COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-048/CENIPA/2019

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PT-LOK**
MODEL:	**CAP-10B**
DATE:	**23MAR2019**

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 23MAR2019 accident with the CAP-10B aircraft model, registration PT-LOK. The accident was classified as “[LALT] Low Altitude Operations and [LOC-I] – Loss of Control in Flight”.

During the take-off, there was an attempt to perform a maneuver at low altitude and the aircraft collided with the balcony of a building under construction.

The aircraft was destroyed.

The pilot suffered fatal injuries.

An Accredited Representative of the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) – France (State where the aircraft was manufactured) was designated for participation in the investigation.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
BEA	*Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile*
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CIV	Pilot's Flight Logbook
CMA	Aeronautical Medical Certificate
COMAER	Aeronautics Command
DCTA	Department of Science and Airspace Technology
EASA	European Union Aviation Safety
FPS	Frames Per Second
HBV	Brazilian Daylight Saving Time
INMET	National Institute of Meteorology
IAC	Civil Aviation Instruction
IAM	Annual Maintenance Inspection
IS	Supplementary Instruction
MNTE	Airplane Single Engine Land Rating
NT	Technical Note
PPL	Private Pilot License - Glider
PPR	Private Pilot License - Airplane
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Aeronautical Certification Regulation
SAMU	Emergency Mobile Care Service
SBR	Restricted Area
SERIPA V	Fifth Regional Aeronautical Accident Investigation and Prevention Service
SIGWX	Significant Weather
SIPAER	Aeronautical Accident Investigation and Prevention System
SN	Serial Number
SSBG	ICAO Location Designator - Bento Gonçalves Aerodrome - RS
TPP	Registration Category of Private Service - Aircraft
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** CAP – 10B **Registration:** PT-LOK **Manufacturer:** *Avions Mudry*	**Operator:** *Condomínio Aeronáutico ZSV*
Occurrence	**Date/time:** 23MAR2019 – 1808 (UTC) **Location:** Urban Area **Lat.** 29°08'43''S **Long.** 051°32'48"W **Municipality – State:** Bento Gonçalves – RS	**Type(s):** "[LALT] Low Altitude Operations [LOC-I] – Loss of Control in Flight" **Subtype(s):** NIL

1.1 History of the flight.

The aircraft took off from the Aerodrome of the Bento Gonçalves Aeroclub (SSBG) - RS, at 1805 UTC, in order to perform a local aerobatic flight, with a pilot on board.

Shortly after the take-off, the aircraft collided with the balcony of a building under construction.

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 after the impact against a building under construction. (Figure 1).

Figure 1 - View of the PT-LOK aircraft wreckage after the impact.

1.4 Other damage.

Part of the balcony of the apartment on the first floor of a building was damaged (Figure 2).

Figure 2 - View from the balcony of the apartment where the first impact occurred.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flown Hours	Pilot
Total	2.000:00
Total in the last 30 days	00:00
Total in the last 24 hours	00:00
In this type of aircraft	33:12
In this type in the last 30 days	00:00
In this type in the last 24 hours	00:00

N.B.: The data relating to the flown hours were obtained through third parties' statements and the electronic CIV. The CIV was not found.

1.5.2 Personnel training.

The pilot took the PPR course at the Bento Gonçalves Aeroclub – RS, in 1989.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PPR and the PPL – Glider Licenses and had valid MNTE Rating.

1.5.4 Qualification and flight experience.

The pilot had not gone through a formal qualification process that would enable him to perform aerobatics.

At the time of the accident, there were no requirements established by the ANAC for this type of operation, and a license was not required for this purpose.

It emerged during the interviews that the pilot had already performed, in previous flights, some maneuvers such as 4-point roll after the take-off and at higher altitudes.

According to reports, he performed aerobatics with a certain frequency and would have done some training with other pilots of the Rio Grande do Sul Aeroclub, aiming to improve his maneuvers.

He also performed aerobatic flights in another aircraft, model EA300/LT, with registration PR-FIX.

Since 14APR2013, there were 238 records, in the pilot's electronic CIV, of flights interspersed between the PT-LOK and the PR-FIX, in addition to flights in other models of aircraft and gliders. About these flights, 66 were performed in the PT-LOK, totaling 33 hours and 12 minutes; and another 172 flights were performed in the PR-FIX, totaling 88 hours and 17 minutes. Most of these flights were local and short-haul, with about 15 to 30 minutes each.

1.5.5 Validity of medical certificate.

The pilot had valid CMA.

1.6 Aircraft information.

The aircraft, registration PT-LOK, model CAP-10B, serial number 223 was manufactured by Avions Mudry in 1988, and it was registered in the TPP category.

The aircraft had valid CA.

The CAP-10B was a conventional aircraft, built in wood, certified in the aerobatics category, with a fixed landing gear, capacity for two crewmembers arranged side by side and dimensions as shown in Figure 3.

