) was performed on the residues collected at the active ends (A and B) of the auto switches and the results are as follows in Figure 51:

Element	A	B	M50 Specification	
	Wt.%		min	max
Cr	5	4.5	3.75	4.25
Mo	3.8	4	4.0	4.5
V	0.9	0.6	0.9	1.1
Mn	0.3	0.5	0.0	0.35
Fe	89	87	remainder	
Ag	0.9	0.8	-	-

Figure 51 - Results of the XRF analysis of the material collected at the ends of the auto switches (A and B) and the specification limits for a bearing material (M50 Specification).

The composition of the collected residue was consistent with the material of the bearing. The iron alloy elements present suggested materials similar to those of the M50 bearing. The analysis also detected traces of silver, which was consistent with the material used to cover the bearing separators.

Continuity testing was performed on the magnetic chip detectors using a multimeter. The tests confirmed that the space resistance at the tip of the detectors was significantly less than the value specified for a clean detector, indicating that the circuits of the detectors were linked, that is, connected (electrical continuity).

The Gearbox had thermal damage on its bottom exterior. It was opened and burnt oil residues, dark colored in its internal components, were observed (Figure 52).

Figure 52 - Gearbox.

The oil pump was dismantled, but no apparent abnormalities were found, only residual oil burned, which prevented its operation, locking its gears and axles.

The oil delivery tube, PN 6851505 and SN BN 13509, was visually inspected and it was found that there were residues of foreign material in the orifice responsible for supplying oil for lubrication of bearing nº 2.

A test was carried out, introducing oil at low pressure, and it was verified that there was no fluid coming out of the hole that directed the lubrication to bearing 2 (Figure 53).

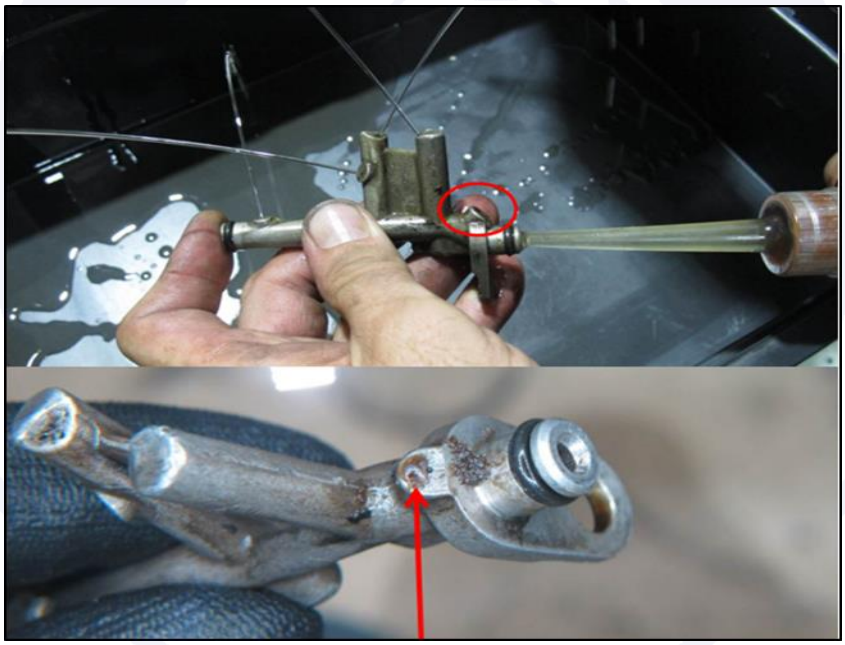
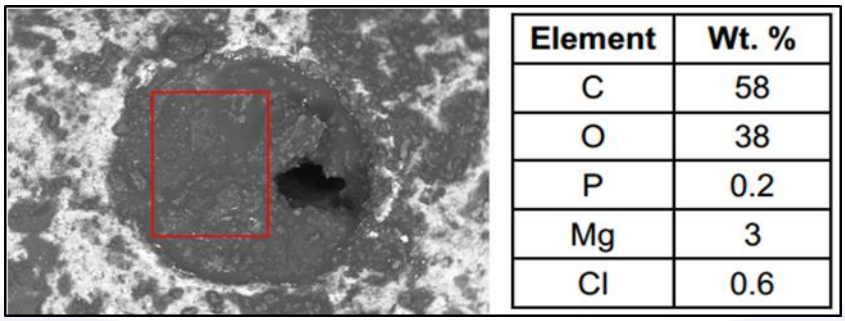


Figure 53 - The oil delivery tube with blocked orifice.

The detailed examination in the orifice that injected oil in bearing nº 2, carried out using the Scanning Electron Microscope (MEV), confirmed that there was the presence of material obstructing the duct responsible for the lubrication of bearing nº 2.

The material was examined by X-Ray Spectroscopy (EDS) and the results indicated that the blocking material was carbonaceous (Figure 54).

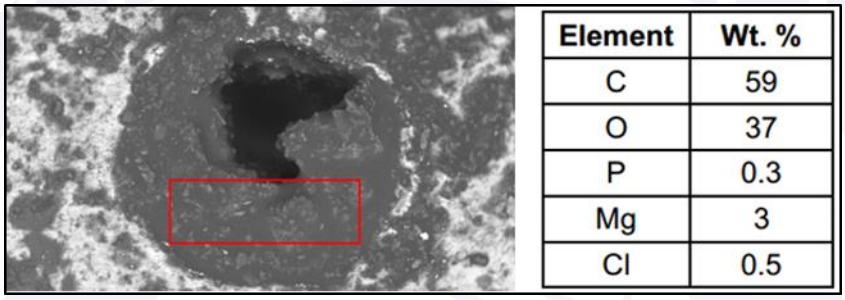


Element	Wt. %
C	58
O	38
P	0.2
Mg	3
Cl	0.6

Figure 54 - Results of the EDS analysis.

The material was partially volatile under vacuum, through the MEV analysis, as evidenced by a morphological change after approximately 15 minutes of exposure to vacuum.

An additional analysis was performed after the morphological alteration and there was no considerable compositional difference in the material. Traces of phosphorus and approximately 3% of magnesium were found in the material (Figure 55).



Element	Wt. %
C	59
O	37
P	0.3
Mg	3
Cl	0.5

Figure 55 - Results of the EDS analysis of the material that blocked the orifice of the oil delivery tube for bearing n° 2, after exposure to vacuum.

The oil delivery tube was subjected to an inspection by Computed Tomography (TC) to assess the extent of the blockage in the passage of the oil jet to bearing nº 2.

The block found in the oil delivery tube filled the entire cross-sectional area and approximately half the length of the oil passage duct for bearing nº 2. There were no variations in intensity on the TC that could have suggested variation in the composition or block density along its length (Figures 56 and 57).

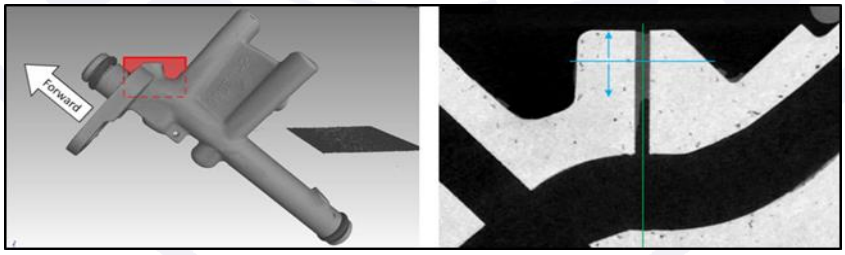


Figure 56 - Result of TC performed on the oil delivery tube. A 2D section along the red plan is shown in detail.

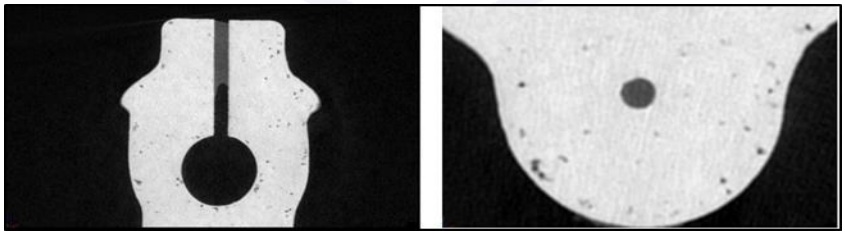


Figure 57 - 2D sections along the plans shown in Figure 56.

Considering what was prevised in the Operation and Maintenance Manual (OMM) RR M250-C20, which required that oil changes to be carried out every 600 hours or 12 months, whichever came first, and in comparison with the maintenance records contained of the available Engine Logbook, it was found that the calendar change interval was exceeded several times, as can be seen in Figure 58.

Data da Troca do Óleo	Horas do Motor	Tempo Calendárico	Horas Decorridas	Óleo Utilizado
25/07/2003	11879.5			MOBIL 254
18/03/2004	11896.2	7.9	16.7	BP 2197
22/10/2004	11983.6	6.9	87.4	BP 2197
17/07/2006	12227.2	20.9	243.6	BP 2197
06/02/2007	12305.1	6.7	77.9	BP 2197
26/11/2007	12423.7	8.7	118,6	BP 2197
12/08/2008	12505.4	8.5	82.0	BP 2197
14/08/2009	12637.2	11.9	131.8	MOBIL 254
18/08/2010	12809.3	12.3	172.1	MOBIL 254
08/11/2013	13246.5	38.7	437.2	MOBIL 254
27/03/2015	13335.3	16.6	88.8	MOBIL 254
20/07/2017	13392.4	27.8	57.1	MOBIL 254
16/05/2018	13416.1	9.9	23.7	MOBIL 254

Figure 58 - Engine oil change history (Calendar time given in months).

It is observed that the Mobil 254 oil was used in 2003 and from 2009 on. Between 2004 and 2008, the BP 2197 oil was used. This replacement does not cause problems, as long as the change is complete (that is, it is not recommended the mixture of these oils).

Bearings nº 1, 2½, 3, 4, 5, 6, 7 and 8 had normal operating conditions.

