COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-082/CENIPA/2020

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-OFI**
MODEL:	**BE 58**
DATE:	**08JUL2020**

This report replaces RF A-082/CENIPA/2020, dated August 15, 2023, previously published on the CENIPA website.

NOTICE

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

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

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

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

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

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

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

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

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

This report replaces RF A-082/CENIPA/2020, dated August 15, 2023, previously published on the CENIPA website.

SYNOPSIS

This is the Final Report of the 08 July 2020 accident with the BE-58 aircraft of registration marks PR-OFI. The accident was typified as “[SCF-PP] Engine failure or malfunction | In-flight engine failure”.

While conducting a ferry flight between the cities of Ubatuba and São Paulo, in the State of São Paulo, close to the “Itaquera” position of the REA-SP (Aircraft Special Route of São Paulo), the pilot informed that one of the aircraft engines had failed, and requested a single-engine approach to SBMT (Campo de Marte Aerodrome, São Paulo, SP).

While landing on runway 30 of SBMT, the pilot performed a go-around, but the aircraft did not gain enough height, and collided first with trees located just past the departure end of the runway, and then with the ground on a public road located a short distance ahead.

The aircraft was destroyed in the crash.

The pilot suffered fatal injuries.

An Accredited Representative of the NTSB (National Transportation Safety Board from the USA, State of aircraft manufacture) was appointed for participation in the investigation of the accident.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
ANP	Brazil's National Agency for Petroleum, Natural Gas and Biofuels
APP-SP	São Paulo Approach Control
ATIS	Automatic Terminal Information Service
CA	Airworthiness Certificate
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CIV	Pilot Individual Logbook
CMA	Aeronautical Medical Certificate
DCTA	Department of Science and Aerospace Technology
DECEA	Department of Aerospace Control
IAM	Annual Maintenance Inspection
IFRA	IFR Flight Rating (Airplane)
METAR	Meteorological Aerodrome Report
MLTE	Multi-Engine Land Class Airplane Rating
MNTE	Single-Engine Land Class Airplane Rating
NSCA	Command of Aeronautics' System Norm
NTSB	USA's National Transportation Safety Board
OM	Maintenance Organization
PCM	Commercial Pilot License – Airplane category
PN	Part Number
PPR	Private Pilot License - Airplane category
RBAC	Brazilian Civil Aviation Regulation
REA	Aircraft Special Routes
ROTAER	Air Routes Auxiliary Manual
SACI	Civil Aviation Information Integrated Center
SBGR	ICAO A/D designator - Governador André Franco Montoro Aerodrome, São Paulo, State of São Paulo (SP)
SBJD	ICAO A/D designator - Comandante Rolim Adolfo Amaro Aerodrome, Jundiaí, State of São Paulo (SP)
SBMT	ICAO A/D designator - Campo de Marte Aerodrome, São Paulo, SP
SDUB	ICAO A/D designator - Gastão Madeira State-Aerodrome, Ubatuba, SP
SIPAER	Brazil's Aeronautical Accidents Investigation and Prevention System
SN	Serial Number
TMA-SP	São Paulo Terminal Area
TWR-MT	Campo de Marte Control Tower
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** BE 58 **Registration:** PR-OFI **Manufacturer:** Beechcraft Aircraft.	**Operator:** Private
Occurrence	**Date/time**: 08JUL2020 – 21:09 UTC **Location:** SBMT (Campo de Marte Aerodrome. **Lat.** 23°30'26"S **Long.** 046°38'53"W **Municipality – State:** São Paulo, SP.	**Type(s):** [SCF-PP] Powerplant failure or malfunction.

1.1. History of the flight.

At around 19:50 UTC, the aircraft took off from SDUB (Gastão Madeira State-Aerodrome, Ubatuba, SP), bound for SBMT (Campo de Marte Aerodrome, São Paulo, SP), on a ferry flight with just the pilot on board.

Close to Itaquera position (along REA-SP), the pilot reported a failure in one of the engines, and requested a single-engine approach towards SBMT.

While landing on runway 30, the pilot decided to go around but the aircraft did not gain enough height, colliding first with trees located near the departure end of the runway and, subsequently, with the ground on a public road located at a short distance ahead.

The aircraft was destroyed, and the pilot suffered fatal injuries.

1.2. Injuries to persons.

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

1.3. Damage to the aircraft.

The aircraft was destroyed.

1.4. Other damage.

There was minor damage to the asphalt and median strip of Braz Leme Avenue, Santana neighborhood, São Paulo, SP.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Hours Flown	
	PIC
Total	984:17
Total in the last 30 days	00:00
Total in the last 24 hours	00:00
In this type of aircraft	54:54
In this type in the last 30 days	00:00
In this type in the last 24 hours	00:00

RMK: Both the aircraft logbook and the pilot's physical Logbook (CIV) were destroyed in the post-impact fire, making it impossible to verify the pilot's total flight hours. Part of the hours flown by him were obtained through the records of his digital CIV of the Civil Aviation Information Integrated System (SACI), but the information was out of date.

By means of data provided by TWR-MT (Campo de Marte Control Tower), it was verified that there were other flight plans filed by the pilot for the same aircraft after May 2020, the month of the last record logged in his digital CIV.

1.5.2. Personnel training.

The PIC (Pilot in Command) did his PPR course (Private Pilot – Airplane) in 2010, at Aeroclube de São Paulo, SP.

1.5.3. Category of licenses and validity of certificates.

The pilot held a PCM license (Commercial Pilot – Airplane), and valid ratings for MNTE (Single-Engine Land Airplane), MLTE (Multi-Engine Land Airplane), and IFRA (IFR Flight - Airplane).

1.5.4. Qualification and flight experience.

Although the PIC's digital CIV was out of date, it was possible to confirm by means of TWR-MT records, that the pilot flew the accident aircraft in the months of May, June, and July, attesting his recent experience in multi-engine airplanes, something that made him qualified and experienced for the conduction of the type of flight.

1.5.5. Validity of medical certificate.

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

1.6. Aircraft information.

The SN TH-607 airplane was a product manufactured in 1975 by Beechcraft Aircraft in the USA, and registered in the Private Air Services Registration Category (TPP).

The aircraft's CA (Airworthiness Certificate) was valid.

The airframe, engine, and propeller logbooks were out of date, and one found that the last Part-I entry had been logged in October 2019.

On account of the post-impact fire, it was not possible to consult the aircraft logbook. However, based on the maintenance records logged in the pertinent logbooks, one estimates that the aircraft had approximately 10,307 flight hours in total.

The last inspection of the aircraft ("Annual Maintenance Inspection" type) was carried out on 14 November 2019 by MTX Aviation Importação de Aeronaves Ltda. Maintenance Organization (Certificate COM no. 1306-41/ANAC). The aircraft flew approximately 9 hours after the said inspection.

In 2017, as per the Service Order no. 986/17, the engines (PN IO-550C-3F, SN 685166 and SN 685165) were removed by MTX Aviation Importação de Aeronaves Ltda. Maintenance Organization for overhauling. At the time, the aircraft had a total flight time of 10,221 hours and 54 minutes.

On 24 October 2017, both engines (left - SN 685.165 and right - SN 685.166) were sent to JL Motores Aeronáuticos Ltda. Maintenance Organization, (Certificate COM no. 0805-41/ANAC), for a comprehensive overhaul (according to SEGVOO 003 extracts, certificates no. JL 294/2017 and JL 295/2017, detailed below).

1.País (County)	2. AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL (BRAZILIAN CIVIL AVIATION AUTHORITY)				3.Certificado nº (Certificate nº/System Tracking Ref.)
BRASIL	CERTIFICADO DE LIBERAÇÃO AUTORIZADA (AUTORIZED RELEASE CERTIFICATE) ETIQUETA DE APROVAÇÃO DE AERONAVEGABILIDADE (AIRWORTHINESS APPROVAL TAG) Formulário (Form) F-100-1 SEGVÔO 003				JL 294/2017
4.Empresa (Organization)	JL Motores Aeronáuticos Ltda - ME Rua Alcidália dos Santos, 90 – Jd. Ferreira - Sorocaba-SP - CEP18080-620 Tel.: (15) 3418-2528 jlmotores@terra.com.br				5.Ordem de Serviço/Contrato/Nota (Work Order/Contract of Invoice) OS 274/17
6.Item (Item)	7.Descrição (Description)	8.Número da Peça (Part Number)	9.Quantidade (Quantity)	10.Número de Série/Lote (Serial/Batch Number)	11.Categoria/Trabalho (Status/Work)
01	MOTOR	IO-550C(3F)	01	685.165	REVISÃO GERAL

1.País (County)	2. AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL (BRAZILIAN CIVIL AVIATION AUTHORITY)				3.Certificado nº (Certificate nº/System Tracking Ref.)
BRASIL	CERTIFICADO DE LIBERAÇÃO AUTORIZADA (AUTORIZED RELEASE CERTIFICATE) ETIQUETA DE APROVAÇÃO DE AERONAVEGABILIDADE (AIRWORTHINESS APPROVAL TAG) Formulário (Form) F-100-1 SEGVÔO 003				JL 295/2017
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6.Item (Item)	7.Descrição (Description)	8.Número da Peça (Part Number)	9.Quantidade (Quantity)	10.Número de Série/Lote (Serial/Batch Number)	11.Categoria/Trabalho (Status/Work)
01	MOTOR	IO-550C(3F)	01	685.166	REVISÃO GERAL

Figure 1 – Extracts of the SEGVOO 003 forms issued for the PR-OFI's engines.