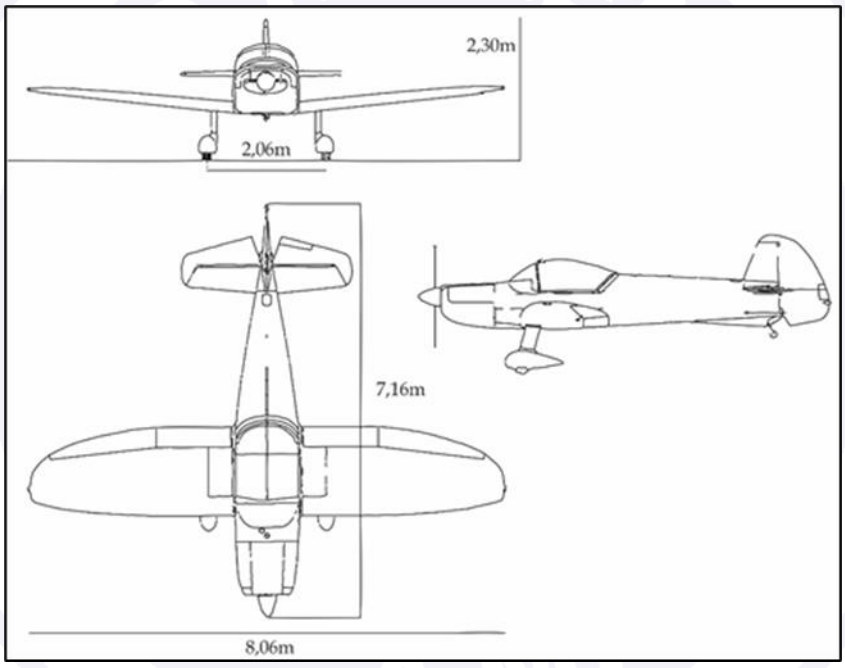

Figure 3 - Dimensions of the CAP-10B aircraft.

The last inspection, the "50 hours/IAM" type, was carried out on 03APR2018 by the Rio Grande do Sul Aeroclub, in Porto Alegre - RS, having flown 8 hours and 55 minutes after the inspection.

1.7 Meteorological information.

According to data from the automatic meteorological station of the INMET, located 2,000m from SSBG, at 1800 UTC, the wind had a direction of 268º and 4 kt of intensity.

The SIGWX, generated at 0417 (UTC), valid until 1800 (UTC) on 23MAR2019, showed that there was no significant weather in the accident region (Figure 4).

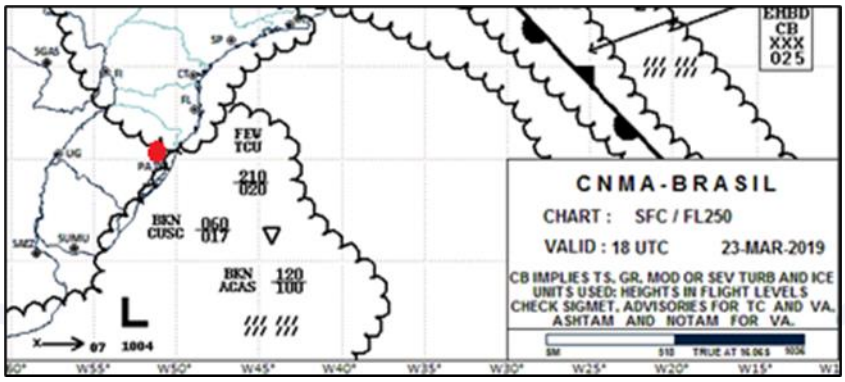

Figure 4 - SIGWX chart dated 23MAR2019, valid until 1800 (UTC).

The weather conditions were favorable for the flight.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The Aerodrome was public, administered by the Bento Gonçalves' City Hall and operated under Visual Flight Rules (VFR) during daytime.

The runway was made of asphalt, with 13/31 thresholds, dimensions of 1,260 x 23 m, with an elevation of 2,207 ft.

Next to the Bento Gonçalves Aeroclub, there was a restricted area "SBR 538 Bento Gonçalves", whose vertical limit varied from FL065 to FL085 and was used for training and instruction in aerobatics.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The first impact occurred in a leveled attitude and with wings inclination above 90° to the right, resulting in the collision of the main landing gears against the balcony of a building under construction, 300 m from the alignment of the SSBG threshold 31 (Figure 5).

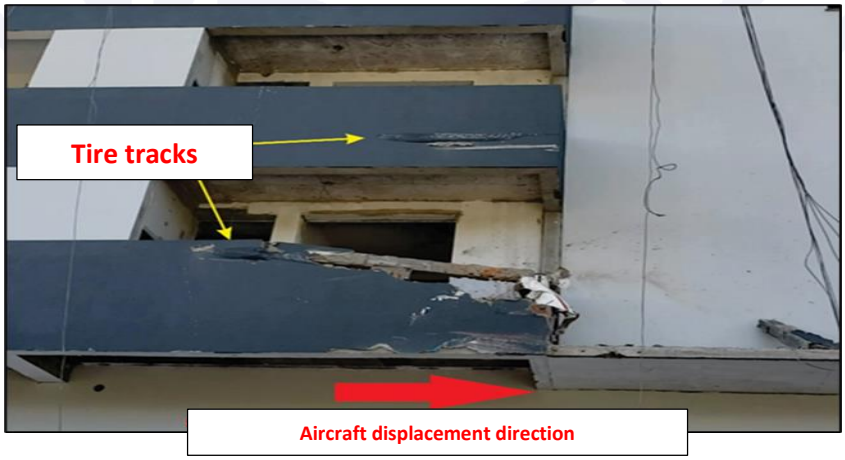

Figure 5 - First point of impact of the PT-LOK against the building.