There was no evidence of irregular burning in the combustion chamber. All components, liner and case, showed a normal and uniform firing pattern, as well, no damage was found in the set of shield and stator blades, although the shield had a rough surface, probably due to material coming from the compressor rubbing (Figures 59 and 60).

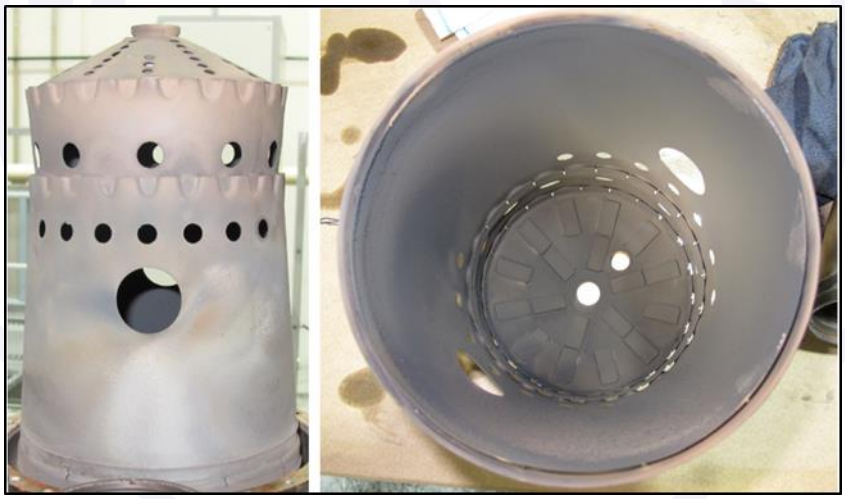


Figure 59 - “Liner” of the combustion chamber.

Figure 60 - Shield, stators and combustion chamber case.

During the analysis of the turbine section, all stages of the turbine and set of stator blades were intact, showing no mechanical damage or signs of temperature extrapolation.

There was soot all along the gases path and oil sludge in the oil collector on bearing nº 8.

The turbine bearings were intact. The supports of the power and gases generator turbines were undamaged and with a normal operating appearance. The turbine shaft was connected and showed no warping or damage.

Research was also carried out on the aircraft's alarm lights panel (Warning and Caution Lights) and on the engine oil pressure and temperature indication instrument (ENG OIL).

The engine oil pressure and temperature indication instrument did not show signs of impact of the measuring pointers against the reading surface, and not being possible to determine their position at the time of the accident (Figure 61).

Figure 61- There were no marks on the face of the dial indicating the impact of the hand.

As for the panel of warning lights (Warning and Caution Lights), each lighting space (slot) was composed of two lamps, which were subjected to stereoscopic exams (Figure 62).

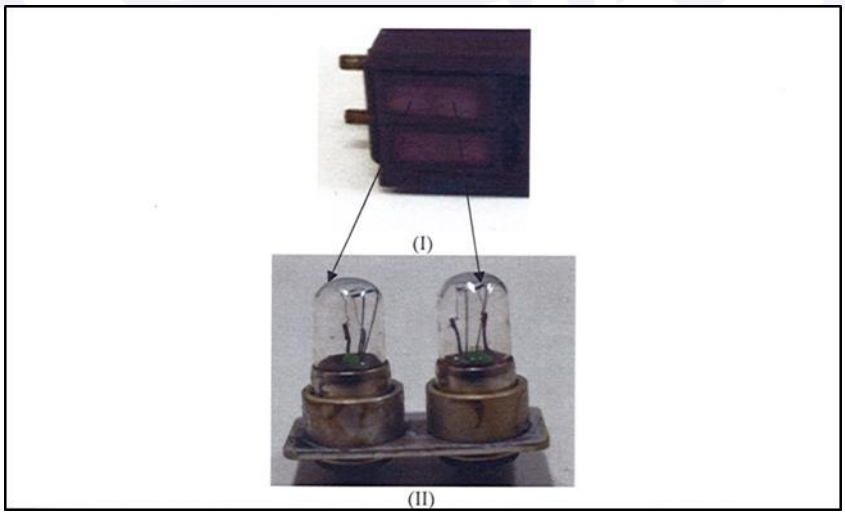


Figure 62 - Each slot consisted of two lamps.

The identified positions from I to VIII and XI did not have a warning function, being called spare (Figure 63).

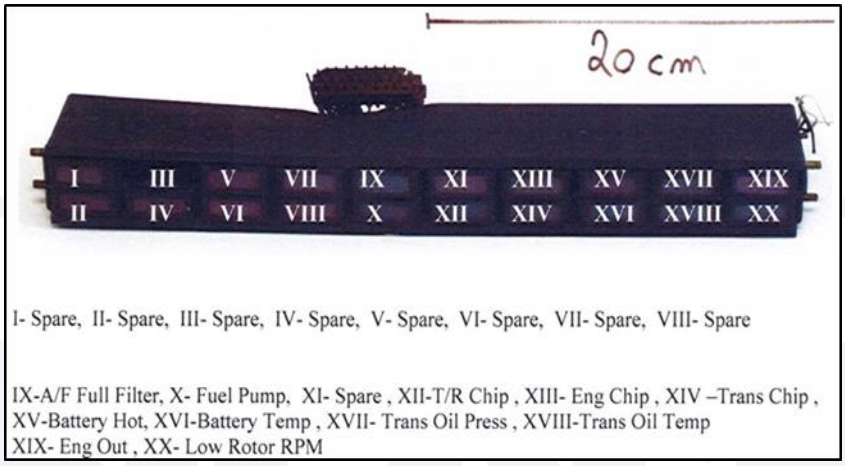


Figure 63 - Overview of the Warning and Caution Lights panel.

When observing the filaments of the lamps in the Warning and Caution Lights panel, it was found that both lamps in the IX-A / F Full Filter slots, X-Fuel Pump, XII-T / R Chip, XV-Battery Hot, XVIII -Trans Oil Temp and XIX-Eng Out did not show filament rupture and had normal deformation caused by use (Figures 64, 65 and 66).

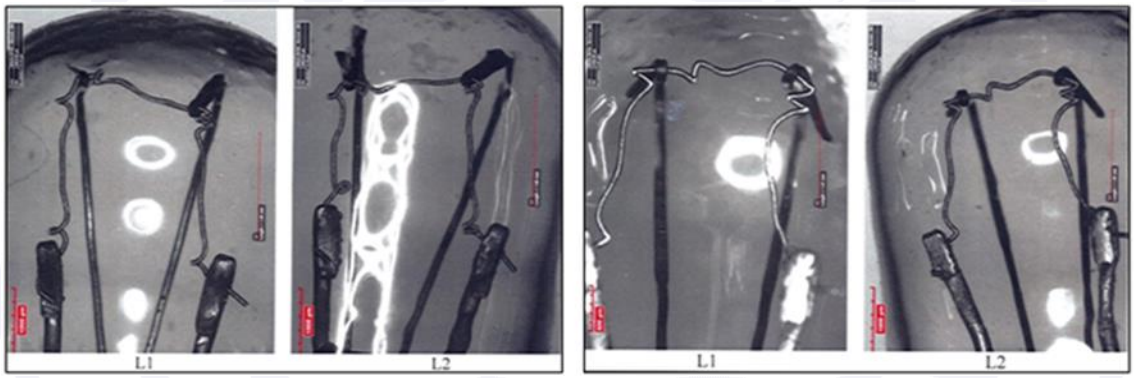


Figure 64 - Normal deformation caused by the use of lamp filaments in slots IX-A / F Full Filter and X-Fuel Pump.

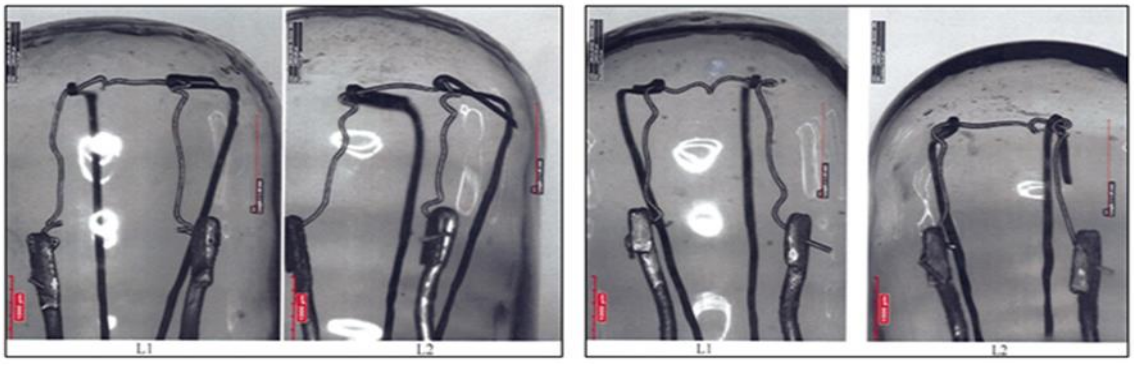


Figure 65 - Normal deformation caused by the use of lamp filaments in slots XII-T / R Chip and XV-Battery Hot.

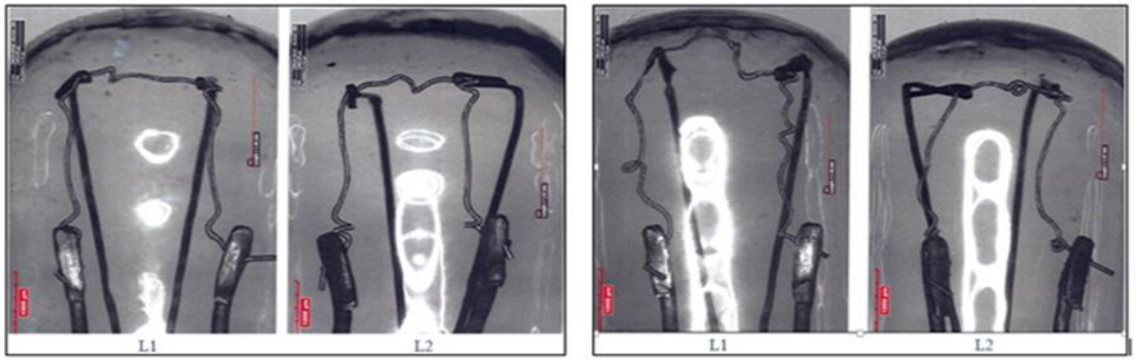


Figure 66 - Normal deformation caused by the use of lamp filaments in slots XVIII-Trans Oil Temp and XIX-Eng Out.