Thus, the engines had approximately 86 hours of operation after the overhaul. Relatively to the number of hours logged after the overhaul, it is worth noting that there was a time interval of around 33 months between the date of service completion and the date of the occurrence.

1.7. Meteorological information.

The SBMT Aerodrome Routine Meteorological Reports (METAR) contained the following information:

METAR SBMT 082100Z 30008KT CAVOK 10/25 Q1014=

METAR SBMT 082200Z 29005KT CAVOK 11/24 Q1015=

According to the meteorological information shown above, the conditions were favorable for VFR flights, with visibility greater than 10 km, wind speed between 5 and 8 kt., and direction varying between 290º and 300º.

According to the SBMT ATIS information "MIKE", issued at 21:00 UTC, the wind direction was 320°, with an intensity of 11 kt., and gusts of up to 27 kt.

Upon being handed over to the TWR-MT frequency, the PR-OFI airplane was informed that the wind was 320° at 9 kt. Nonetheless, the pilot was advised to be aware of the possibility of gusts up to 27 kt.

After the pilot acknowledged the message, TWR-MT corrected the information ("gusts up to 10 kt").

1.8. Aids to navigation.

NIL.

1.9. Communications.

According to the transcripts of the audios of communication between the PR-OFI airplane and the ATC agencies, the pilot maintained radio contact with APP-SP (São Paulo Approach Control) and with TWR-MT all the way through the flight without any technical abnormalities.

In order to support the analysis of the sequence of events that preceded the attempt to land the aircraft, the Investigation Committee highlighted a number of transmissions that can help to understand the dynamics of the accident. The time reference used is UTC (Universal Time Coordinated).

- At 20:48:03, the PR-OFI airplane made the initial call to APP-SP.

- At 21:00:07, the pilot informed APP-SP that the PR-OFI airplane had an engine fire, and would proceed on a single-engine flight to SBMT.

- After that, the PR-OFI pilot was enquired about the number of persons on board, presence of dangerous goods, and amount of remaining fuel.

- The pilot answered that the aircraft had only one person on board, and three quarters of fuel remaining in the tanks.

- At 21:07:52, the PR-OFI pilot made an initial call to TWR-MT.

- The control tower informed that the aircraft was cleared to land on runway 30, with a surface wind of 320° at 9 kt. The pilot was advised to be aware of gusts up to 27 kt. Shortly later, the controller rectified the information by saying that the wind at the moment had gusts of up to 10 kt. at the maximum.

-The pilot acknowledged the information.

- At 21:09:49, the PR-OFI airplane reported initiating a go-around.

- At 21:09:51, TWR-MT asked the PR-OFI pilot to which side the aircraft would turn.

- At 21:09:57, the PR-OFI pilot made the last transmission, informing that the aircraft would turn to the left.

At no time, during the exchange of messages, did the pilot declare a distress or urgency situation, just stating that he had “fire in the engine”.

1.10. Aerodrome information.

SBMT was a public/military aerodrome under INFRAERO administration, operating VFR during day- and night-time.

The asphalt-sealed runway measured 1,600 m x 45 m, with thresholds 12/30, at an elevation of 2,371 ft.

1.11. Flight recorders.

Neither required nor installed.

1.12. Wreckage and impact information.

The aircraft came to a complete stop on Braz Leme Avenue, at a distance of 550 m away from the departure end of the runway 30. The first impact of the aircraft was against high vegetation in the overshoot area.

The distribution of the wreckage was concentrated and, due to its characteristics, the impact occurred with low forward speed.

Figure 2 – Aerial image of Runway 12 threshold (i.e. departure end of rwy 30) and vegetation where the first impact occurred.

Figure 3 – Aerial image of the aircraft trajectory.

The collision was witnessed by the TWR-MT operator and by pilots of another aircraft that was awaiting at the take-off holding point short of runway 30.

At the analysis of the wreckage, it was possible to observe that the cylinder number 5 of the right-hand engine was lying approximately 10 m away from the aircraft wreckage.

From the position of the right-hand engine propeller (feathered), and from the evidence found by the Investigation Committee, there were indications that the right-hand engine was not operating (motionless) at the moment of impact, as informed by the pilot.

Figure 4 – Aircraft wreckage in the crash site.

Figure 5 – Detail of the right-hand engine without the cylinder number 5.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

The autopsy report, as well as earlier health inspections, were analyzed, showing no evidence that issues of physiological or incapacitating nature might have affected the pilot's performance.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

The PIC had a 10-year experience as a pilot, and, according to his wife, flying was his childhood dream that had come true after his retirement as a salesman. Furthermore, the pilot's father was also involved with the aviation activity.

Besides flying airplanes, the PIC also worked as an aeronautical dispatcher (in his own enterprise). His first contact with the owner of the accident airplane took place while he was working as a dispatcher. He was later hired by the owner of the airplane for the position of aircraft captain.

The pilot was described by members of his family as a very communicative, helpful and solicitous person. In professional terms, he was seen as a responsible and interested individual, with conservative attitudes when it came to flight safety, someone who was attentive to the legislation requirements.

His wife stated that he was enjoying a happy moment in life. They had been married for twenty-three years, and had two children. Their family relationship was harmonious and pleasant.

She also said that, for her husband, having been commissioned for the first time as a captain was a matter of great pride and satisfaction.

Before becoming a captain, the pilot had flown for three other air-taxi companies as a copilot.

In those companies, according to reports, he worked without formal employment bonds. In 2019, after being recommended by a friend, he was hired to fly as a captain of the PR-OFI airplane.

The relationship between the pilot and the owner of the airplane was described by the latter as very pleasant and straightforward. The pilot had stayed as a guest at the airplane owner's house a few times after the flights, and was admired by him, who valued the pilot's dedication and proactivity.

The PIC's wife reported that on the day of the occurrence she found it strange that he had left in the morning without his suitcase and, upon questioning him, received the answer that he believed he would not fly that day, as the plane had presented a strange noise in the left-hand engine. At around noon, the pilot returned home to get his suitcase, and told her that he was going to fly, since the failure in the left engine had been fixed while the aircraft was still in SBMT.

At an interview, the owner of the aircraft stated that, on the day of the occurrence, he spoke with the pilot by telephone, and was informed about an abnormal noise in the left-hand engine. The pilot told him that he would request a mechanic to verify the problem. Later on that day, the pilot got in touch again saying that the problem had been fixed, and that the flight would take place.

After the first leg of the flight, in which the owner was transported to Ubatuba, the pilot requested to return to spend the night in São Paulo, on account of his wedding anniversary. The request was granted, and the pilot returned alone to SBMT, where the accident occurred.

1.14. Fire.

The aircraft caught fire after the impact with the ground. The fire was controlled and extinguished by the fire-fighting team of SBMT.

1.15. Survival aspects.

The only occupant of the aircraft perished in the crash.

1.16. Tests and research.

At SBMT, the Investigation Committee collected gasoline samples from the truck which had refueled the aircraft on the day of the accident.

Those samples of fuel were sent for physicochemical tests, and were in accordance with the Norm n° 5 of the National Agency for Petroleum, Natural Gas and Biofuels (ANP), dated 03 February 2009. The results showed no signs of contamination.

The Investigation Committee conducted the analysis of the Continental IO-550C-3F left- and right-hand engines (SN 685166 and SN 685165, respectively).

Relatively to the left-hand engine (SN 685166), the analysis showed that it had been functioning normally and developing power at the moment of impact with the ground.

In relation to the right-hand engine (SN 685165), during the preliminary verification of the wreckage, one found that the cylinder no. 5 had separated from the engine assembly and was found approximately 10 meters away from the airplane. Pieces of the crankcase studs of the cylinder number 5 were found in the lower cowling of the engine, as shown in Figure 6, and were segregated for analysis.

Figure 6 – Image of fragments of studs and nuts of the right engine.