The second impact occurred in a similar way to the first one, however the collision was against the balcony of another building under construction, about 6m away from the previous

one. After the second impact, the aircraft collided with the ground and some civil construction equipment were totally destroyed (Figure 6).

Figure 6 - Overview of the aircraft impact points from SSBG threshold 31.

From threshold of runway 31 of SSBG, to street level at the accident site, there was a difference of 63m (Figure 7).

Figure 7 – View of threshold 31, from the building where the collision occurred.

People close to the impact site reported having heard the noise of the aircraft's engine in operation, moments before the collision.

The aircraft crashed into the ground with great energy. The engine broke free and was thrown 30m away (Figure 8).

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Figure 8 - View of the engine, after the impact of the PT-LOK against the building.

The propeller was made of wood and was destroyed on impact. Some larger pieces were found near the aircraft, and the root of one of the blades was partially intact, attached to the crankshaft (Figure 9).

Figure 9 - Detail of the root of the blade that remained attached to the shaft.

Given the degree of destruction of the structure and components of the flaps, it was not possible to determine the position of their aerodynamic surfaces. However, it was found that the control lever was in the up position (0°) and the tests allowed to verify its normal operation.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

During the investigation, some laboratory tests, the cadaveric report, the report of the post mortem toxicological tests of the pilot and the last medical expert examination form were analyzed for the purpose of obtaining the CMA.

The pilot had a 2nd class CMA valid until 26DEC2022. Its last expert examination was carried out on 17DEC2017 and all reports were in accordance with the RBAC No. 67, “Requirements for Granting Aeronautical Medical Certificates, for the Accreditation of Physicians, Accreditation of Clinics and Agreement with Public Entities”.

During the interviews, the pilot was described as a healthy person, who ate and rested properly, practiced physical activities regularly and had no evidence of work overload. He did not use any type of medication and was not a carrier of any type of disease.

In the days before the accident, the pilot slept early, about eight hours a night. The people who found him at the Aeroclub, in the afternoon of the occurrence, reported that he was fine and did not show any discomfort. The pilot was flying for leisure and his last flight had been over a month ago.

The autopsy report showed that the cause of death was polytrauma caused by a blunt object. There was no description of any finding in the tests that could corroborate the hypothesis of sudden illness.

Blood samples were sent for research on alcohol and drugs. There was no detection of alcohol or drugs. Lidocaine was detected in the blood, which may have been administered at the time of the rescue, since the patient was seen still alive at the scene of the accident.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot was a businessman in the furniture business and was defined by people close to him as a person who had a lot of involvement with aviation. From Monday to Saturday, he frequented the Bento Gonçalves Aeroclub, close to his company's headquarters.

He owned two aircraft and liked to perform aerobatic flights, being the only pilot in the Aeroclub who performed this type of flight. According to reports obtained, he was training new maneuvers with an instructor at another Aeroclub. At the Bento Gonçalves Aeroclub, he taught flight instruction in gliders.

He was described by those around him as influential and persuasive. He maintained a good interpersonal relationship, being respectful, cheerful and predominantly good-humored.

As a pilot, he was considered a reference by his peers in the region, including for having flown in other countries.

According to collected data, he performed maneuvers at low altitude, did not have the habit of planning flights and did not perform full pre-flight inspection. However, there were reports that he took longer than usual in the pre-flight inspection that day.

He had a behavioral pattern that was considered bold and self-confident. Also, he enjoyed filming himself while flying.

Commonly, as noted, the pilot was not warned about the low altitude maneuvers he was performing. However, once, he was guided by a member of the management of the Aeroclub about the risks of his maneuvers, when he would have replied in a scathing manner

("film and send it to the ANAC"). Although he disregarded this member of the board's observations, he maintained a pleasant and friendly demeanor with everyone at the Aeroclub.

As a flight instructor, he was described as someone who maintained a relaxed relationship with his students and who allowed them greater operational autonomy.

According to reports, professionally, the pilot was very happy in recent days, as he had closed important deals for his company. Even before the flight that culminated in the accident, he talked about the company's business with one of its employees, who was also a pilot.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

After the collision, some people close to the accident site called the SAMU, which rescued the pilot still alive and took him to the hospital. He suffered trauma and multiple fractures, and died a few minutes after the rescue.

1.16 Tests and research.

The aircraft engine, fuel injector, right and left magnetos, and other instruments were analyzed by experts from the DCTA.

The disassembly procedure of the engine, model AEIO-360-B2F, SN L-24671-51A, manufactured by Lycoming, was carried out at the premises of the *Drawanz Motores Aeronáuticos*, in Cachoeirinha - RS.