It was observed that one of the lamps in the XIV-Trans Chip, XVI-Battery Temp, XVII-Trans Oil Press and XX-Low Rotor RPM slots showed a filament rupture (Figure 67).

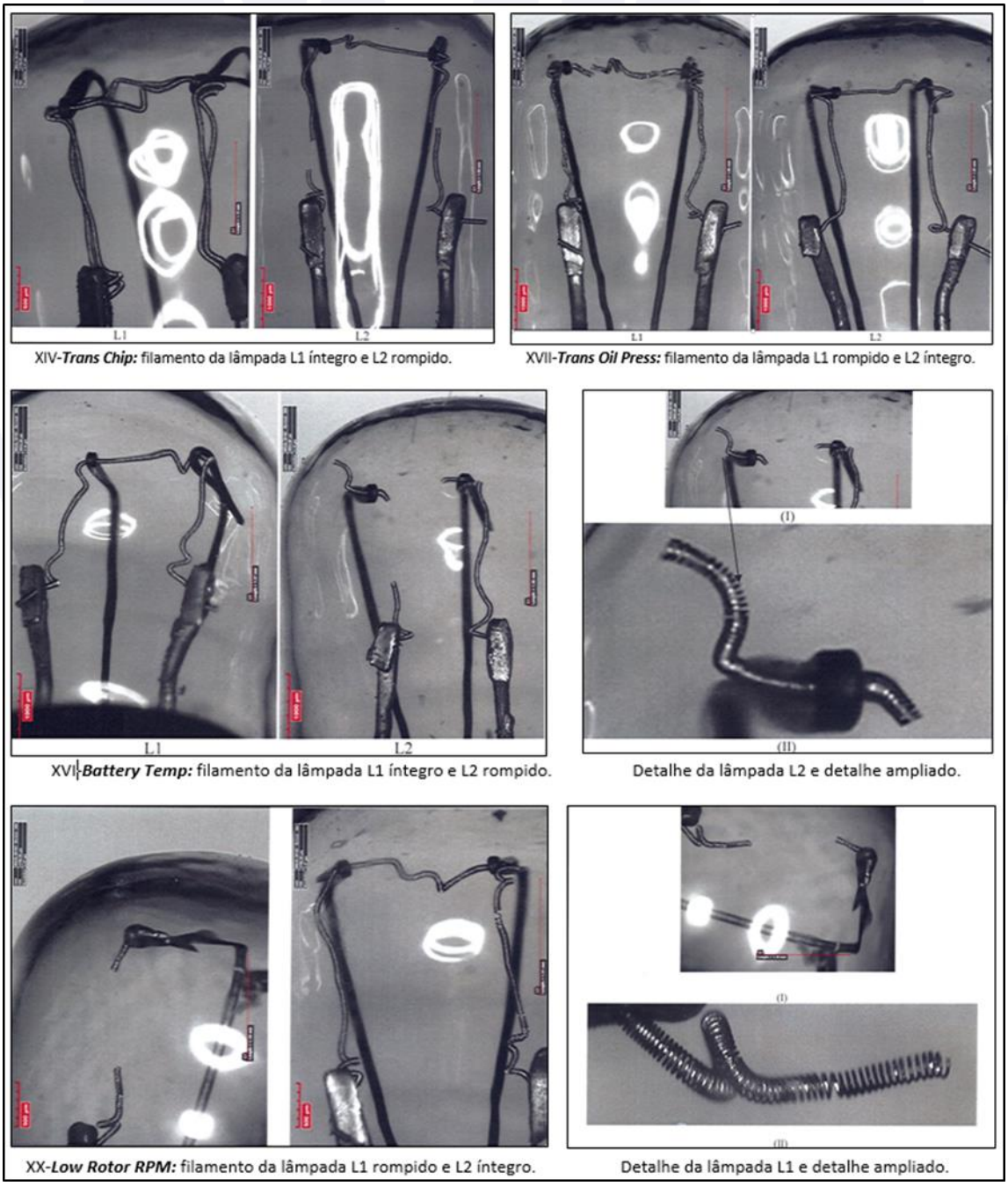


Figure 67 - Slots that presented one of the two lamps with broken filament.

The two lamps in the slot referring to the XIII-Eng Chip position had their filaments broken with no sign of elongation (Figures 68 and 69).

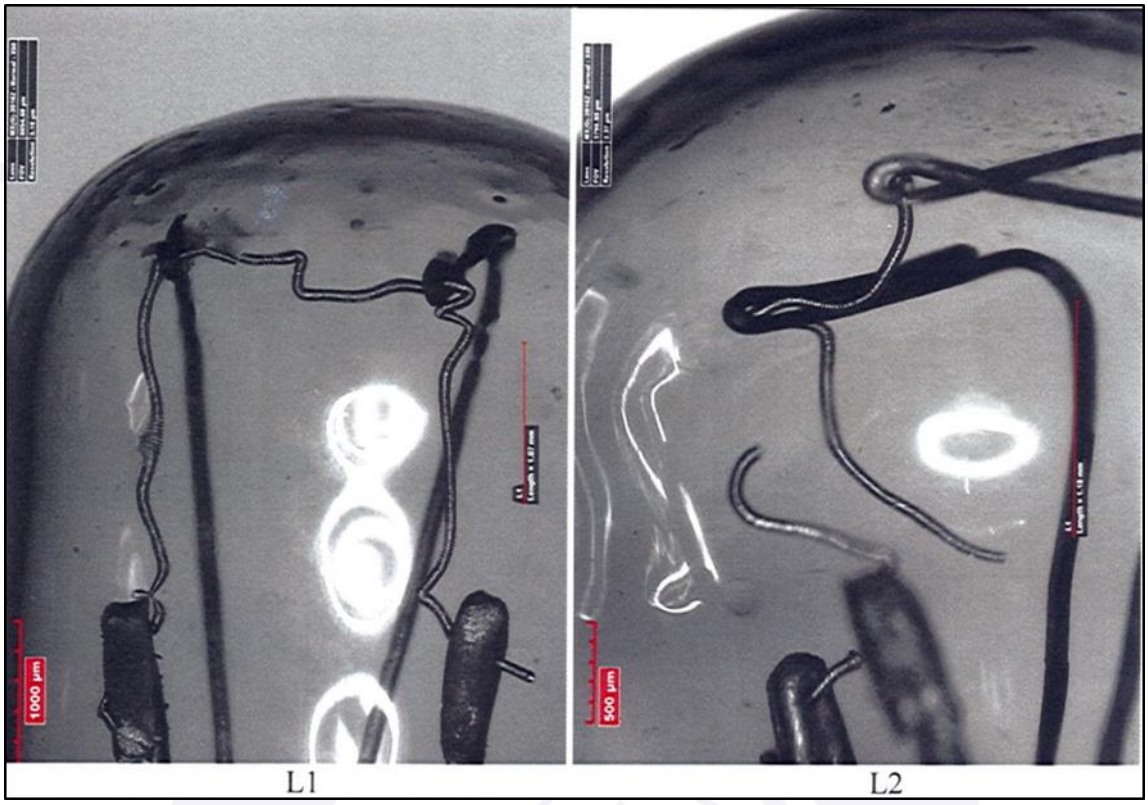


Figure 68 - L1 and L2 lamps in slot XIII-Eng Chip with broken filaments.

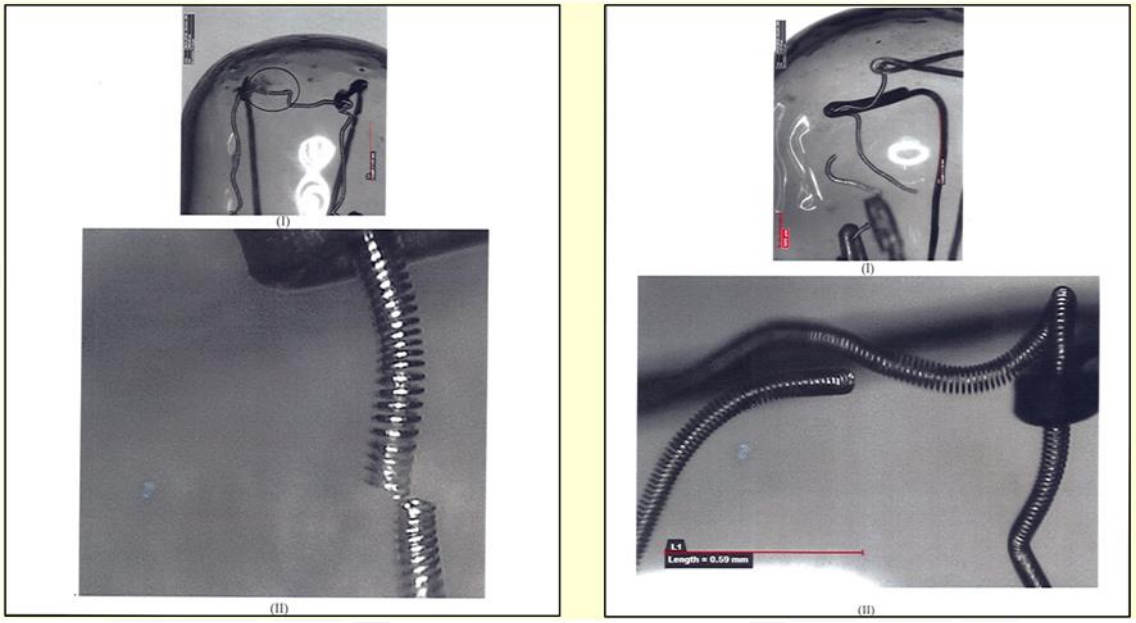


Figure 69 - Details of the broken filaments of the L1 and L2 lamps in slot XIII-Eng Chip.

All lamps in the panel showed deformation compatible with use, with no evidence of rupture with hot deformation.