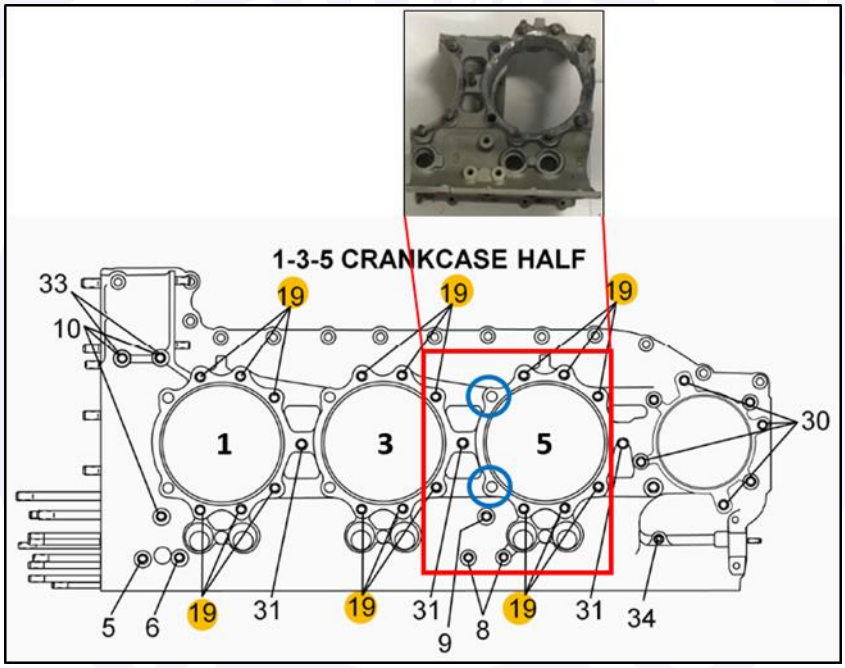


Figura 7 – Image of the right section of the PR-OFI's right engine's semi-crankcase, with the corresponding drawing extracted from the manual. Yellow highlights indicate the fixed studs .44-14 X .44-20, PN 646140-1. The blue circles show the position of the through-bolts .50-20 X 10.75, PN 641931-10.75, at the level of cylinder n° 5.

The analysis of this material revealed that one of the fractured studs, PN 646140-1, showed a fractured surface perpendicular to the longitudinal axis (Item I in Figure 8), with typical characteristics of fatigue failure (Item II in Figure 8).

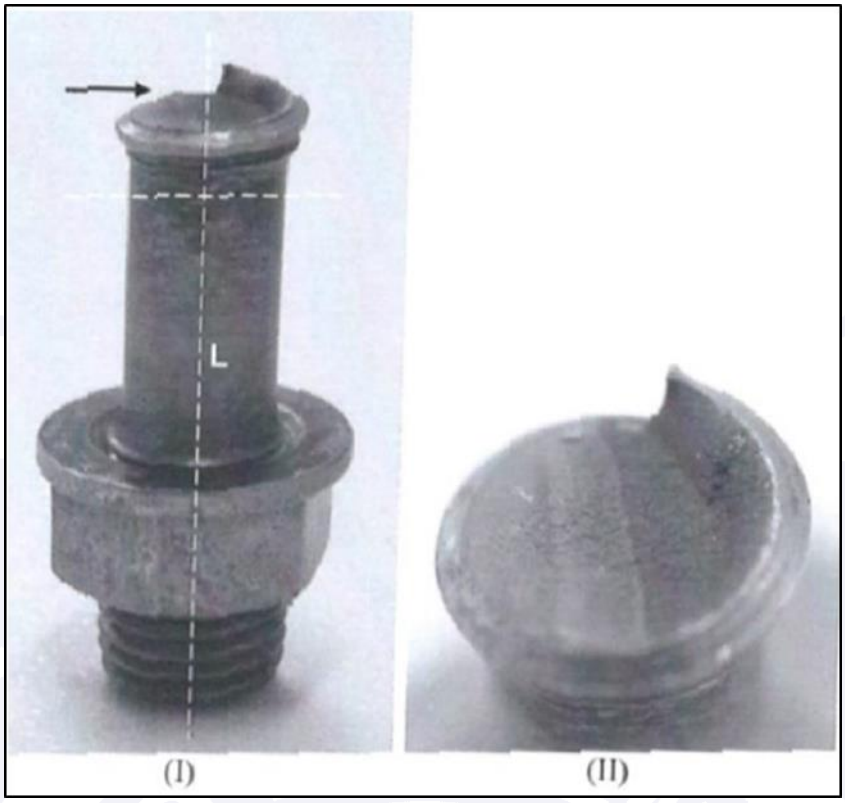


Figure 8 - Image extracted from the analysis of the right engine's stud.

Additionally in the region where the bolt fracture began, grooves were found on the thread similar to those resulting from a material removal process in the form of chips. However, it was not possible to determine how these characteristics may have formed in that region (Figure 9)

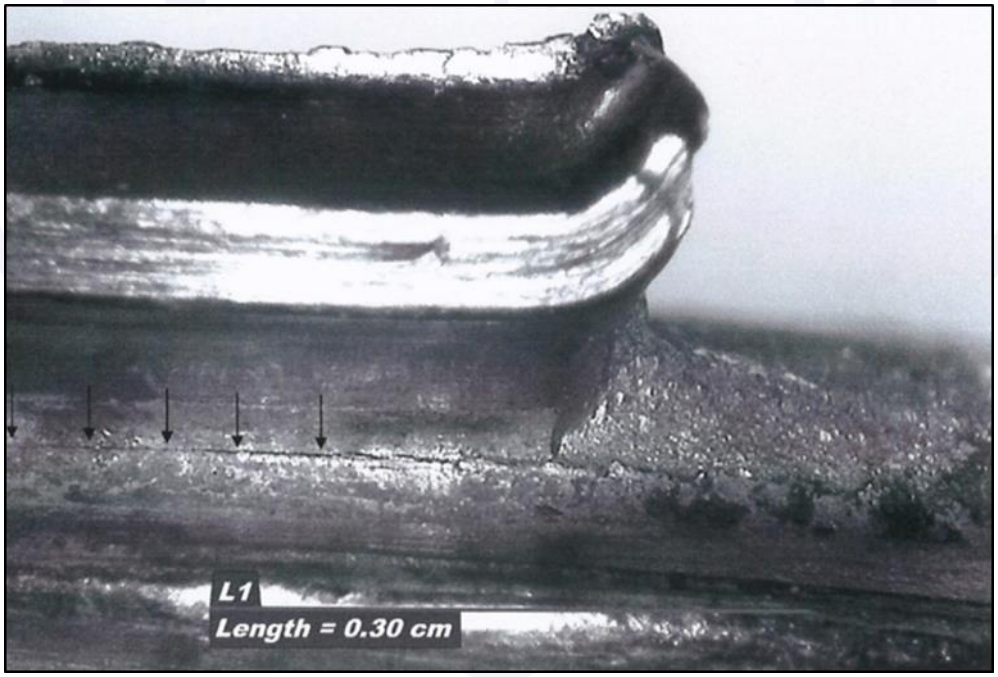
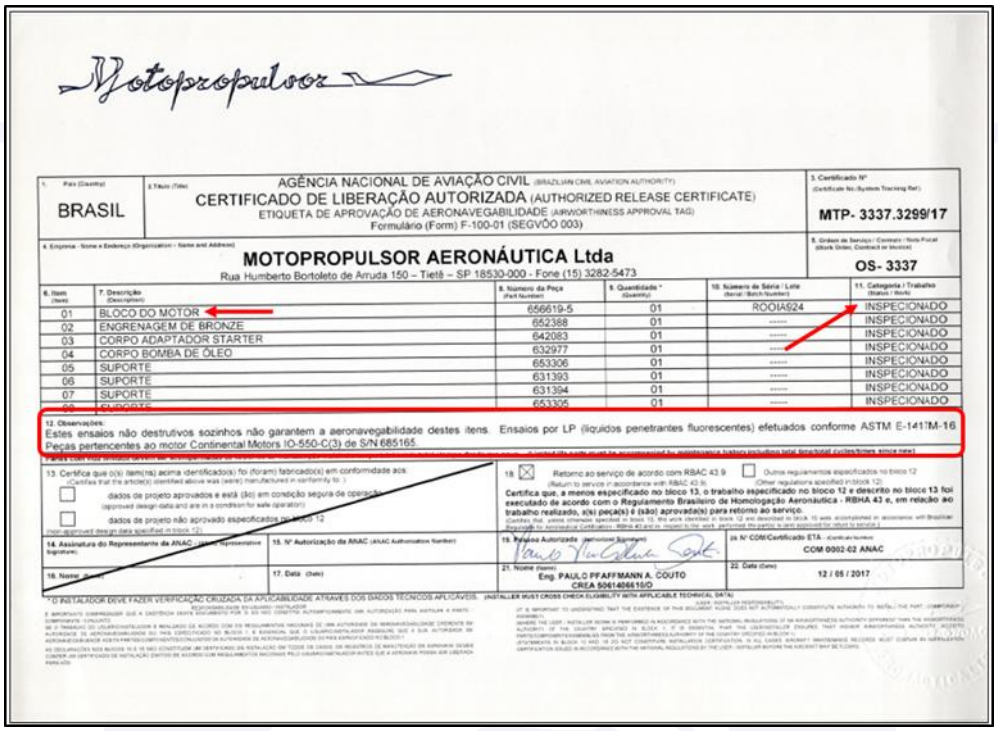


Figure 9 – Detail of the groove with characteristics of material removal in the form of chips at the root of the thread on the same plane as the crack (black arrows).

These engine block studs (PN 646140-1) in the region of each cylinder, including cylinder number 5, were items whose removal was not required during the general overhaul, and they underwent non-destructive testing along with the engine block.