Due to the impact with the ground, the engine had severe damages. Upon disassembly, it was found that the ignition system, in both magnetos, had normal operation. On the spark plugs, which could be examined, there was the presence of soot characteristic of a normal take-off operation, when using the richest air/fuel mixture. It was also observed that the porcelain of the spark plugs had a normal functioning appearance and color.

The lubrication system had evidence of good functioning and no signs of contamination or obstructions were found.

Excessive wear of the engine's moving components or the presence of filings was not found. An early wear on the camshaft cams was noted, however, it was considered that this discrepancy did not affect the normal performance of the engine.

In the fuel supply system, no discrepancies were found that could cause engine malfunction or power deficiency.

The cylinders had no damage or scratches on the piston skirts. There was also no evidence that they operated at high temperature or suffered detonation. It was observed that, at the moment the aircraft was involved in the accident, the engine was operating with rich mixture.

In Figure 10, the arrow indicates the point at the end of the blade where it collided with the obstacle, a fact that generated resistance to its movement and caused its breakage at the root, together with the fixation on the engine flange. It was also observed that there was a rupture at the end of this blade with a forward-facing displacement.

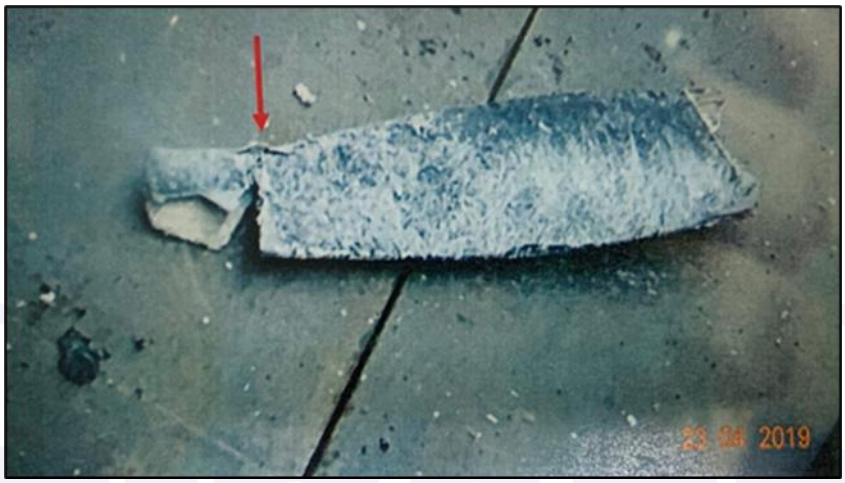

Figure 10 - View of the blade, highlighting the place where the collision occurred.

On the opposite blade, it was observed that the point of collision with the obstacle was close to the root, where the arrow in Figure 11 indicates the deformation in the wood fiber. This originated a moment that caused the rupture of fibers with different lengths, forming an angle close to 45º.

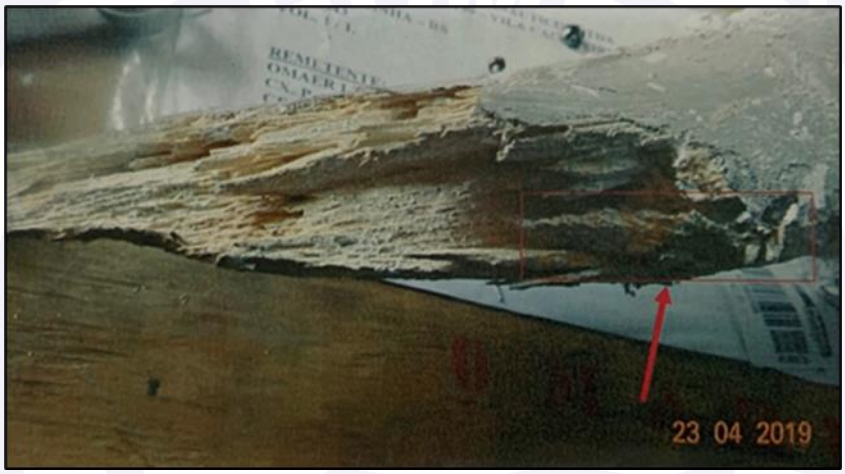

Figure 11 - View of the blade, highlighting the place where the collision occurred.

Such fractures would not be possible if the engine was stopped or with low power at the moment of the collision.

Thus, all components that could be inspected and/or tested did not show evidence of malfunction. All evidence found indicated that the engine developed power at the moment of impact.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

The pilot arrived at the Aeroclub in the afternoon and prepared the PT-LOK aircraft for the flight with the help of another pilot. The latter fueled the aircraft with about 25 liters in the front tank and 5 liters in the rear tank.

According to the available data, the aircraft was found to be within the weight and balance limits specified by the manufacturer.

According to information from other pilots at the Aeroclub, when wind conditions allowed, it was usual to take off from threshold 31, given its proximity to the hangars.

However, the pilot proceeded to threshold 13. Despite this choice, these pilots did not identify any abnormality in the taxi sequence.

During the take-off, the aircraft was sighted keeping two meters high above the runway as it passed in front of the hangar of the Aeroclub. Afterwards, it was seen through the cracks in the hangar door, with a 90º inclination to the left, suggesting the execution of an aerobatic maneuver at low altitude.