1.17 Organizational and management information.

The company, considered small, was composed by two owners (the pilot, who died in the occurrence and his son), the GSO and the flight coordinator.

It also had another pilot, without a formal employment contract, to operate the Robinson R22 and R44 helicopters. The Bell “Jet Ranger” (helicopter of the occurrence) was operated exclusively by the pilot-owner and belonged to the company since 2003.

In the last nine months, after hiring the new person responsible for the GSO, weekly meetings were held to discuss matters related to safety with the members of the company. The report of this person responsible for the GSO points out that he was present at the company every Tuesday; on other days, management was done remotely.

The pilot-owner had changed the company responsible for carrying out the maintenance of the aircraft in 2017. In the perception of the GSO, the contracted maintenance company met what was expected from the work performed and determined by the operator.

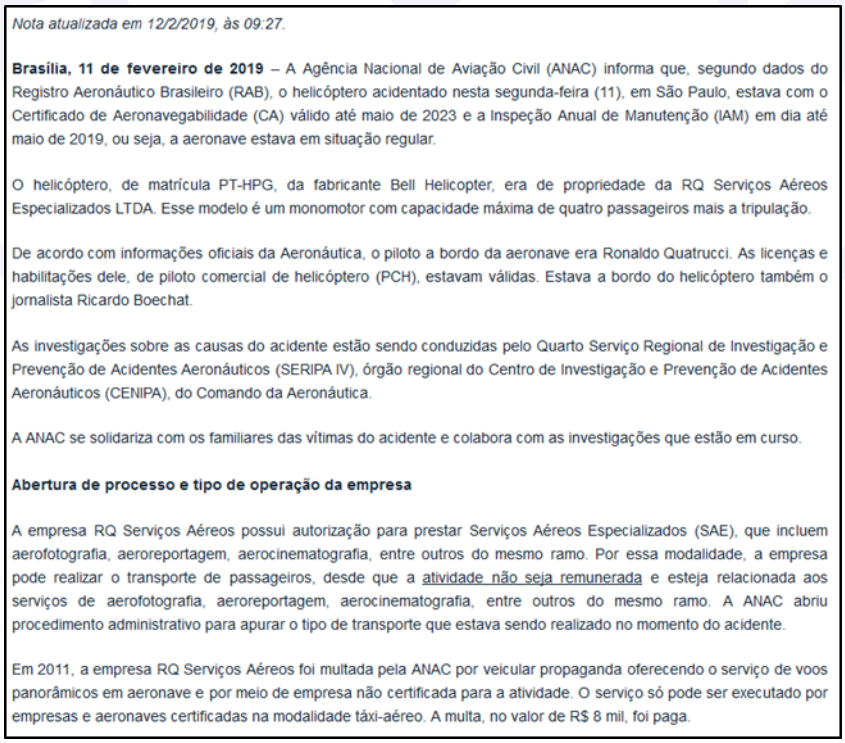
The company, in the last months of operation, had been performing about three and a half hours of monthly flight, alternating the aircraft. The pilot-owner was considered to be very focused on company matters and followed everything related to it, according to employees’ statements.

The organizational climate was considered very good, due to the fact that there is also a family and friendship bond between the owner and the employees.

According to information posted on the ANAC website, through a press release, the operator RQ *Serviços Aéreos Especializados* Ltd. he was authorized to provide Specialized Aircraft Services (SAE), which included aerial photography, aerial reporting, and aerial cinematography, among others in the same industry.

The operational authorization to operate a public air service specialized in aero report, aero photography, aero cinematography activities had been renewed on 03JUL2015, for five years, in the decisions published in the Union Official Journal of 06JUL2015.

The ANAC Note also stated that the company could only transport passengers, provided that the activity was unpaid and related to the specialized services for which it was authorized (Figure70).



Nota atualizada em 12/2/2019, às 09:27.

Brasília, 11 de fevereiro de 2019 – A Agência Nacional de Aviação Civil (ANAC) informa que, segundo dados do Registro Aeronáutico Brasileiro (RAB), o helicóptero acidentado nesta segunda-feira (11), em São Paulo, estava com o Certificado de Aeronavegabilidade (CA) válido até maio de 2023 e a Inspeção Anual de Manutenção (IAM) em dia até maio de 2019, ou seja, a aeronave estava em situação regular.

O helicóptero, de matrícula PT-HPG, da fabricante Bell Helicopter, era de propriedade da RQ Serviços Aéreos Especializados LTDA. Esse modelo é um monomotor com capacidade máxima de quatro passageiros mais a tripulação.

De acordo com informações oficiais da Aeronáutica, o piloto a bordo da aeronave era Ronaldo Quatrucci. As licenças e habilitações dele, de piloto comercial de helicóptero (PCH), estavam válidas. Estava a bordo do helicóptero também o jornalista Ricardo Boechat.

As investigações sobre as causas do acidente estão sendo conduzidas pelo Quarto Serviço Regional de Investigação e Prevenção de Acidentes Aeronáuticos (SERIPA IV), órgão regional do Centro de Investigação e Prevenção de Acidentes Aeronáuticos (CENIPA), do Comando da Aeronáutica.

A ANAC se solidariza com os familiares das vítimas do acidente e colabora com as investigações que estão em curso.

Abertura de processo e tipo de operação da empresa

A empresa RQ Serviços Aéreos possui autorização para prestar Serviços Aéreos Especializados (SAE), que incluem aerofotografia, aeroreportagem, aerocinematografia, entre outros do mesmo ramo. Por essa modalidade, a empresa pode realizar o transporte de passageiros, desde que a atividade não seja remunerada e esteja relacionada aos serviços de aerofotografia, aeroreportagem, aerocinematografia, entre outros do mesmo ramo. A ANAC abriu procedimento administrativo para apurar o tipo de transporte que estava sendo realizado no momento do acidente.

Em 2011, a empresa RQ Serviços Aéreos foi multada pela ANAC por veicular propaganda oferecendo o serviço de voos panorâmicos em aeronave e por meio de empresa não certificada para a atividade. O serviço só pode ser executado por empresas e aeronaves certificadas na modalidade táxi-aéreo. A multa, no valor de R$ 8 mil, foi paga.

Figure 70 - Note published on 11FEB2019 on the ANAC website.

Also according to the Note, the RQ *Serviços Aéreos Especializados* Ltd. had been fined, in 2011, for offering the panoramic flight service, which could only be performed by companies and aircraft certified in the TPX – Air Taxi category, in accordance with RBAC 135 .

In order to operate in accordance with RBAC 135, it would be necessary that, in addition to the COA, issued on behalf of the certificate holder and the authorization to provide remunerated public air transport services for passengers or cargo, the operator had submitted a training program approved by the ANAC, which would ensure adequate training to perform the duties of each crewmember, among other obligations.

The RQ *Serviços Aéreos Especializados* Ltd. did not have an approved operational training program and was not certified by the ANAC, according to the RBAC 135, and did not have authorization to provide remunerated public air transport services for passengers or cargo.

The RQ *Serviços Aéreos Especializados* Ltd. website, at the time of the accident, offered the following services: aerial photographs, aerial shooting, aerial reports, air taxi, aerial searches, aerial inspections, weddings, panoramic flights, escorts, transportation of valuables and events (Figure 71).

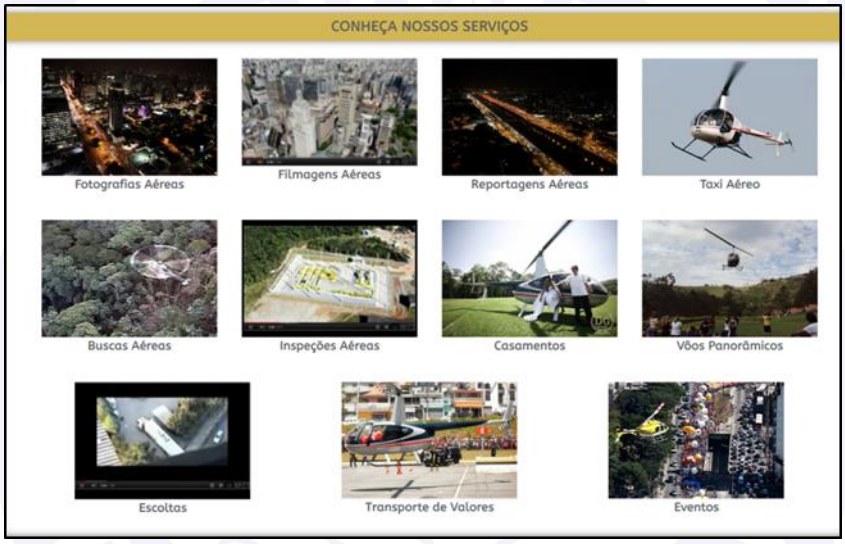


Figure 71 - Services offered at the RQ *Serviços Aéreos Especializados* Ltd.
http://www.rqhelicopteros.com.br/.

The company *Zum Brasil*, which operated in the corporate events sector, coordinated the landing authorization at the Royal Palm Plaza Helipad (SSQW) on 11FEB2019 for the passenger to disembark at 1300 (UTC) and to re-boarding at 1530 (UTC).

The company *Zum Brasil*, through a press release, made the following statement:

> ... ”For the displacement of the journalist […] to participate in a convention of a pharmaceutical laboratory in Campinas, *Zum Brasil* hired the RQ *Serviços Aéreos Especializados* Ltd., which had the Airworthiness Certificate and the aircraft Annual Maintenance Inspection in regular situation, according to the ANAC"...

The air taxi service should be authorized and supervised by the ANAC and could only be provided by companies that met a series of requirements and demands that accredited them to provide the service in a legal and regular manner, in accordance with the RBAC 135.

1.18 Operational information.

On the day of the PT-HPG aircraft accident, the pilot arrived at the Campo de Marte Aerodrome, more precisely at the Marte Updates and Avionics Hangar, around 0945 (UTC), and went to prepare for the flight that would take place at 1100 (UTC).

According to observers, the pilot performed the pre-flight of the aircraft, passed the flight notification and called the fuel company.

At 1038 (UTC), fueling the aircraft started with JET A1 fuel, and at 1041 (UTC) fueling was completed. The total fuel supplied during refueling was 100 liters of aviation kerosene.