The JL Motores maintenance organization presented the SEGVOO 003, Authorized Release Certificate n° MTP-3337.3299/17, containing the information that the right engine block had undergone non-destructive testing and was approved for return to service, as shown in Figure 10.



Motopropulsor

AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL (BRAZILIAN CIVIL AVIATION AUTHORITY)

BRASIL

CERTIFICADO DE LIBERAÇÃO AUTORIZADA (AUTHORIZED RELEASE CERTIFICATE)

ETIQUETA DE APROVAÇÃO DE AERONAVEGABILIDADE (AIRWORTHINESS APPROVAL TAG)

Formulário (Form) F-100-01 (SEGVOO 003)

MTP- 3337.3299/17

MOTOPROPULSOR AERONÁUTICA Ltda

Rua Humberto Bortoleto de Arruda 150 – Tietê – SP 18530-000 - Fone (15) 3282-5473

OS- 3337

6. Item	7. Descrição	8. Número da Peça	9. Quantidade	10. Número de Série / Lote	11. Categoria / Trabalho
01	BLOCO DO MOTOR	656619-5	01	ROOIA624	INSPECIONADO
02	ENGRENAGEM DE BRONZE	652388	01	-----	INSPECIONADO
03	CORPO ADAPTADOR STARTER	642083	01	-----	INSPECIONADO
04	CORPO BOMBA DE ÓLEO	632977	01	-----	INSPECIONADO
05	SUPORTE	653306	01	-----	INSPECIONADO
06	SUPORTE	631393	01	-----	INSPECIONADO
07	SUPORTE	631394	01	-----	INSPECIONADO
08	SUPORTE	653305	01	-----	INSPECIONADO

12. Observações:
Estes ensaios não destrutivos sozinhos não garantem a aeronavegabilidade destes itens. Ensaios por LP (líquidos penetrantes fluorescentes) efetuados conforme ASTM E-1417M-16
Peças pertencentes ao motor Continental Motors IO-550-C(3) de S/N 685165.

13. Certifica que o(s) item(ns) acima identificado(s) foi (foram) fabricado(s) em conformidade aos:
(Certifies that the article(s) identified above was (were) manufactured in conformity to:)
☐ dados de projeto aprovados e está (ão) em condição segura de operação
(approved design data and are in a condition for safe operation)
☐ dados de projeto não aprovado especificados no bloco 12
(non-approved design data specified in block 12)

18. ☒ Retorno ao serviço de acordo com RBAC 43.9 ☐ Outros requerimentos especificados no bloco 12
(Return to service in accordance with RBAC 43.9) (Other regulatory specified in block 12)
Certifica que, a menos especificado no bloco 13, o trabalho especificado no bloco 12 e descrito no bloco 13 foi executado de acordo com o Regulamento Brasileiro de Homologação Aeronáutica - RBHA 43 e, em relação ao trabalho realizado, a(s) peça(s) é (são) aprovada(s) para retorno ao serviço.

14. Assinatura do Representante da ANAC (ANAC Representative signature):
15. Nº Autorização da ANAC (ANAC Authorization Number):
19. Pessoa Autorizada (Authorized Signature):
20. Nº CGH/Certificado ETA (Certificate Number): CGH 0002-02 ANAC
16. Nome (Name):
17. Data (Date):
21. Nome (Name): Eng. PAULO PFAFFMANN A. COUTO CREA 5061406610/D
22. Data (Date): 12 / 05 / 2017

*O INSTALADOR DEVE FAZER VERIFICAÇÃO CRUZADA DA APLICABILIDADE ATRAVÉS DOS DADOS TÉCNICOS APLICÁVEIS. (INSTALLER MUST CROSS CHECK ELIGIBILITY WITH APPLICABLE TECHNICAL DATA)

Figure 10 - SEGVOO 003 approving the right engine block for return to service.

Additionally, as a result of the analysis of this engine, it was found that the through-bolts securing cylinder number 5 (Crankcase Through Bolts .50-20 X 10.75, PN 641931-10.75) also experienced fatigue failure (Figure 11). Consequently, the nuts on the other studs on this cylinder became overloaded and fractured. This allowed the cylinder to detach, resulting in engine stoppage.

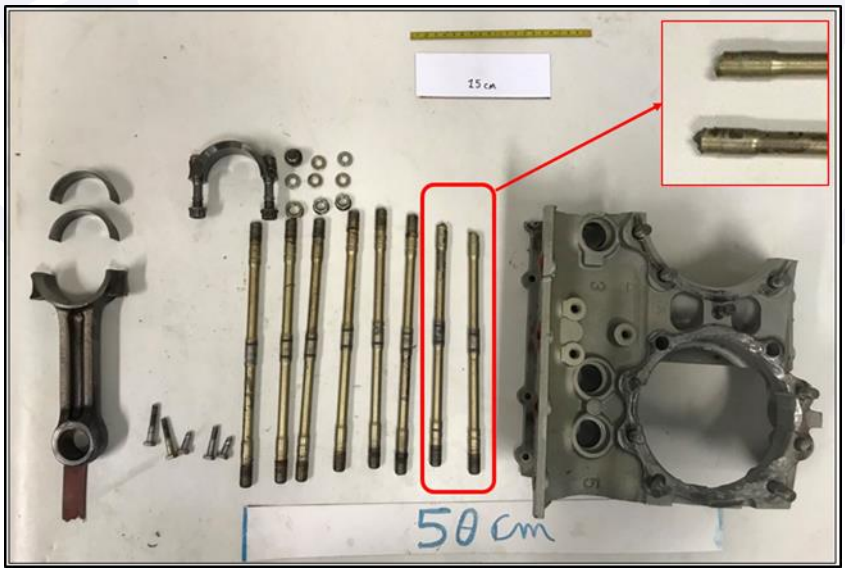


Figure 11 – Parts of the right engine during analysis, highlighting two fractured crankcase through-bolts.

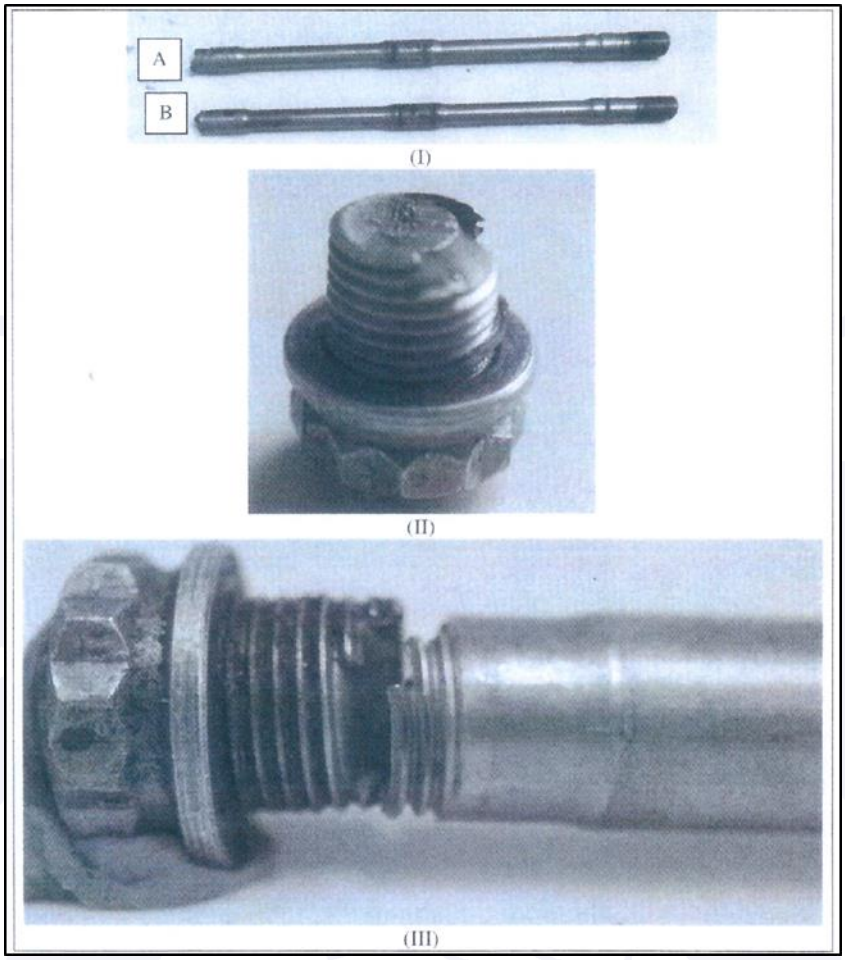


Figure 12 – Image detailing the fractured crankcase through-bolts. The details (II) and (III) pertain to bolt A.