According to reports from observers who were in the region of the accident, the aircraft would have traveled a flight path as illustrated in Figure 12.

Figure 12 - Flight path estimated based on observers' information.

During the investigation, a video generated by a security camera was identified, and it recorded the moment of impact of the aircraft, with a recording rate of 12 Frames Per Second (FPS) (Figure 13).

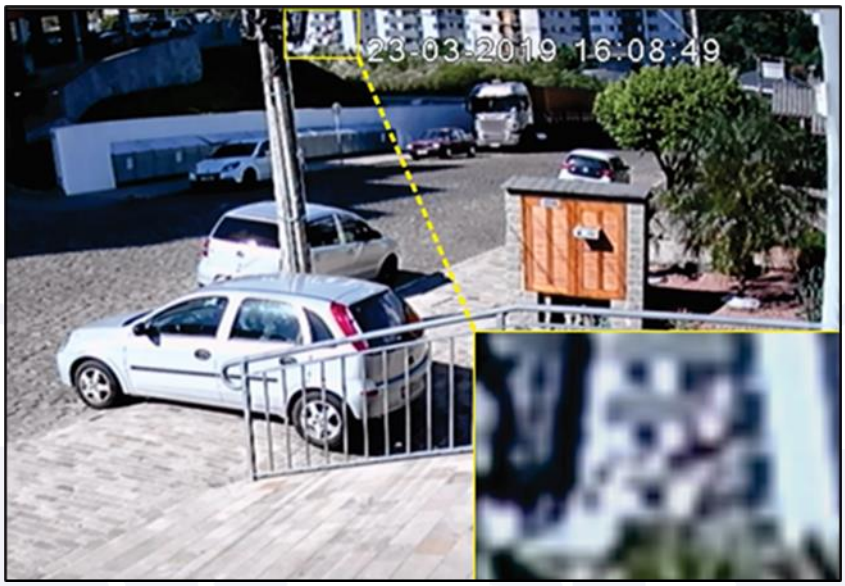

Figure 13 - Image captured by the security camera with an emphasis on the aircraft.
(clock adjusted to the HBV).

The sequence of images in Figure 14 (frame by frame numbered from 1 to 6) shows the aircraft with a 60º roll to the right (frame 1) and, in the sequence, with an inclination increasing from 90º (frame 2) until the moment of impact (frame 5).

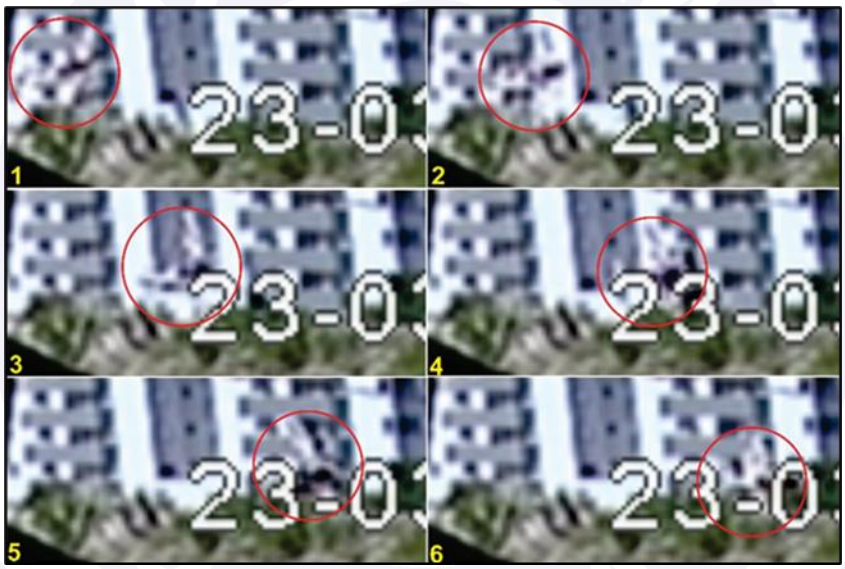

Figure 14 - Frame sequence showing the collision between the aircraft and the building.

Taking as reference the first two frames of the sequence, as well as the dimensions of the CAP-10B aircraft, it was possible to calculate the aircraft's ground speed.

Thus, considering the uncertainties generated by the low image quality and the 12 FPS rate, it was possible to estimate that the aircraft's speed at the moment of impact was 133 ± 5 kt (Figure 15).

Figure 15 - Measurements for calculating the aircraft's speed during the impact.

1.19 Additional information.

According to letter "g", number "5", section 91.303, Subpart D - Special Flight Operations, of the RBHA No. 91, of 07AUG2019, it was defined as aerobatic flight:

> 91,303 AEROBATIC FLIGHTS, AIR DEMONSTRATION, AIR COMPETITION AND AIR EVENTS IN GENERAL
>
> [...]
>
> (g) For the purposes of this section, the following definitions apply:
>
> [...]
>
> (5) Aerobatic flight is one that involves the intentional performance of aerial maneuvers that involve sudden changes in altitude, flights in abnormal attitudes or abnormal variations in speed, not necessary for normal flight.