The total fuel capacity of the Bell 206B model aircraft was 291.7 liters (77.06 US Gallons), and the usable fuel was 287.7 liters (76 US Gallons) (Figure 72).

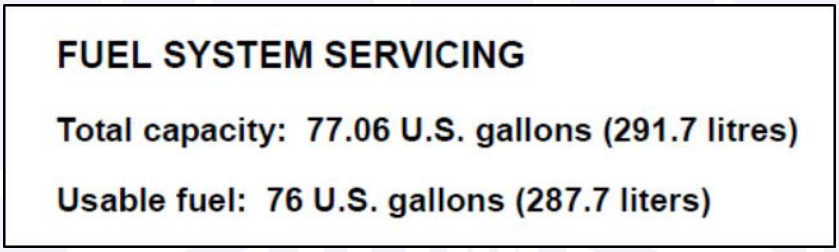


Figure 72 - Bell 206B fuel load capacity, Rotorcraft Flight Manual - Revision B-55 - 06DEC2018.

It was found that the average fuel consumption of the Bell 206B aircraft was approximately of 100 liters per flight hour.

It was not possible to calculate the total amount of fuel that the aircraft had to perform the flights of 11FEB2019. However, no evidence was found that the available fuel was not sufficient to carry out the programmed routes.

Since the amount of fuel existing before refueling was unknown, it was not possible to calculate the weights, both at SBMT takeoff, as well as at the time of the accident. However, no evidence was found, such as excess of passengers or cargo, to indicate that the aircraft was overweight and not balanced at the time of the accident.

During the procedures that preceded the engine start (Engine Prestart Check), described in Section 2 of the Rotorcraft Flight Manual - Revision B-55 - 06DEC2018, it was necessary to accomplish several tasks and, among them, was to check the lights of the aircraft alarm panel lights, “Warning and Caution Lights - Test” (Figure 73).

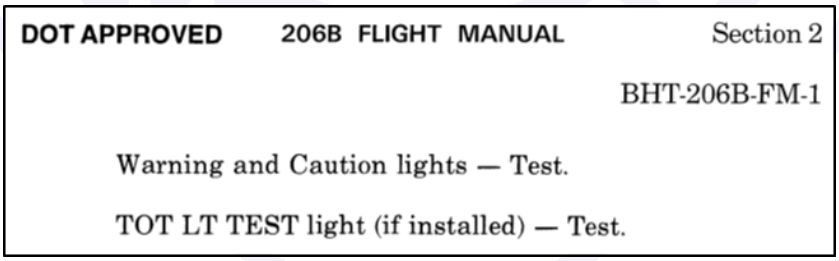


Figure 73 - Extract from the Engine Prestart Check, Rotorcraft Flight Manual - Revision B-55 - 06DEC2018.

The tasks described in the Engine Prestart Check procedure were to be performed before all aircraft engine starts.

It is important to note that if any of the lights on the alarm panel (Warning and Caution Lights) were inoperative, the flight could not be performed.

The aircraft took off from SBMT at approximately 1120 (UTC) to the Bandeirantes Helipad (SDBH), São Paulo - SP, 6.8 NM away, and it landed at approximately 1128 (UTC).

At about 1147 (UTC), after the passenger boarded, the aircraft took off from SDBH to the Royal Palm Plaza Helipad (SSQW), Campinas - SP, 44.4 NM away, where it landed at around 1215 (UTC) .

After the passenger disembarked, the pilot took off from SSQW to the Campos dos Amarais State Aerodrome - Prefeito Francisco Amaral (SDAM), Campinas - SP, at about 5 NM, where he landed at an Aerodrome square near a Maintenance Organization.

According to information from the shop staff, the pilot reported that there was a light on the aircraft panel, but he did not specify which.

The OM's owner questioned whether the pilot would want to carry out maintenance, in order to be able to open a Service Order, which he declined.

The owner of the OM also said that he had made the use of the hangar available for the maintenance to be carried out outside the headquarters by the WM *HELICÓPTEROS*, responsible for the last maintenance of the aircraft, if it was in the pilot's interest.

The pilot spent approximately 45 minutes on the ground and with the engine fairing open, while waiting for the time to return to SSQW. At no time was the SDAM airport operator informed of the landing by the aircraft pilot.

At 1340 (UTC), the aircraft landed on SSQW. The pilot disembarked, with the rotor spinning and boarded the passenger. At 1349 (UTC), the aircraft took off to SDBH.

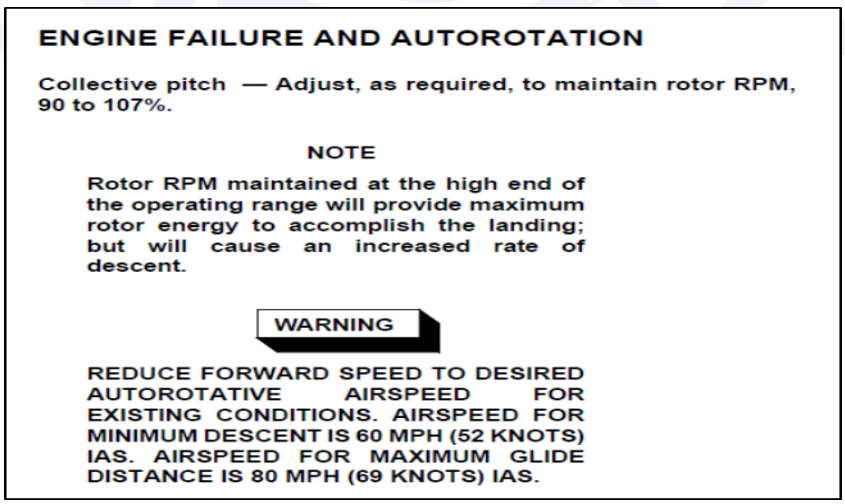
Just before 1405 (UTC), the PT-HPG aircraft started to be recorded by a security camera from the Rodoanel Mário Covas concessionaire, CCR Rodoanel, SP-021 Highway, Km 7, on a downward trajectory.

A video analysis was performed, in order to obtain an estimate of the aircraft speed in horizontal displacement and, for this purpose; the aircraft length and video frames were used as a reference. Thus, the approximate speed obtained was of 60kt.

The profile observed in the recordings of the security camera, regarding the horizontal speed and sink rate was compatible with the autorotation maneuver.

The speeds with the lowest descent rate and maximum range of the aircraft in self-rotation, according to the Rotorcraft Flight Manual, were, respectively, 52kt and 69kt.

The autorotation procedure is required when the engine fails in flight (Figure 74).



ENGINE FAILURE AND AUTOROTATION

Collective pitch — Adjust, as required, to maintain rotor RPM, 90 to 107%.

NOTE

Rotor RPM maintained at the high end of the operating range will provide maximum rotor energy to accomplish the landing; but will cause an increased rate of descent.

WARNING

REDUCE FORWARD SPEED TO DESIRED AUTOROTATIVE AIRSPEED FOR EXISTING CONDITIONS. AIRSPEED FOR MINIMUM DESCENT IS 60 MPH (52 KNOTS) IAS. AIRSPEED FOR MAXIMUM GLIDE DISTANCE IS 80 MPH (69 KNOTS) IAS.

Figure 74 - Engine failure and autorotation, Rotorcraft Flight Manual - Revision B-55 - 06DEC2018.

Near the landing, making a profile compatible with the autorotation profile, the aircraft collided with a truck moving perpendicularly (Figure 75).

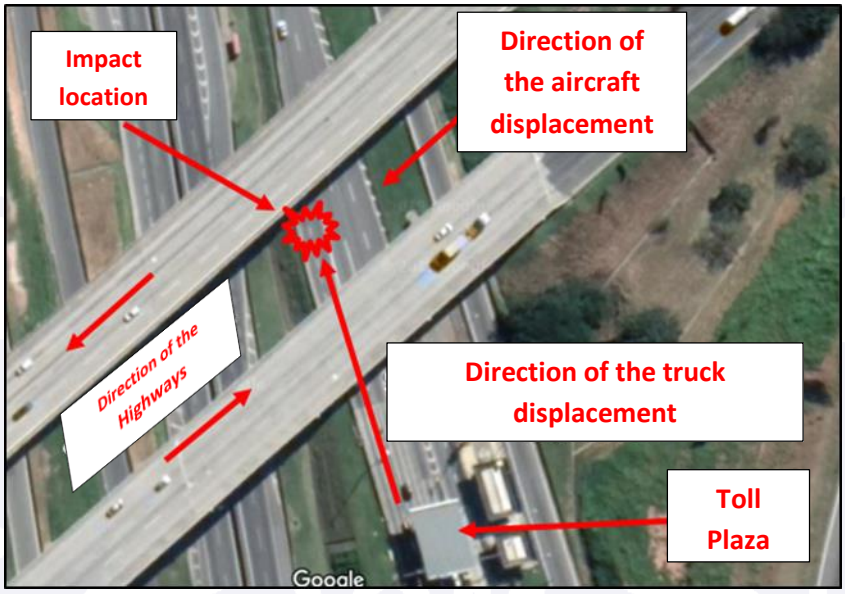


Figure 75 - Sketch of the occurrence site.

The analysis of the images did not suggest any problem of controllability of the helicopter during the whole recording.

The last two FAPs, related to the HMNT qualification revalidation exams, of the years 2016 and 2018, brought the information that he performed the autorotation procedure satisfactorily.

1.19 Additional information.

On 17APR2019, the ANAC launched https://sistemas.anac.gov.br/voeseguro/, using *VOE SEGURO* – Air Taxi, through apps for mobile devices or electronic address (Figure 76).

Figure 76 - Visualization of the *VOE SEGURO* – Air Taxi consultation page, on the ANAC website.

The *VOE SEGURO* – Air Taxi was an initiative of the Agency to try to curb the practice of clandestine air taxi.

The ANAC recommended to the user that, before hiring a chartered air transport, consult if the company was authorized to offer the expected service and if the aircraft could be used for this purpose.