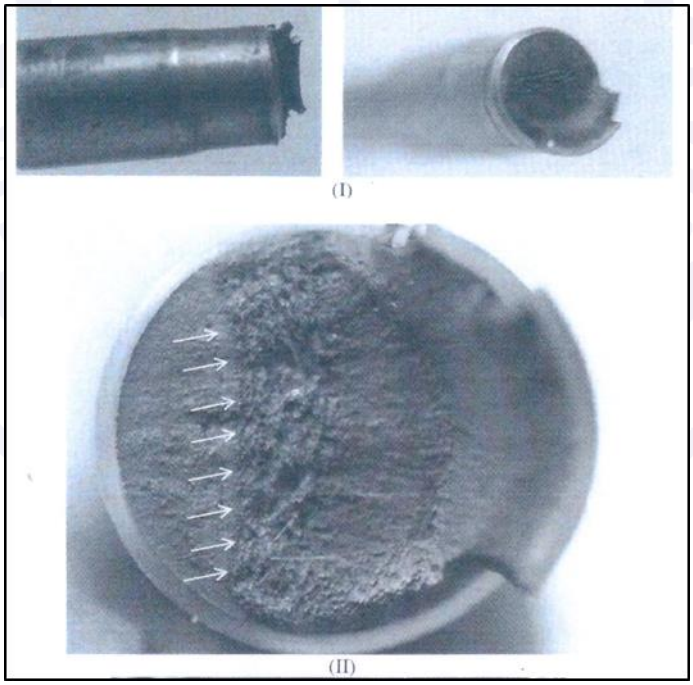


Figure 13 - Image detailing the fracture of the long end of the through-bolt A. in detail (II), under stereoscopy, the white arrows indicate beach marks characteristic of material fatigue fracture.

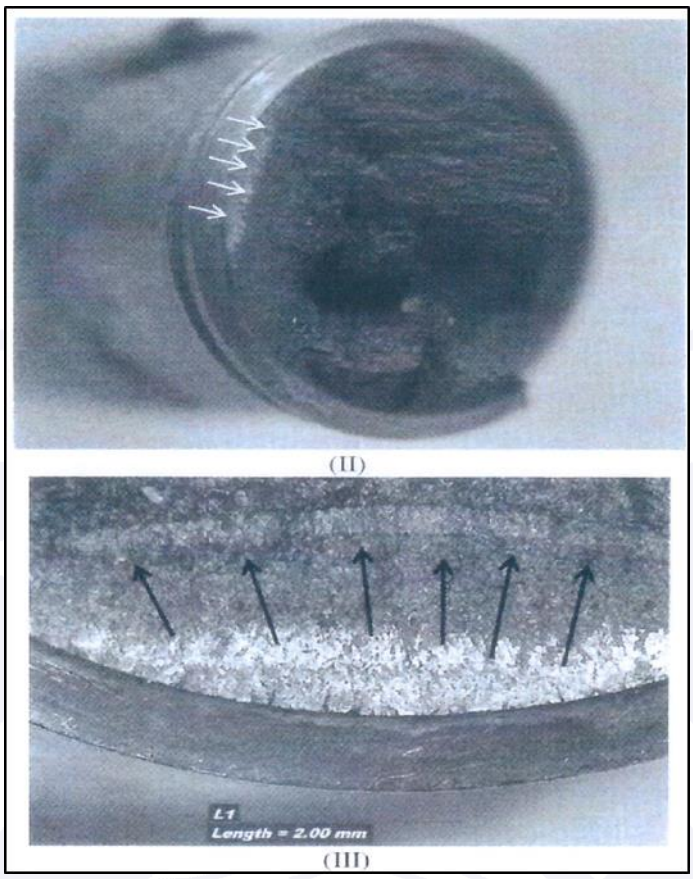
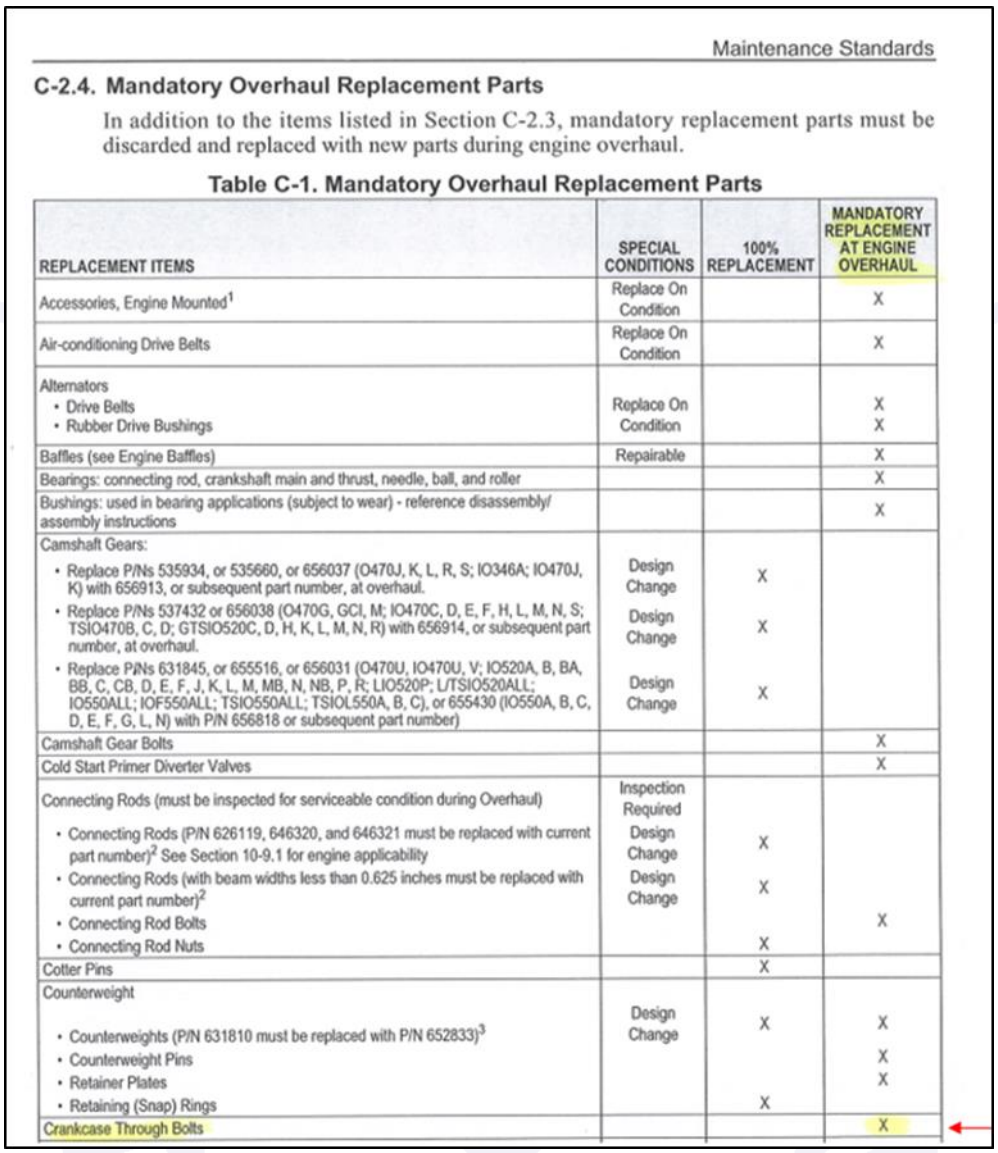


Figure 14 - Image detailing the fracture of the end of through-bolt B.
In detail (II), under stereoscopy, the arrows indicate beach marks characteristic of material fatigue fracture. In detail (III), the fracture surface is magnified.

The Investigation Committee obtained access to the engine documentation related to the maintenance services performed in 2017, as well as the maintenance manuals from Teledyne Continental Motors.

The Mandatory Overhaul Replacement Parts section of the maintenance manual specified the replacement of the Crankcase through Bolts as mandatory items during the General Overhaul (Mandatory Replacement at Engine Overhaul).



Maintenance Standards

C-2.4. Mandatory Overhaul Replacement Parts

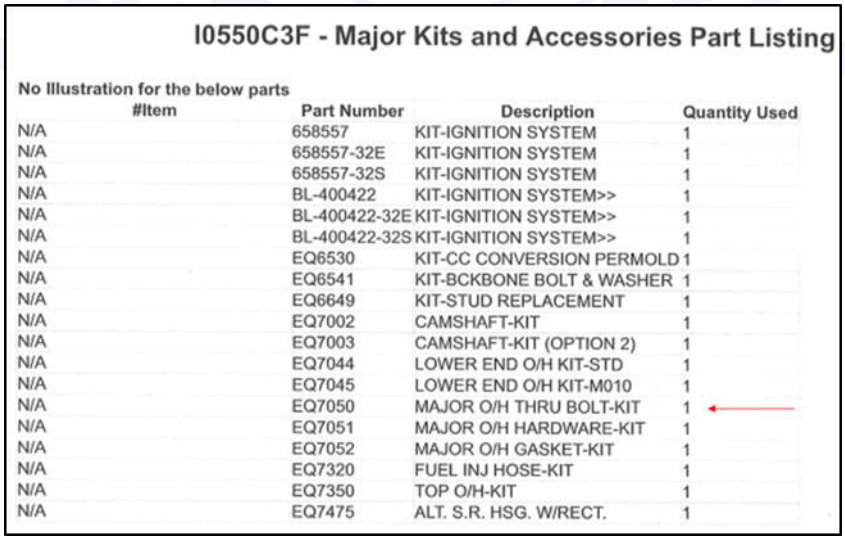
In addition to the items listed in Section C-2.3, mandatory replacement parts must be discarded and replaced with new parts during engine overhaul.