The RBAC No. 61, Amendment No. 03 of 23JUN2014, which regulated Licenses, Ratings and Certificates for Pilots, had the following requirements for granting the license of aerobatics pilot in subpart Q, item 61,273:

> (a) The candidate for an aerobatics pilot's license must complete the following:
>
> (1) prerequisite: hold a pilot license of the aircraft category for which the aerobatics pilot license is required, with the license corresponding to the valid aircraft used for the aerobatics operation;
>
> (2) theoretical knowledge:
>
> (i) have successfully completed a specific aerobatics pilot course, approved by the ANAC, for the category of aircraft corresponding to the license or certificate in which the rating will be endorsed, covering at least the following aspects:
>
> (A) aerodynamics applied to low-altitude flight and aerobatic maneuvers;
>
> (B) planning of aerobatic operations;
>
> (C) aviation medicine applied to aerobatic air operations;
>
> (D) meteorology applied to aerobatic air operations;
>
> (E) weight and balance of aerobatic aircraft;

(F) specific legislation for aerobatic operations;

(G) flight safety and accident prevention regulations;

(H) air traffic regulations; and

(ii) having passed, in the last 12 (twelve) months, on a theoretical examination by the ANAC regarding the qualification of an aerobatics pilot in accordance with the required aircraft category;

(3) flight instruction: having successfully completed a practical aerobatics pilot course, approved by the ANAC, for the aircraft category corresponding to the license or certificate in which the rating will be endorsed, covering at least the following aspects:

(i) operation area approaches;

(ii) accelerations and decelerations;

(iii) execution of aerobatic maneuvers; and

(iv) operating procedures;

(4) experience: demonstrate flight experience of at least 100 (one hundred) total hours of flight performed in the category of aircraft for which the license is requested, with at least 20 (twenty) of these hours performed in instruction of flying during the practical course set forth in paragraph (a)(3) of this section;

(5) proficiency: demonstrate ability to perform, as pilot-in-command of an aircraft of the category for which the license is requested, the procedures and maneuvers specified in paragraph (a)(3) of this section, with a degree of competence appropriate to the prerogatives that the aerobatic pilot license confers on its holder, and for:

(i) recognize and manage threats and errors;

(ii) operate the aircraft within its usage limitations;

(iii) execute all maneuvers smoothly and accurately;

(iv) show good judgment and have flying skills;

(v) apply aeronautical knowledge;

(vi) maintain control of the aircraft during the flight time, so that there are no doubts as to the success of any procedure or maneuver; and

(6) when the aircraft used in the proficiency exam has accommodation for only one crewmember, it may be carried out by field assessment, in which the assessor, on the ground, watches the performance of the operations by the assessed person, positioned in such a way as to be able to observe the set of maneuvers necessary for the development of aerobatic air operations.

As of the issuance of Amendment No. 4 of RBAC No. 61, published on 19SEPT2014, the requirements established up to Amendment No. 3, Subpart Q are no longer required.

The revocation of Subpart Q of RBAC No. 61 and the IAC 060-1001, which dealt with aerobatic pilot and aerial demonstration, was included in process 00065.030048/2013-11, available for public research in the Electronic Information System (SEI) of the ANAC, at the link https://www.anac.gov.br/*pesquisa-publica-de-processos-e-documentos*.

In researching the process, it was found that the subject was initially addressed on sheet 666v (Process volume 4.4 (2331810)), where the exclusion of Subpart Q was justified "because there is no provision for enabling an aerobatics pilot in the Annex 1, FAR 61 or LAR 61".

Further on, on page 768v, the ANAC Attorney's Office, in item 97, suggested checking whether the existing regulation referred to the issue or specifically addressed this qualification, so as not to leave a regulatory vacuum or normative incompatibility. This was answered in sheets 775v-776, both of Process Volume 5.3 (2332554), maintaining the proposed revocation of the former Subpart Q.

On sheet 1012v (Process Volume 6.5 (2332652), the justification for the revocation was changed to:

> Only in Brazil, there is the requirement for an aerobatics pilot's license. It was understood that this is an aero sports activity in which there is no asymmetry of information on the part of the participants and low risk of externalities, due to the fact that these activities are normally carried out in areas reserved for this purpose and far from unsuspecting people. Thus, it was understood as good not to regulate the qualification of aerobatics pilots by issuing a specific license.

The ANAC's Attorney's Office returned to the issue in pages 1002-1002v (Process Volume 6.6 (2332655)), suggesting the evaluation of the revocation of IAC 060-1001, which dealt with aerobatics pilot and aerial demonstration.

The revocation of this IAC was dealt with in sheets 1030v-1031, through Technical Note (NT) No. 51/2014. On sheet 1051, the justification for revocation was changed from sheet 1012v, excluding the first sentence, because it was identified that the EASA would have an aerobatics rating, which would become mandatory from 08APR2015 on.

On sheets 1054-1056 of that case, there was an NPR of revocation of the IAC 060-1001, all of which is available in Case volume 7 (2332659).

Thus, on 17SEPT2014, and through Resolution No. 344, Amendment No. 04 was published, revoking Subpart Q of RBAC No. 61 and the IAC 060-1001.