After researching the CENIPA website, , it was verified the existence of a Final Report 103/CENIPA/2013, which occurred with the PR-DJC aircraft on 30MAY2013, where a passenger was hit by the main rotor of the aircraft after the commander left the aircraft with the engine running.

Regarding the passenger boarding and disembarkation operation, the (RBHA) 91, in Section 91.102 (e), nº 2 and nº 3, valid at the time, established that:

> (e) No pilot in command of an aircraft may allow passengers to board or disembark his aircraft with the aircraft engine(s) running, **unless *:**
>
> (2) for a **helicopter ***, in addition to the applicable requirements of paragraph (f) (1) of this section, it is possible to stop the main rotor(s) or, if this is not possible, the engines are maintained idling and the height of the lower main rotor plane is sufficient to allow passengers to pass under it with a safety margin; and
>
> (3) the pilot in command takes responsibility for the operation and takes appropriate **measures to ensure the safety of the operation ***.
>
> (f) No pilot in command of an aircraft may allow his aircraft to be fueled with the engine(s) running (except APU's), unless the operation is conducted by the pilot in command in accordance with procedure established in the aircraft Flight Manual or in accordance with other procedures approved by the DAC. Additionally,
>
> (1) there cannot be a passenger on board.
>
> *** our emphasis**

In addition, Law nº 7,565, from 19DEC1986, the CBA, in its Chapter III (Of Infractions), Art. 302, item II, letter S, established that infractions are attributable to airmen or aircraft operators, leave the aircraft with the engine running without a crewmember on board.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a chartered flight, between the Bandeirantes Helipad (SDBH), São Paulo - SP, and the Royal Palm Plaza (SSQW), Campinas -SP, in round-trip legs, hired by the *Zum Brasil* Company, which operated in the Corporate Events Sector, to transport a passenger who would attend a pharmaceutical laboratory convention, in the city of Campinas.

Although it was not possible to confirm the fuel and weight information, there was no evidence that the fuel available on the aircraft was not sufficient to carry out the scheduled flights or that the weight and balance may have contributed in any way to the event in question.

However, the Operating Company did not have an operational authorization issued by the ANAC to carry out passengers transport, in the air taxi category, although it offered this service on its digital website. In 2011, the company had already been fined by the ANAC for offering services without proper certification.

Thus, the pilot was not qualified to perform passengers or cargo non-regular public air transportation in the air taxi category, since, for this, he should have undergone an operational training program approved by the ANAC, under the terms of the RBAC 135.

According to a press release, the company that hired the passenger transport service, even after the accident, believed that the Airworthiness Certificate and the Annual

Maintenance Inspection of the aircraft were enough to certify the operator's adherence to the standards, and the ability to provide the contracted service.

However, passengers transportation for a fee could only be carried out by companies certified by the ANAC for a specific purpose and that met a series of regulatory requirements that accredited them to provide the service in a legal and regular manner. The provision of the air taxi service by the RQ *Serviços Aéreos Especializados* Ltd. could not be performed and it characterized a violation of the current regulations issued by the ANAC.

Although it was reported by some interviewees that accepting work outside the company's EO was not the pilot's usual behavior, this had already occurred previously, as recorded in a notice issued by the regulatory agency.

People close to the pilot-owner reported that the acceptance of this charter might have occurred due to financial issues, as the company was in low demand for jobs at the time, flying about three and a half hours a month, which worried the pilot-owner.

This perception was reinforced by the behavior of the pilot-owner. It was reported that he worked on Saturdays, Sundays and holidays to cover financial obligations. He kept the office phone transferred to his cell phone on weekends, so as not to miss the opportunity to make new flights that might appear.

In this context, it is possible that the Company's financial situation has fostered, over time, the adoption of attitudes and practices that differed from the rules and procedures prevised for air operations carried out by the Company.

The flight started in SBMT with the initial transfer to SDBH, where the passenger was taken to the Royal Palm Plaza Helipad (SSQW), Campinas - SP.

After leaving the passenger at the destination, the helicopter was transferred to SDAM, where there was an OM. According to its owner, the pilot mentioned that there was a light on the aircraft panel, without specifying which light was that.

The owner of the shop claimed that he made normal protocol requirements to receive the aircraft, such as opening a Service Order, which resulted in the commander's refusal.

At 1340 (UTC) the aircraft returned to SSQW. The pilot disembarked, with the rotor working, with no one at the controls of the helicopter, and boarded the passenger. At 1349 (UTC), takeoff was made to SDBH.

Although it did not influence the accident in question, the abandonment of the cabin with the rotors working to assist the passenger, during boarding, characterized a non-compliance with the rules.

As for the flight back to SDBH, the analysis of the video from the Rodoanel concessionaire's security camera allowed the aircraft horizontal speed to be estimated at approximately of 60kt. This value was compatible with the procedure required for aircraft with engine failure in flight and was among the lowest descent and maximum reach speeds during the autorotation maneuver.

The images also made it possible to rule out the possibility of failures involving the controllability of the helicopter during the flight.

Analyzing the images of the field investigation and the sketch, the Investigation Team inferred that the aircraft approached the grassy space between the two elevated runways of the Rodoanel, and perpendicularly to the marginal lane of the Anhanguera Highway (Figures 31 and 32).

The pilot was unsuccessful in this approach and ended up overcoming the probable intended landing site, having no option but to try to land on the marginal lane of the Anhanguera Highway.

Thus, it was found that there may have been an inadequacy in the use of the controls, which would have allowed the aircraft not to reach the chosen area during the autorotation, culminating with the attempt to land on the place where the accident occurred.

The commander of the aircraft died as a result of injuries caused by the collision of the aircraft against the truck. The dosage of carbon monoxide found in his body characterized carbonization as secondary, that is, post mortem.

Therefore, after analyzing the video images from the security camera, it was concluded that the flight profile was compatible with an autorotation and that hypotheses of failures that involved the helicopter's controllability during the flight were discarded, the research lines were directed to the powertrain.

Thus, when analyzing the connection shaft between the Gearbox and the tail rotor (Figure 34), it was noticed that it was sectioned. The examinations concluded that the rupture occurred due to overload.

The flexible blades had different aspects between the side referring to the tail rotor and the side referring to the freewheel exit (Figure 35), showing a possible locking of part of the shaft connected to the tail rotor and a continuous rotation of part of the shaft connected to the Gearbox and, consequently, the freewheel assembly.

The fracture morphology of the connecting shaft rupture without helical deformation on the connection side with the tail rotor and with deformation on the output side of the Gearbox indicated that it was rotating at the moment of the collision with the truck.

The rotation of the connecting shaft could indicate that the engine was working at the time of the collision or that, even with the engine inoperative, the freewheel system was maintaining the rotation of the shaft while the main rotor was spinning.

Since the aircraft was carrying out a flight profile that suggested the execution of an autorotation, it is possible that, with the engine inoperative, the freewheel was correctly transmitting the turn between the main and tail rotors. However, in the face of an unsuccessful forced landing, the tail rotor would have collided with obstacles, causing it to lock up before the main rotor stopped.

Such dynamics would explain the flexible blades present different aspects between the side referring to the tail rotor and the side referring to the freewheel exit and the morphology found in the section of the connection shaft between the engine Gearbox and the tail rotor.

The fuel system and its components showed no discrepancies or indications that it worked abnormally, which ruled out its contribution to stopping the engine.

The compressor section showed no signs of material ingestion. Likewise, the turbine section showed no mechanical damage or signs of having worked at abnormal temperatures. Its bearings, shafts, rotating blades and stator were shown to have a normal operating appearance, suggesting the absence of material ingestion by the compressor, eliminating the Foreign Object Damage (FOD) hypothesis.

The stator and rotor vanes of the axial compressor did not present any deformations.

A small loss of material was seen in the impeller of the centrifugal compressor in a small area in its diameter, not configuring ¼ of rotor rotation turn, in addition to a rubbing in the housing surrounding this compressor. This information allowed us to affirm that there was no rotation of the compressor shaft and that the engine had a mechanical lock before the moment of the collision with the truck.

The Gearbox, connected to the compressor section, showed thermal damage in its lower external part, probably due to the fire of the occurrence, which is confirmed by the state of the burnt oil residues (sludge) found inside (Figure 52), locking its components.

The Gear Box module was considered a maintenance item *on condition* (OC). The repair service on the Gear Box module by the ATC company, for which the SEGVOO 003 ATC 417/11 was issued, was considered the last record of maintenance intervention found in the available documentation.

During the separation between the compressor section and the Gearbox, bearing nº 2 was found broken and locked, with the ball separator fractured in several parts, in addition to the balls showing abnormal wear and ovalization.

The bearing was a PMA component, with FAA approved design and production. However, it was not possible to identify, in the documentation obtained by the Investigation Team, when this item was installed and/or inspected on the SN CAC-30992F compressor.

Stereoscopic examinations showed wear and loss of material in the external and internal tracks of bearing nº 2, probably due to having been subjected to work overload.

Once the failure of bearing nº 2 was identified, efforts were directed towards the lubrication system responsible for its oiling and cooling.

There was not enough oil in the lubrication system to collect and perform spectrometric analysis, due to the rupture of the lines.

Continuing the analysis of the lubrication system, no foreign material dirt / wreckage was observed when inspecting the oil pressure filter element, as well as in its housing.

The upper and lower Magnetic Chip Detectors, installed in the Gearbox, contained a significant amount of material, apparently ferrous, covered by an oily substance similar to gel.

The X-ray fluorescence analysis (XRF) performed on the collected residues at the active ends of the auto switches revealed that the composition of the collected residues was consistent with the material of a common bearing. The analysis also detected traces of silver, which were compatible with the material used to cover the bearing separators (Figure 51).

The continuity tests on the fillings magnetic detectors confirmed that the resistance of the space at its ends was significantly less than the value specified for a clean detector, indicating electrical continuity, that is, the circuit was closed. In this condition, the Eng Chip light indication on the cabin's Warning and Caution Lights should be on.

The tests carried out on the aircraft's Warning and Caution Lights panel lamps showed that the two lamps in the slot referring to the Eng Chip warning had broken filaments, presenting deformation compatible with use, not related to the impact. Thus, it was concluded that, even though the circuit was closed, the Eng Chip's warning was not ON at the alarm lights panel, at the moment of impact.