Table C-1. Mandatory Overhaul Replacement Parts

REPLACEMENT ITEMS	SPECIAL CONDITIONS	100% REPLACEMENT	MANDATORY REPLACEMENT AT ENGINE OVERHAUL
Accessories, Engine Mounted[1]	Replace On Condition		X
Air-conditioning Drive Belts	Replace On Condition		X
Alternators • Drive Belts • Rubber Drive Bushings	Replace On Condition		X X
Baffles (see Engine Baffles)	Repairable		X
Bearings: connecting rod, crankshaft main and thrust, needle, ball, and roller			X
Bushings: used in bearing applications (subject to wear) - reference disassembly/ assembly instructions			X
Camshaft Gears: • Replace P/Ns 535934, or 535660, or 656037 (O470J, K, L, R, S; IO346A; IO470J, K) with 656913, or subsequent part number, at overhaul. • Replace P/Ns 537432 or 656038 (O470G, GCI, M; IO470C, D, E, F, H, L, M, N, S; TSIO470B, C, D; GTSIO520C, D, H, K, L, M, N, R) with 656914, or subsequent part number, at overhaul. • Replace P/Ns 631845, or 655516, or 656031 (O470U, IO470U, V; IO520A, B, BA, BB, C, CB, D, E, F, J, K, L, M, MB, N, NB, P, R; LIO520P; LTSIO520ALL; IO550ALL; IOF550ALL; TSIO550ALL; TSIOL550A, B, C), or 655430 (IO550A, B, C, D, E, F, G, L, N) with P/N 656818 or subsequent part number)	Design Change Design Change Design Change	X X X	
Camshaft Gear Bolts			X
Cold Start Primer Diverter Valves			X
Connecting Rods (must be inspected for serviceable condition during Overhaul) • Connecting Rods (P/N 626119, 646320, and 646321 must be replaced with current part number)[2] See Section 10-9.1 for engine applicability • Connecting Rods (with beam widths less than 0.625 inches must be replaced with current part number)[2] • Connecting Rod Bolts • Connecting Rod Nuts	Inspection Required Design Change Design Change	 X X X	 X
Cotter Pins		X	
Counterweight • Counterweights (P/N 631810 must be replaced with P/N 652833)[3] • Counterweight Pins • Retainer Plates • Retaining (Snap) Rings	Design Change	X X	X X X
Crankcase Through Bolts			X

Figure 15 – Image from the Teledyne Continental Motors maintenance manual.

As shown in Figure 16, each engine should use a bolt kit (PN EQ7050 – MAJOR O/H THRU BOLT – KIT) which included the PN 641931-10.75 through-bolts as a Mandatory Replacement at Engine Overhaul.



I0550C3F - Major Kits and Accessories Part Listing

No Illustration for the below parts

#Item	Part Number	Description	Quantity Used
N/A	658557	KIT-IGNITION SYSTEM	1
N/A	658557-32E	KIT-IGNITION SYSTEM	1
N/A	658557-32S	KIT-IGNITION SYSTEM	1
N/A	BL-400422	KIT-IGNITION SYSTEM>>	1
N/A	BL-400422-32E	KIT-IGNITION SYSTEM>>	1
N/A	BL-400422-32S	KIT-IGNITION SYSTEM>>	1
N/A	EQ6530	KIT-CC CONVERSION PERMOLD	1
N/A	EQ6541	KIT-BCKBONE BOLT & WASHER	1
N/A	EQ6649	KIT-STUD REPLACEMENT	1
N/A	EQ7002	CAMSHAFT-KIT	1
N/A	EQ7003	CAMSHAFT-KIT (OPTION 2)	1
N/A	EQ7044	LOWER END O/H KIT-STD	1
N/A	EQ7045	LOWER END O/H KIT-M010	1
N/A	EQ7050	MAJOR O/H THRU BOLT-KIT	1
N/A	EQ7051	MAJOR O/H HARDWARE-KIT	1
N/A	EQ7052	MAJOR O/H GASKET-KIT	1
N/A	EQ7320	FUEL INJ HOSE-KIT	1
N/A	EQ7350	TOP O/H-KIT	1
N/A	EQ7475	ALT. S.R. HSG. W/RECT.	1

Figure 16 – Image from the Teledyne Continental Motors maintenance manual.

The Investigation Committee did not have access to records proving traceability of the MAJOR O/H THRU BOLT kit installed in the engines, making it impossible to verify whether the fatigued item was indeed replaced, as required by the Mandatory Overhaul Replacement Parts section of the maintenance manual.

1.17. Organizational and management information.

NIL.

1.18. Operational information.

The aircraft was performing a ferry flight back to SBMT after transporting a passenger between the cities of São Paulo and Ubatuba.

The aircraft took off at 19:50 UTC. The flight plan indicated SBJD (Comandante Rolim Adolfo Amaro aerodrome, Jundiaí, SP) as the alternate aerodrome.

During the cruise flight along the VFR corridors, and close to Itaquera position, the pilot called APP-SP to report that one of the engines was on fire.

The pilot maintained a single-engine cruise flight from Itaquera position up to SBMT.

Itaquera position was at a distance of 6.7 NM away from SBGR (Governador André Franco Montoro Aerodrome, Guarulhos, SP), which had two runways, one of which measured 3,700 m x 45 m, whereas the other measured 3,000 m x 45 m.

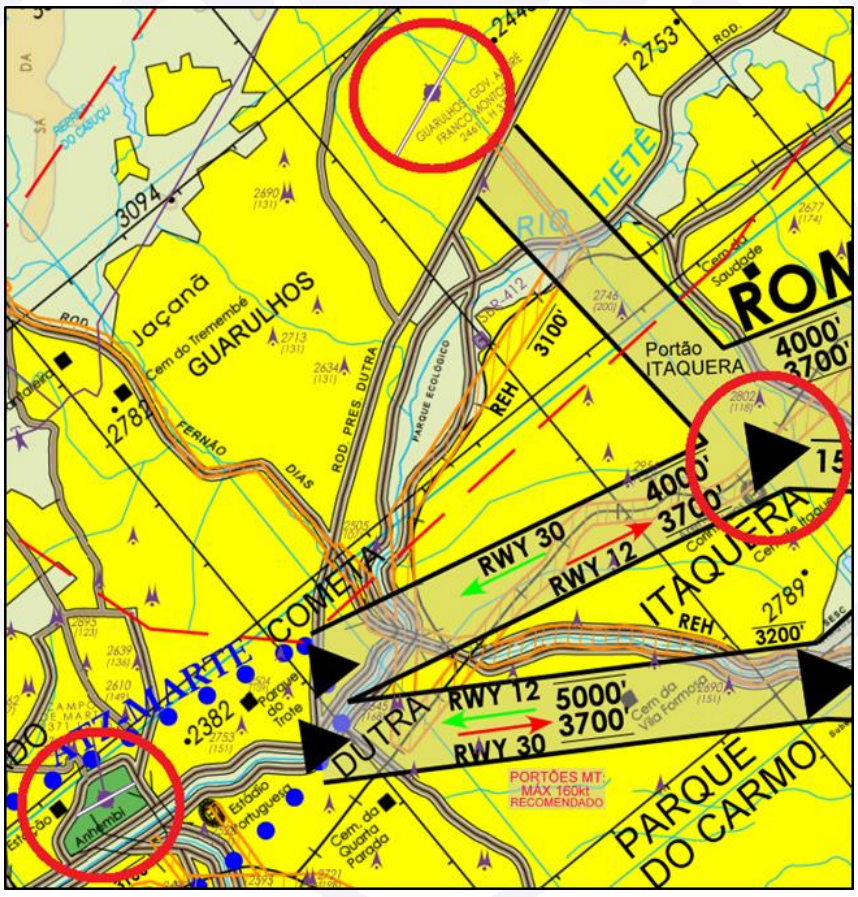


Figure 17 - REA TMA-SP 2 with Itaquera, SBMT, and SBGR positions.

In accordance with the ROTAER, SBGR could not be used as a diversion option by fixed-wing aircraft flying VFR.

Relatively to that aspect, the Section 91.3 of the RBAC-91 defined the following requirements in the case of an in-flight emergency:

91.3 Responsibility and authority of the pilot in command

(a) The pilot-in-command of an aircraft has ultimate authority and responsibility for the operation and safety of the flight.

(b) In an emergency requiring immediate action, the pilot-in-command is allowed to deviate from any requirement of this Regulation to the extent required to deal with the emergency.

(c) Each pilot-in-command who deviates from a requirement pursuant to paragraph (b) of this section must log the occurrence in the aircraft logbook, and send a written report to the ANAC describing and justifying such deviation.