The Amendment No. 04 brought several changes, most of which were resolved with the introduction of the endorsement requirement provided for in item 61.199 of RBAC No. 61, below:

> 61,199 Prerogatives and limitations of the holder of category and class rating
>
> (a) Observed the compliance with the precepts established in this Regulation, the prerogatives of the holder of a category or class rating are to pilot aircraft of the category or class in which he has been qualified, in the role of pilot-in-command or second-in-command.
>
> (b) The holder of a category or class rating may exercise his privileges on all aircraft models belonging to the category or class in which he is entitled.
>
> (1) Notwithstanding the provisions of the caput, the ANAC may establish, through a Supplementary Instruction, the requirement for minimum training and endorsement by the CIV to operate specific aircraft models (our emphasis). In these cases, the exercise of the prerogatives of the holder of a category or class rating is subject to prior completion of training and obtaining the endorsement.

In IS No. 61-006, which established the procedures for the entry of endorsements in the pilots' flight records, there was no provision for an endorsement to operate aircraft in the aerobatics category.

In addition, at the time of the accident, Amendment No. 09 of RBAC No. 61 was in force, and it did not mention requirements for qualification in aerobatics. The ANAC website, however, had the following information regarding the practice of aerobatics:

> Aerobatics
>
> Aerobatics is the execution of intentional maneuvers that involve sudden changes in altitude or acceleration of an aircraft other than normal flight. This sport has as objectives the individual leisure of the practitioner and demonstrations in shows and air championships.
>
> Rating
>
> The ANAC does not issue a specific rating for the practice of aerobatics.
>
> The judgment on the proficiency of pilots and their ability to perform certain maneuvers is the responsibility of the Director of Operations of the event or air show.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a local flight, to perform aerobatics, which took off at 1805 UTC.

The weather conditions were favorable for the visual flight with no cloudiness and low intensity wind (4 kt) with a direction of 268º.

Observers reported that the aircraft took off from runway 13, keeping about two meters high when passing in front of the hangar of the aeroclub and that they saw it tilted 90º to the left, suggesting an aerobatic maneuver.

From the threshold of the SSBG runway 31 to the street level of a building located 300m in line with the runway, there was a drop of 63m. Based on the reports of observers and on images from a security camera, which recorded the moment of impact, it was found that, after crossing the threshold 31, the aircraft descended below the level of the runway and reversed the inclination, performing a turn of great inclination to the right, until colliding with the building, with an estimated speed of 133 kt.

The PT-LOK aircraft, model CAP-10B, was conventional, made of wood, certified in the aerobatic category, with fixed landing gear and capacity for two crewmembers arranged side by side. It had a valid CA and the planned inspections had been carried out in maintenance organizations certified by the ANAC. Maintenance records were duly registered in the respective logbooks.

The analysis of the engine, after the accident, revealed that the components tested did not show signs of malfunction. Despite the existence of the beginning of wear on the cams, it was concluded that this discrepancy did not affect the normal performance of the engine.

Analysis of the propeller identified that there was a break at the end of one of the forward-facing blades. On the opposite blade, it was observed that the point of collision with the obstacle was close to the root, resulting in a moment that caused the rupture of the wood fibers in a pattern that revealed that the engine was developing power at the moment of impact.

At the time of the accident, the aircraft was within the weight and balance limits specified by its manufacturer.

Given the level of destruction of the structure and components of the flaps, it was not possible to determine the position of their aerodynamic surfaces. However, it was found that the control lever was in the up position (0°) and the functional tests allowed to verify its normal operation.

Thus, no technical conditions of failure or malfunction of systems and/or components of the aircraft that could have affected its performance or its control in flight were evidenced.

The pilot had a valid CMA and was described as a healthy person, who ate and rested properly, practiced regular physical activities and had no evidence of work overload. In the days before the accident, the pilot slept early, about eight hours a night. People who met him at the Aeroclub on the afternoon of the accident reported that he was fine and not showing any discomfort.

The exams performed did not identify the presence of alcohol or drugs and the autopsy report showed that the cause of death was multiple trauma caused by a blunt object.

Thus, there was no evidence that physiological or incapacitation considerations affected the pilot's performance in flight.

There were no records that the pilot had undergone a formal qualification process that would enable him to perform aerobatics. He had operated aerobatic aircraft since 2013 and was looking to conduct training flights with other more experienced pilots.

Most of the flights recorded on the CAP-10B and EA300/LT aircraft were local and short-haul, suggesting that he performed aerobatics on these flights. In all, 238 flights were registered, 172 of which in the EA300/LT model, which had advanced aerobatic characteristics, and 66 in the CAP-10B (accident aircraft), considered a more basic model.

At the time of the take-off, the wind had low intensity with a more favorable alignment for takeoff from runway 31, which was preferred by pilots operating in SSBG because it was close to the hangar of the Aeroclub. However, the PT-LOK headed for takeoff from threshold 13, farther away and with a slight tail wind.

The fact that the aircraft presented a 90º inclination, at a low altitude over the runway and then sinked in the existing unevenness after the threshold 31, suggests that the pilot tried to perform aerobatics at low altitude and allowed the aircraft to assume an abnormal attitude, in conditions of speed and inclination beyond the point where it would be possible to avoid the impact against the building.