The Team noted that, before each start, the pilot was expected to check the operation of the Warning and Caution Lights alarm lights. If any lamp did not light up during the test, or even if any lamp remained ON after starting, there would be a need for corrective maintenance action.

As the aircraft was not equipped with flight recorders, it was not possible to verify whether the tasks described in the Rotorcraft Flight Manual, among which the task of checking the Warning and Caution Lights during the Engine Prestart Check, were performed by the pilot.

Thus, it was not possible to specify the condition of the Eng Chip light when the Engine Prestart Check was performed, before the SDAM took off, taking into account that it was carried out in accordance with the recommendations in the checklist.

Another element of the lubrication system, verified in detail, was the oil delivery tube, which was visually inspected and residues of foreign material were observed in the hole responsible for supplying oil for lubrication of bearing nº 2 (Figure 53).

The low-pressure test and the examination performed using the scanning electron microscope confirmed the obstruction of the duct responsible for lubricating this item.

Inspection using TC, which assessed the extent of the blockage in the passage of the oil jet, allowed us to conclude that approximately half the length of the passage duct was blocked, preventing the correct functioning of the lubrication system.

Bearing nº 2 was not receiving lubricating oil from the plugged hole it was intended for, and possibly, it only received oil splashes from other lubrication points in the Gearbox.

The results observed in the examinations, tests and researches allowed to conclude that the obstruction of the orifice that directed oil to the bearing n° 2 resulted in a deficient lubrication and later fracture, due to overload, without indications of fatigue in the material.

It was possible to identify that the type of material present in the obstruction of the tube was basically composed of carbon.

Bearing nº 2 failed due to insufficient flow of cooling and lubricating oil. As a result of this failure, bearing nº 2 no longer axially positioned the compressor rotor, allowing contact between the impeller and the compressor housing. The contact of the rotating part with the static part caused a drag in the N1 system and a disruption in the engine airflow, leading to loss of power in flight.

During the investigation, it was not possible to locate and access all the maintenance records of the PT-HPG aircraft, being possible to consult only part of the information.

The airframe and engine logbooks analyzed were outdated (Part I). The last registration had been made in December 2018 (Figure 6).

So that the airframe and engine logbooks analyzed were updated, the last entry should have been made on 05FEB2019, in accordance with IS No. 43.9-003, Revision A, in force on the date of the accident.

The Airframe Logbook, 02 / PT-HPG / 03, had its opening term dated 15MAR2003 and its closing date on 01DEC2012 (Figures 7 and 8, respectively) and the Airframe Logbook nº 05 / PT-HPG / 12 had its opening term dated on the same day as 02 / PT-HPG / 03. Although the entire documentation of the aircraft was not made available, it would not be possible to have logbooks 03 and 04; therefore, the numbering sequence is inconsistent.

In addition, there were signs of erasures on the inside pages of both logbooks, pages without identification and / or in disagreement with what was stated in the opening term.

Such information raised doubts about all maintenance records for the PT-HPG aircraft, leading to the need of consulting the records made available by the ANAC and by different OMs that performed services for the operator.

The consultation of the Log Cards allowed to identify that the compressor installed on the aircraft, SN CAC-30992F, had gone through Overhaul on 01JUL1988 (Figure 16).

On May 8 and 9, 2017, the aircraft was considered “non-airworthy” when submitted to the VTE carried out by the ANAC. Among the non-conformities reported in the RNC, the last line of item nº 03 described that the 3,500-hour inspection of the SN CAC 30992F compressor was overdue.

According to the record contained in the Engine Log, Part IV - Controlled Components Installation and Removal Records, the SN CAC 30992F compressor was removed for the

reason “Overhaul”, as it had reached 3,510.1 hours TSO, and the SN CAC 31284 compressor it was installed with TSO 0.0h (Figure 22).

After replacing the compressor and proving the correction of the non-conformity, the ANAC released the aircraft on 09AUG2017.

However, seventy days after the aircraft was released by the ANAC, the SN CAC-30992F compressor set was re-installed on the PT-HPG aircraft engine, by the OM WM Helicópteros and it was recorded on page 120/151 of the Engine Logbook that the compressor would be with 373.3 hours TSO (Figure 23).

After the removal of the SN CAC 30992F compressor by the HBR Company, no record was found and / or presented that proves it had been submitted to another Overhaul after 01JUL1988.

Service Order No. 3408, issued by the maintenance organization WM Helicopters (Figure 24), also stated that the SN CAC-30992F compressor would be with 373.3 hours TSO. Attached to this OS, there was a copy of the record called Log Cards Part IV, page 3, which attempted to support the installation of the SN CAC-30992F compressor set on the engine and, consequently, its release for return to service of the aircraft on 18OCT2017 (Figure 25).

As described in the registration of this Log Card, presented by the WM Helicópteros, the OM ATC-Aeronaves Turbinas e Componentes Ltd., it would have performed the Overhaul on the SN compressor CAC-30992F on 08DEC2011 and, from that date on, its Overhaul time would start running again, that is, considering the manufacturer's maintenance program, it would have 3,500 hours until the next Overhaul.

Also in the Log Card Part IV, page nº 3 of the compressor set, in the Remarks area, it was indicated the Work Order (W / O) nº 24177 for details of the works performed.

When consulting the monthly report of services performed by the ATC Company (Figure 18), referring to December 2011, it was possible to identify that W / O 24177 referred to SEGVOO 003 ATC 414/11, which attested the return to service of the complete engine (SN CAE821758), while W / O 24179 referred to SEGVOO 003 ATC 417/11, and attested the return to service of the compressor module (SN CAC30992F), both after repair.

No record was found in the copies of SEGVOO 003 No. ATC 00414/2011 (Figure 26) and SEGVOO 003 No. ATC 00417/2011 (Figure 17), which mentioned any Overhaul service performed by the Aeronaves Turbinas e Componentes Ltd. Company, on the SN compressor CAC30992F.

The SN CAC30992F compressor module had undergone repair due to fillings and remained, after maintenance, with 3,136.8 hours TSO according to SEGVOO 003 No. ATC 00417/2011, dated 09DEC2011 (Figure 17).

The copy of the monthly report of services performed by the ATC Company, referring to December 2011, corroborated that the service performed by the maintenance organization was a repair completed on 09DEC2011, in the SN compressor module CAC30992F, documented by SEGVOO 003 ATC 417 / 11.

When consulting the entry and exit control of items (Figure 27), dated 09DEC2011, from the ATC Maintenance Organization, it was possible to observe that the SN compressor module CAC30992F entered and left the company with 3,136.8 hours of TSO.

Based on all information collected from the OM ATC-Aeronaves Turbinas e Componentes Ltd., it was possible to state that the SN CAC-30992F compressor module did not undergo Overhaul service in December 2011.

Thus, the reinstallation of the SN CAC-30992F compressor, without having passed through Overhaul, took the aircraft to the same “non-airworthy” condition found on May 8 and 9, 2017, during the VTE, carried out by the ANAC (Figure 21). In addition, it was also not possible to conclude the reason why it was attested that the SN CAC-30992F compressor had 373.3h TSO, in OS 3408 and in the Log Card Part IV, page nº 3.

Considering that the ANAC attested, during VTE, that the aircraft was not airworthy using the SN CAC-30992F compressor, it was clear that the operator and the OM, which reinstalled the component, could not claim to be unaware of the need to perform the Overhaul.

In addition, according to the RR M250-C20 Operation and Maintenance Manual (OMM), engine oil changes should be carried out every 600 hours or 12 months, whichever comes first, but the maintenance records contained in the available Engine Logbook attested that the calendar interval for exchange was exceeded several times and for long periods of time.

This inadequate maintenance of the oil system possibly led to the formation of a sediment block in the channel from which the jet of oil supply to bearing nº 2 would leave, which led to a condition of lack of lubrication, contributing to the failure of the engine in flight.

In turn, if the manufacturer's maintenance program had been carried out, bearing nº 2 would have been inspected and submitted to approval criteria when performing the overhaul of the SN CAC-30992F compressor module, according to manual M250-C20 Series Manual Overhaul, which would allow identifying the wear presented by bearing nº 2 and the deficiency verified in the lubrication system.

Thus, regardless of whether the pilot ignored the result of the lamp test or failed to do so, conducting the maintenance actions described above demonstrates that there was an attitude of non-observance of important procedures for the decision to fly safely.

In view of the scenario already exposed, it is possible that such an attitude was reinforced by the motivation that the pilot-owner would have in making the flight, considering the context of scarcity of jobs that his company was going through that year.

Thus, the financial relevance of this chartered flight for the company, at that moment, may have had an influence on the decision of the pilot-owner to assume it, even if he does not have authorization for this type of service, and compromised his ability to critically analyze the conditions in which he would operate it regarding safety.

In this scenario, the various aspects raised during the investigation revealed flaws in the organizational culture related to operational safety, from the sale of flights for which the company was not certified, to deficiencies in the maintenance processes.