(d) The report dealt with in paragraph (c) of this section must be forwarded to the ANAC within a maximum period of 20 (twenty) working days from the occurrence, unless a different period is required or authorized by the ANAC.

In the images of SBMT forwarded to the Investigation Committee, it was possible to observe the approach of the aircraft, which touched the runway three times and, after that, started a go-around. After gaining a few meters in altitude, the aircraft remained in level flight, close to the runway, and then lost altitude, colliding with vegetation located past the departure end of runway 30.

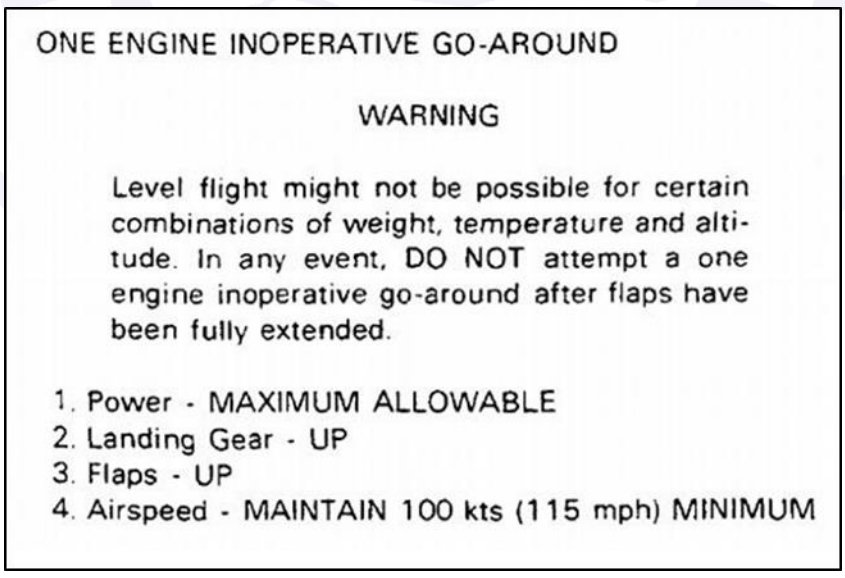
From accounts made by observers located in the control tower (TWR-MT), and by pilots who were awaiting at the holding point of the runway 30 threshold, the aircraft approached at a speed that seemed higher than usual. According to the manufacturer's manual, the recommended speed on the final approach was 90 kt.

The analysis of the images also revealed that the aircraft initiated the go-around procedure roughly at the mid-point of the runway.

After the impact with the vegetation, the airplane no longer kept flying, and crashed into the asphalt-paved surface of Braz Leme Avenue, located about 60 m ahead of the point where it had impacted the trees.

Due to the low degree of lighting at the time of the video recordings, it was not possible to determine the flap settings of the airplane during the approach and go-around.

The go-around procedure with failure in one of the engines (recommended in the Pilot Operation Handbook - POH - of the aircraft) is depicted in Figure 18.


ONE ENGINE INOPERATIVE GO-AROUND

WARNING

Level flight might not be possible for certain combinations of weight, temperature and altitude. In any event, DO NOT attempt a one engine inoperative go-around after flaps have been fully extended.

1. Power - MAXIMUM ALLOWABLE
2. Landing Gear - UP
3. Flaps - UP
4. Airspeed - MAINTAIN 100 kts (115 mph) MINIMUM

Figure 18 –Procedure for ONE ENGINE INOPERATIVE GO-AROUND.
Source: Aircraft POH.

According to the manufacturer's manual, the aircraft would be capable of performing a single-engine go-around, depending on the conditions of weight, temperature, and elevation of the aerodrome. Furthermore, it emphasized that a go-around should not be attempted with the flaps fully lowered.

From the analysis of the communications exchange between APP-SP and the pilot, one found that, shortly before the accident, the aircraft had approximately three quarters (¾) of fuel in the tanks. The temperature at the aerodrome was 25°C, and the aerodrome elevation was 2,371 ft.

Thus, analyzing the Takeoff Climb Gradient - One Engine Inoperative diagram (Section V of the aircraft POH), and estimating an aircraft weight of approximately 5,000 pounds (2,267 kg.), one would obtain a gradient of 3%, according to the projection of the graph in Figure 19.

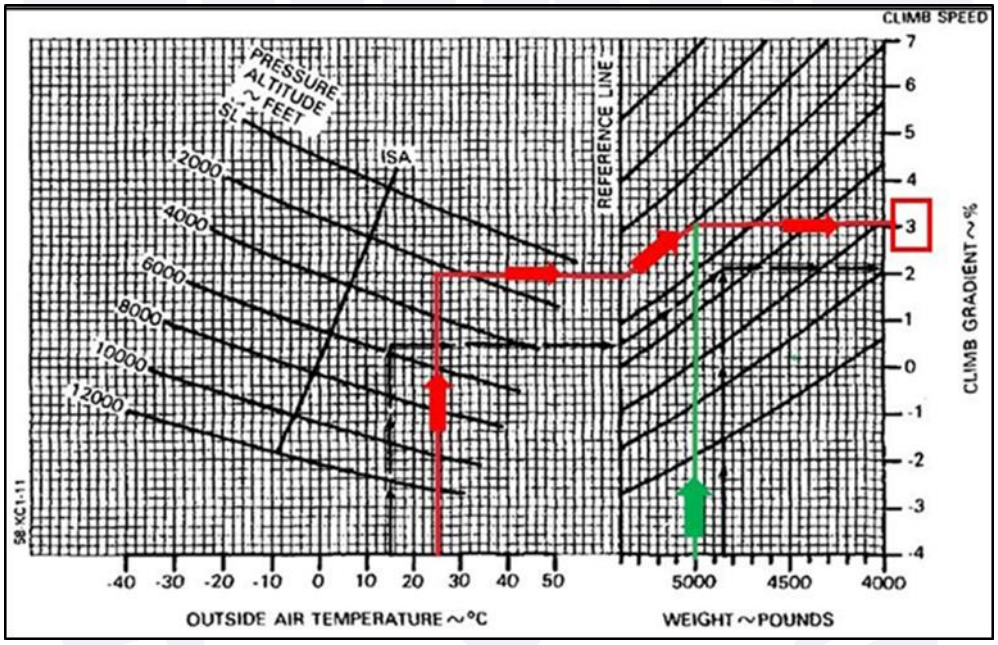


Figure 19 - Extract from the Take-off Climb Gradient – One Engine Inoperative of the aircraft POH.

Considering the only operating engine adjusted for takeoff power, with the aircraft landing gear and flaps retracted, inoperative engine with its propeller feathered, at a speed of 94 kt. recommended by the POH, a rate of climb of 282 ft. /min would be obtained.

Considering that the go-around maneuver would have been initiated at the mid-point of the runway, it is possible to affirm that the aircraft would have a distance of 1.2 NM to the highest obstacle located along the takeoff axis of the runway 30 (i.e. a hill located in the neighborhood of Casa Verde), at an elevation of about 200 ft. (61 m). Maintaining the prescribed speed of 94 kt., the aircraft would travel 1.2 NM to the obstacle in 46 seconds, and would be able to climb approximately 220 ft.

If the pilot had chosen to apply the brakes from the mid-point of the runway onwards, and if one analyzes the Landing Distance diagrams in Section V, assuming that the aircraft was subjected to a headwind of 10 kt (as informed via radiotelephony by the control tower) with the landing gear extended and the flaps down, at an approach speed of 91 kt., and fully applying the brakes, the aircraft would be able to stop in 1,350 ft. (412 m), as per the performance diagram illustrated in Figure 20. The length of the runway in SBMT was 1,600 m.

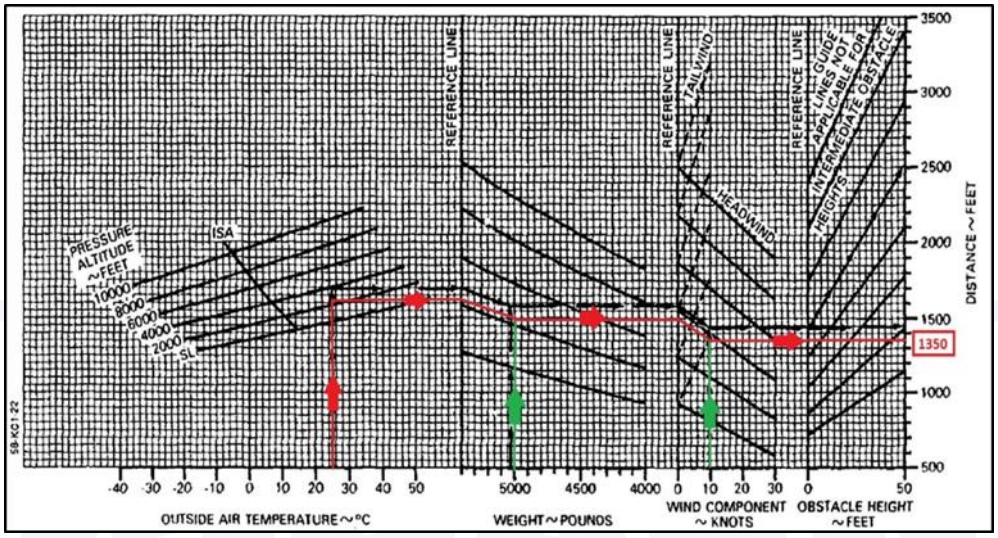


Figure 20 – Extract from the aircraft POH Landing Distance diagram.