The pilot had greater experience of aerobatic flights on the EA300/LT aircraft, which had more precise and agile command responses and, therefore, this may have induced him to overestimate the performance of the CAP-10B under the same circumstances.

Considering the fact that the pilot demonstrates a behavioral pattern that is considered bold, inflexible and self-confident, it is likely that he felt able and safe to perform a maneuver at low altitude in the CAP-10B, thus overvaluing his knowledge and skills, without evaluating the fact of being in an aircraft with more basic aerobatic flight characteristics.

Likewise, the option to take off from runway 13, without technical reasons for doing so, points out that he sought to position himself to perform the maneuver in a way that would allow the other pilots who were in the SSBG hangars to have a better view.

On the day of the accident, the pilot took longer than usual in the pre-flight inspection. This caught the attention of people at the Aeroclub, as he was not in the habit of performing this procedure in detail, which raises the hypothesis that he was planning to perform a bolder maneuver than usual.

Additionally, it is necessary to point out that from 19SEPT2014 on, with the issuance of Amendment No. 4 of the RBAC-61, a series of requirements aimed at ensuring the experience, theoretical knowledge and minimum practical training of aerobatic pilots left to be required.

In addition, IS No. 61-006, which established the procedures for entering endorsements in pilot flight records, did not require an endorsement provision to operate aircraft in the aerobatic category.

At the time of the accident, Amendment No. 09 of RBAC No. 61 was in force, and it did not mention requirements for aerobatics rating.

Although, even informally, the pilot seeks to learn from other experienced pilots, accumulate experience and carry out frequent training in aerobatic flights, the possibility that gaps have occurred in his learning process cannot be ruled out, which he may not have experienced, ensuring the necessary training to recognize and minimize the risks inherent in that type of operation.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had valid CMA;

b) the pilot had valid MNTE Rating;

c) there was no evidence that physiological or incapacitation considerations affected the pilot's performance in flight;

d) the pilot had experience in the type of flight, but had not gone through a formal training process;

e) the qualification of aerobatic pilots, by issuing a specific license, was not regulated by the ANAC;

f) the pilot showed personal characteristics of an influential, dominant type, with high power of persuasion;

g) the pilot had a behavioral pattern considered bold and self-confident;

h) of the 238 flights recorded, 172 were in the EA300/LT model, which had advanced aerobatic flight characteristics, and 66 in the CAP-10B (accident aircraft);

i) the pilot's electronic CIV, in the CAP-10B model, recorded a total of 33 hours and 12 minutes flown;

j) the aircraft had valid CA;

k) there was no evidence of failure or malfunctioning of systems and/or components of the aircraft that could have affected its performance or its control in flight;

l) the wind had low intensity with a more favorable alignment for takeoff from runway 31;

m) runway 31 was preferred by the pilots because it was close to the Aeroclub's hangar;

n) the aircraft took off from runway 13, despite the longer taxi and the tail wind component;

o) the aircraft was sighted keeping about two meters high and 90º to the left when passing in front of the Aeroclub's hangar;

p) the aircraft descended below runway level, after threshold 31, and made a steep right-hand turn;

q) there was a collision with the balcony of a building under construction, with an estimated speed of 133 kt;

r) the aircraft was destroyed; and

s) the pilot suffered fatal injuries.

3.2 Contributing factors.

- **Control skills – a contributor.**

The fact that the aircraft presented a 90º inclination, at low altitude over the runway and then sinked in the existing unevenness after the threshold 31, allowed the aircraft to assume an abnormal attitude, in conditions of speed and inclination beyond the point where it would be possible to avoid the impact against the building.

- **Attitude – undetermined.**

Considering the pilot's behavioral pattern, it is possible that there was an appreciation of his own operational capacity, to the point of faithfully relying on his ability to perform maneuvers at low altitude in a more basic performance aircraft.

- **Training – undetermined.**

The informality of the pilot training process may not have ensured the level of proficiency necessary to recognize and avoid the risks involved in the type of operation performed.

- **Piloting judgment – undetermined.**

The pilot had greater experience of aerobatic flights on the EA300/LT aircraft, which had more precise and agile command responses and, therefore, this may have induced him to overestimate the performance of the CAP-10B aircraft under the same circumstances.

- **Insufficient pilot's experience – undetermined.**

The pilot's electronic CIV recorded a total of 33 hours and 12 minutes flown on the CAP-10B model. These total hours flown may indicate little experience in the aircraft to perform the type of maneuver observed at the time of the accident.

- **Support systems – undetermined.**

The absence of a set of rules and requirements aimed at enabling pilots to be able to perform aerobatics may have led to a failure in the development of the pilot's ability to recognize the risks inherent in that type of operation.

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-048/CENIPA/2019 - 01 **Issued on 10/04/2021**

Establish qualification standards that ensure the necessary experience, theoretical knowledge and minimum practical training of pilots, so that they are considered capable of performing aerobatics without exposing themselves and/or third parties to intolerable risks.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On October 04th, 2021.