Thus, the company, throughout its operation, adopted conducts that generated unacceptable risk conditions for the activity, showing vulnerabilities that contributed to the accident.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had valid CMA;

b) the pilot had valid HMNT Rating;

c) the pilot was not qualified in that kind of flight (TPX – Air Taxi);

d) the RQ Serviços Aéreos Especializados Ltd. had operational authorization to operate a public air service specialized in aerial reporting, aerial photography and aerial cinematography activities;

e) the RQ Serviços Aéreos Especializados Ltd. was not certified by the ANAC, according to RBAC 135, for paid passenger transportation (air taxi);

f) the digital website of the RQ Serviços Aéreos Especializados Ltd. offered aerial photography, aerial filming, aerial reporting, air taxi, aerial searches, aerial inspections, weddings, panoramic flights, escorts, transportation of valuables and events;

g) the Zum Brasil Company hired the RQ Serviços Aéreos Especializados Ltd. to transport a passenger between the Bandeirantes Helipad (SDBH), São Paulo - SP, and the Royal Palm Plaza Helipad (SSQW), Campinas - SP, in round-trip legs;

h) the aircraft had a valid Airworthiness Certificate (CA);

i) it was not possible to verify if the aircraft was within the weight and balance parameters;

j) the airframe and engine logbooks records were outdated;

k) the closing term for the Airframe Logbook No. 02 / PT-HPG / 03 and the opening term for the Airframe Logbook No. 05 / PT-HPG / 12 were dated 01DEC2017;

l) there were erasures on the internal pages of Airframe Logbooks No. 02 / PT-HPG / 03 and 05 / PT-HPG / 12;

m) it was not possible to specify the number of the Engine Logbook, due to the erasure in the identification of the number in the opening term. It was also observed that some pages were identified with the number 02, others with the number 03 and some without identification;

n) it was not possible to locate and have access to all aircraft maintenance records;

o) the weather conditions were favorable for the flight;

p) the aircraft had flown 8 hours and 20 minutes after the last inspections performed on 06DEC2018;

q) the aircraft was submitted to VTE, carried out by the ANAC, on 8 and 9 May, 2017;

r) the aircraft was considered “non-airworthy” during VTE;

s) the VTE Non-Conformity Summary described that the 3,500h inspection of the SN CAC 30992F compressor was overdue;

t) the last Overhaul performed on the SN CAC 30992F compressor module was on 01JUL1988;

u) the SN CAC-31284 compressor was installed in the engine and the ANAC released the aircraft on 09AUG2017;

v) seventy days after the aircraft was released by the ANAC, the SN CAC-31284 compressor set was removed and the SN CAC-30992F compressor set was reinstalled;

w) the M250 engine, which equipped the PT-HPG, allowed modular overhaul;

x) the compressor module, SN CAC-30992F, underwent repair due to filings on 09DEC2011;

y) in the entry and exit items control, from 09DEC2011, of the ATC company, the compressor module entered and left the company with 3,136.8 hours TSO;

z) the record on page 120/151 of the Engine Logbook presented the information that the compressor, SN CAC-30992F, was running 373.3 hours TSO;

aa) Service Order No. 3408, issued by the maintenance organization WM *Helicópteros*, presented the information that the compressor, SN CAC-30992F, was running 373.3 hours TSO;

bb) attached to Service Order No. 3408, issued by the maintenance organization WM *Helicópteros*, there were copies of Log Cards;

cc) according to the registration of Card Part IV, page nº 3, presented by the WM *Helicópteros,* the OM ATC-*Aeronaves Turbinas e Componentes* Ltd. would have performed an overhaul on the SN compressor CAC-30992F on 08DEC2011;

dd) Card Part IV, page 3 of the compressor set, in the Remarks area, indicated Work Order (W / O) no. 24177 for details of the work performed;

ee) W / O 24177 referred to SEGVOO 003 ATC 414/11;

ff) SEGVOO 003 ATC 414/11 attested the return to full engine service after maintenance and did not refer to the overhaul of the compressor SN CAC-30992F;

gg) SEGVOO 003 ATC 417/11 attested the return to service of the compressor module after repair and did not refer to the overhaul of the item;

hh) the monthly report of services performed by the ATC Company, referring to December 2011, described the compressor module as REPAIRED in the “service performed” area;

ii) no Overhaul record was presented or found on the SN CAC 30992F compressor module after 01JUL1988;

jj) during the displacement of the aircraft between Helipads Royal Palm Plaza (SSQW), Campinas - SP, and Bandeirantes (SDBH), São Paulo - SP, an engine failure occurred in flight;

kk) the displacement of the aircraft was recorded by security cameras on SP-021 Highway, Km 7;

ll) analysis of the cameras’ footage allowed to discard hypotheses of failures that involved the controllability of the helicopter during the flight;

mm) the estimated ahead speed of the aircraft was of 60kt;

nn) the aircraft speed and descending profile were compatible with the autorotation procedure;

oo) there was a flat area at the top of the Rodoanel runways, compatible for landing on autorotation;

pp) the approach was made to the marginal lane of the Anhanguera Highway, between the two elevated lanes of the Rodoanel;

qq) during the landing attempt, the aircraft collided with a truck moving perpendicularly;

rr) the post-accident analysis concluded that the connection axis between the Gear Box and the tail rotor had rupture, due to overload applied to the material;

ss) the flexible blades presented different aspects between the side referring to the tail rotor and the side referring to the free wheel exit;

tt) the fractures found in the connection axis between the engine Gearbox and the tail rotor had different morphologies;

uu) the connection axis between the Gearbox and the tail rotor was spinning at the time of the collision with the truck;

vv) bearing nº 2 was locked and the ball separator fractured in several parts;

ww) the balls of bearing n° 2 showed abnormal wear and were oval;

xx) the fracture of this bearing occurred due to overload without any signs of fatigue in the material;

yy) bearing nº 2 failed due to insufficient flow of lubricating oil;

zz) the oil delivery tube was half the length of the oil passage duct for bearing No. 2, which was blocked;

aaa) the maintenance records contained in the Engine Logbook attest that the calendar interval for changing engine oil has been exceeded several times and for long periods of time;

bbb) the M250 - C20 Series Overhaul Manual provided that bearing nº 2 would be inspected and submitted to acceptance criteria during the Overhaul of the compressor module;

ccc) the upper and lower magnetic particle detectors (Magnetic Chip Detectors) had a significant amount of ferrous material, covered by an oily substance similar to gel;

ddd) the detectors' circuits were linked, that is, they were connected (electrical continuity);

eee) the composition of the ferrous material collected in the Magnetic Chip Detectors was consistent with the material of bearing n° 2;

fff) the two lamps referring to the Eng Chip indication had their filaments broken at the moment of impact;

ggg) all lamps in the Warning and Caution Lights panel showed deformation compatible with use, with no evidence of hot deformation;

hhh) the tasks described in the Engine Prestart Check procedure should be performed before all aircraft engine starts;

iii) the Engine Prestart Check prevised the check of the Warning and Caution Lights warning lights;

jjj) the aircraft could not take off if one of the lights was on, or if any of them were not operating;

kkk) the aircraft was destroyed; and

lll) the occupant of the truck left unharmed and the occupants of the helicopter suffered fatal injuries.

3.2 Contributing factors.

- **Control skills – undetermined.**

There may have been an inadequacy in the use of the controls, which may have caused the aircraft not to reach the chosen area during the autorotation, culminating with the attempt to land on the place where the accident occurred.

- **Attitude – a contributor.**

The conduct, by the operator, of the maintenance actions demonstrated that there was an attitude of non-observance of important procedures for the decision to perform a flight safely.

In addition, the pilot disregarded the terms described in the RBAC 135 related to the air taxi mode, according to which he could not take this type of flight.

- **Organizational culture – a contributor.**

The conduct presented at the company related to the use of the aircraft, as well as maintenance, reflected flaws in the organization's culture with regard to operational safety, since it was possible to observe a set of practices adopted that generated unacceptable risks for the execution of the activity.

- **Flight indiscipline – a contributor.**

The pilot-owner of the RQ *Serviços Aéreos Especializados* Ltd. performed a flight that went beyond the limits of the operator's authorization and for which he was not qualified.

In addition, the pilot-owner operated the aircraft with the TBO of the engine compressor module expired, which made it non-airworthy.

- **Piloting judgment – a contributor.**

There was an inadequate evaluation by the pilot of the parameters related to the operation of the aircraft during the execution of the autorotation and landing maneuver, which contributed to the outcome of the occurrence.

- **Aircraft maintenance – a contributor.**

The reinstallation of the compressor module with the expired TBO, as well as the subsequent release of the aircraft for return to service, showed inadequacy of the maintenance procedures performed by the OM.

Failure to comply with the maintenance program, particularly in relation to the calendar interval for changing the engine oil and reinstalling the compressor module with the expired TBO, demonstrated the non-adherence of the operator, who is primarily responsible for maintenance, in relation to the requirements of Continued Airworthiness, which contributed to this accident.

- **Motivation – undetermined.**

The financial return that the flight would bring to the company, in a time of shortage of contracted flights, may have motivated the pilot-owner to assume it, even though it was not certified for this.

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

The operational conditions in which the flight was performed, demonstrated that there was no critical analysis of the entire scenario involved, observing the possible risks and consequences inherent to the decision to execute it.

- **Organizational processes – a contributor.**

There was an inefficiency, both on the part of the operator and the maintenance organization, in monitoring and executing the maintenance processes.

The operator was aware of the fact that installing the compressor module without performing the overhaul, as well as exceeding the oil change intervals, contradicted the maintenance program provided for the aircraft engine, thus making it “not airworthy ”.

Likewise, the fact that the OM approved the return to service of the aircraft without proof of overhaul of the compressor module, contradicted the maintenance program previsto to the aircraft engine, since the helicopter would be “non-airworthy”.

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-030/CENIPA/2019 - 01 **Issued on 10/29/2020**

Disseminate the lessons learned in this investigation, in order to alert pilots and operators of the Brazilian civil aviation about the consequences resulting from the non-compliance with the established in the Maintenance Programs of the manufacturers or approved by the Civil Aviation Authority.

A-030/CENIPA/2019 - 02 **Issued on 10/29/2020**

Disseminate the lessons learned in the present investigation, in order to alert the Maintenance Organizations about the consequences resulting from the non-compliance with the Maintenance Programs established by the manufacturers or approved by the Civil Aviation Authority.

A-030/CENIPA/2019 - 03 **Issued on 10/29/2020**

Work with the WM *Helicópteros* (COM nº 0304-05 / ANAC), in order to ensure that the maintenance services performed by it, occur in full compliance with the provisions of the Maintenance Programs previsted by the manufacturers or approved by the Civil Aviation Authority.

A-030/CENIPA/2019 - 04 **Issued on 10/29/2020**

Operate with the Civil Aviation System, aiming to prevent irregular conduct of non-regular public air transport in the air taxi mode.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

Although this accident was not the reason that triggered the action by the ANAC, on 17APR2019, it was launched, through apps for mobile devices or electronic address, https://sistemas.anac.gov.br/ *voeseguro*/, the VOE SEGURO - air taxi. This tool provides information about authorized companies and aircraft able to provide air taxi services.

On October 29th, 2020.