However, it was not possible to determine the speed of the aircraft on the approach, nor the pilot's real motivation in choosing the single-engine go-around.

1.19. Additional information.

NIL.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was ferry flight back to SBMT, after a private flight transporting a passenger to Ubatuba in the State of São Paulo.

According to accounts from the pilot's family members and from the owner of the PR-OFI airplane, the PIC stated that the airplane had undergone maintenance on the left-hand engine at SBMT on the morning of the day of the accident, thus allowing the flight to take place on the afternoon of the same day.

However, the Investigation Committee did not find any records in the airplane's documentation, nor could it confirm this information with the maintenance service providers at the aerodrome, suggesting that if the service was indeed provided, it was not recorded.

Nevertheless, it was possible to confirm from analysis of the wreckage, that the left-hand engine was operating normally and developing power at the moment of the aircraft collision with the vegetation and, subsequently, with the ground.

Regarding the right engine, it was found that two of the crankcase through-bolts for cylinder number 5 had fractured due to fatigue during the flight. This occurred when the engine had approximately 86 hours of operation since the overhaul, with an elapsed time interval of around 33 months.

Following the fatigue failure of the two crankcase through-bolts, the nuts on the other bolts of this cylinder became overloaded, leading to their failure and detachment in flight, which resulted in the shutdown of the right engine.

Although the engine underwent a general overhaul with the replacement of mandatory parts, including non-destructive tests of its components, it is possible that the crankcase studs and through-bolts had already begun to experience fatigue, which went undetected during the overhaul procedures.

The pilot had reported noises from the left engine, indicating concern about the condition of the aircraft. Thus, it is possible that, upon noticing the left engine no longer making noise, the pilot's situational awareness diminished, leading to a failure to perceive potential signs of malfunction in the right engine, which subsequently failed during the occurrence.

The Investigation Committee also considered the hypothesis that the noise reported by the pilot might have originated from the right engine, not the left, and could have been related to the failure of one or more bolts due to an ongoing fatigue process. However, since it was not possible to verify where the maintenance intervention was performed, this hypothesis could not be confirmed.

After the in-flight failure of the right-hand engine, the pilot correctly identified the issue, and feathered the propeller. Despite operating on a single-engine condition, the aircraft continued to fly from Itaquera position to SBMT.

When in contact with APP-SP to report the engine failure, the pilot informed of his intention to proceed to land in SBMT, and mentioned that he had approximately three-quarters of fuel remaining in the tanks. During the referred communication, the option of landing at another location was not considered.

Although the ROTAER contained information that SBGR could not to be used as a diversion option for fixed-wing aircraft flying VFR in an emergency, it would have been a rather viable alternative, since it was close to the airplane's location, and offered longer runways with few obstacles along their extensions.

This possibility of landing in SBGR was supported by the requirements of the RBAC-91, which provided for the possibility of deviations from the regulations in the case of in-flight emergencies.

Thus, the Investigation Committee concluded that the decision to proceed to SBMT, which had more restrictions, such as a shorter runway and obstacles near the thresholds, demonstrated a lack of thorough assessment of the options that would have offered a greater probability of successfully managing the emergency.

The aircraft flew a single-engine approach to the runway 30 of SBMT, touched down three times in sequence on the runway and then initiated a go-around procedure. Initially, the aircraft gained lift and got airborne, maintained the altitude and, shortly later, lost height. During this period, the pilot retracted the landing gear, but it was not possible to determine the flap configuration due to the degree of destruction of the aircraft after the crash.

The most likely hypothesis is that the pilot opted for the single-engine go-around procedure from the ground due to the high speed used on the final approach for landing, and the fact that he had already touched down halfway along the runway.

The landing took place after sunset, a fact that can potentially impair human depth-perception. These circumstances certainly increased the cockpit workload, and may have led to a reduction in the pilot's situational awareness, resulting in the improper application of flight controls during the descent procedure and contributing to an unstable final approach.

The Investigation Committee considered that the decision to return to São Paulo, close to nightfall, may have been influenced by the pilot's motivation, on account of his wedding anniversary.

Analyzing the climb gradient performance diagrams for the single engine takeoff of the airplane, given the flight conditions, one verified that there was little margin of aircraft performance to conduct a single-engine go-around procedure. In this scenario, the

airplane would achieve a rate of climb of approximately 282 ft. /min with a clean configuration, a speed of 94 kt., and with the inoperative engine propeller feathered.

In such scenario, the airplane would be able to fly over the Casa Verde hill by only 20 ft., since it would have reached approximately 220 ft. since the moment of rotation. This hypothesis does not yet take into account the presence of obstacles, such as threes and buildings. Furthermore, the position of the flaps at the time of the go-around procedure would also affect the airplane's climb performance.

If the pilot had chosen to remain on the ground, even after the three successive bounces on the runway, the landing distance calculation indicated that the aircraft could have come to a complete stop within 412 meters, still within the runway limits. Such calculation considered a headwind condition of 10 kt, landing gear and flaps down, approach speed at 91 kt., and maximum braking.

At that point, the choice between, on the one hand, executing a go-around in a single-engine condition and, on the other hand, attempting to stop the aircraft on the ground proved to be a challenging decision that had to be made in a short amount of time. For unknown reasons, the pilot chose to perform the single-engine go-around, during which the aircraft collided with the ground.

3. CONCLUSIONS.

3.1. Findings.

a) the pilot had a valid CMA (Aeronautical Medical Certificate);

b) the pilot held valid ratings for MLTE (Multi-Engine Land Airplane) and IFRA (IFR Flight - Airplane);

c) the pilot had qualification and experience for the type of flight;

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

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

f) the records of the airframe, engine, and propeller logbooks were out of date;

g) the meteorological conditions were consistent with the conduction of the flight;

h) it was reported that a maintenance service was performed on the left-hand engine of the aircraft just a few hours before the first takeoff;

i) there was failure of the right-hand engine on the return flight from Ubatuba to SBMT;

j) the cylinder number 5 of the right-hand engine disconnected from the block due to fatigue-related rupture of the crankcase studs (PN 646140-1) and through-bolts (PN 641931-10.75);

k) in one of the studs (PN 646140-1), grooves were observed in the thread similar to those resulting from a material removal process in the form of chips;

l) the aircraft performed the approach for landing in SBMT, touched down on the runway three times, and started a go-around procedure from the ground;

m) shortly after getting airborne, the aircraft collided with trees located past the departure end of runway 30, and crashed into the asphalt-sealed surface of Braz Leme Avenue;

n) the aircraft was destroyed by the impact and fire; and

o) the pilot suffered fatal injuries.

3.2. Contributing factors.

- **Handling of aircraft flight controls – a contributor.**

The fact that the aircraft performed an unstabilized approach, above the recommended speed, resulting in an attempt to make a go-around from the ground, showed failure in the application of the flight controls.

- **Piloting judgment – a contributor.**

The pilot opted for a single-engine approach, even with a borderline condition for that, under penalty of not being able to overcome the existing obstacles after the departure end of the runway.

- **Aircraft maintenance – undetermined.**

The right engine of the airplane failed in flight, having operated approximately 86 hours after its last overhaul. The time elapsed from the date of this service to the date of the occurrence was approximately 33 months.

It was found that one of the studs (PN 646140-1) and two trough-bolts (PN 641931-10.75) near cylinder 5 had fractured due to fatigue. Additionally, for the stud PN 646140-1, the presence of grooves in the thread fillet was observed, resembling those resulting from a material removal process in the form of chips.

Although the engine underwent overhaul with the replacement of mandatory parts, including non-destructive testing of its components, it is possible that the procedures employed were not effective enough to detect the compromise of these bolts at that time.

- **Motivation – undetermined.**

It is possible that, due to the fact that the day of return coincided with his wedding anniversary, the pilot had a decrease in his situational awareness, impairing his perception of the signs of aircraft engine failure, or even his decision-making by not choosing to land in another aerodrome.

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

Both the decision to proceed to SBMT for landing under the circumstances and, after an unstabilized approach, the decision to perform a single-engine go-around procedure on the ground proved to be wrong.

The risks related to an emergency landing would have been substantially lower in an alternate aerodrome with larger runway dimensions.

4. SAFETY RECOMMENDATIONS

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

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

To Brazil's National Civil Aviation Agency (ANAC):

A-082/CENIPA/2020 - 01 **Issued on 12/19/2024**

Work jointly with *JL Motores Aeronáuticos Ltda.* Maintenance Organization (COM N°0805-41/ANAC), to ensure that it demonstrates both possession and application of all necessary resources, in accordance with relevant regulations, for the adequate provision of engine maintenance services during overhaul procedures, specifically for Continental IO-550C-3F engines.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On December 19th, 2024.