COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-028/CENIPA/2022

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PP-XDB**
MODEL:	**---**
DATE:	**27FEV2022**

NOTICE

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

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

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

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

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

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

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

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

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

SYNOPSIS

This is the Final Report of the 27 February 2022 accident involving the aircraft of registration marks PP-XDB. The accident was typified as “[SCF-PP] Engine failure or malfunction and [LOC-I] Loss of control in flight”.

At around 13:00 UTC, the aircraft took off from the municipality of *Bebedouro* in the State of *São Paulo*, bound for *Itumbiara* in the State of *Goiás,* on a private flight, with a pilot and a passenger on board.

After taking off, the aircraft lost power and crashed into the ground.

The aircraft was destroyed.

The pilot and the passenger suffered fatal injuries.

Since the United Kingdom was the State of design of the aircraft, the UK’s AAIB (Air Accidents Investigation Branch) designated an Accredited Representative for participation in the investigation of the occurrence.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ABNT	Brazilian Association of Technical Standards
ADI	Attitude Directional Indicator
AFM	Aircraft Flight Manual
ANAC	Brazil's National Civil Aviation Agency
ANP	Brazil's National Agency of Petroleum, Natural Gas, and Biofuels
CA	Certificate of Airworthiness
CANAC	ANAC Code
CAVE	Experimental-Flight Authorization Certificate
CBA	Brazilian Code of Aeronautics
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CFR	Code of Federal Regulations (USA)
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
CVA	Airworthiness-Verification Certificate
DECEA	Department of Airspace Control
ECU	Electronic Control Unit
FAA	Federal Aviation Administration (USA)
FADEC	Full Authority Digital Electronic Control
HSA	Health Status Annunciator
ADI	Attitude Directional Indicator
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
INVA	Flight Instructor Rating (Airplane)
IS	Supplementary Instruction
MNTE	Single-Engine Land Airplane Rating
NBR	Brazilian Technical Norm
NSCA	Command of Aeronautics' System Norm
PCM	Commercial Pilot License (Airplane)
PET	Amateur Aircraft Construction Registration Category
PF	Pilot Flying
PIC	Pilot in Command
PPR	Private Pilot License (Airplane)
PSO-BR	Brazilian Civil Aviation Safety Program
RAB	Brazilian Aeronautical Registry
RBAC	Brazilian Civil Aviation Regulation

SBIT	ICAO location designator – *Itumbiara*'s Hydro-Electrical Plant Aerodrome, State of *Goiás*
SBRP	ICAO location designator - *Leite Lopes* Aerodrome, *Ribeirão Preto*, State of *São Paulo*
SBSR	ICAO location designator - *Professor Eriberto Manoel Reino* Aerodrome, *São José do Rio Preto*, State of *São Paulo*
SDBB	ICAO location designator - Aerodrome of *Bebedouro*, State of *São Paulo*
SDNI	ICAO location designator - *Nascimento I* Aerodrome, *Vargem Grande Paulista*, State of *São Paulo*
SIPAER	Aeronautical Accidents Investigation and Prevention System
SN	Serial Number
SNEM	ICAO location designator - *Aeroclube de Pernambuco* Aerodrome, *Recife*, State of *Pernambuco*.
SNZO	ICAO location designator - Aerodrome of *Fazenda Bebida Velha*, *Touros*, *Rio Grande do Norte*
TAF	Terminal Area Forecast
UTC	Coordinated Universal Time
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** --- **Registration:** PP-XDB **Manufacturer:** Undetermined	**Operator:** Private
Occurrence	**Date/time**: 27FEV2022 – 13:00 UTC **Location:** Rural Area **Lat.** 20°54'25"S **Long.** 048°27'51"W **Municipality – State:** *Bebedouro – São Paulo*	**Type(s):** [SCF-PP] Powerplant failure or malfunction [LOC-I] Loss of control - inflight

1.1. History of the flight.

At around 12:45 UTC, the aircraft took off from SDBB (Aerodrome of *Bebedouro*, State of *São Paulo*), bound for SBIT (Aerodrome of the Hydroelectric Plant of *Itumbiara*, State of *Goiás*, on a private flight with a pilot and a passenger on board .

After takeoff, the aircraft lost power and crashed into the ground.

The aircraft was destroyed.

The pilot and the passenger suffered fatal injuries

Figure 1 – Picture of the aircraft taken at the initial investigation action.

1.2. Injuries to persons.

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

1.3. Damage to the aircraft.

The aircraft was destroyed.

The engine separated from the aircraft's structure, with breakage of the propeller and several other components. The cockpit was destroyed.

All the landing gear struts were broken. The wings along with their control surfaces sustained significant twists and bends, the fuselage was substantially damaged, and the tail cone was severed, being the part of the aircraft with the least apparent damage.

1.4. Other damage.

NIL.

1.5. Personnel information.

1.5.1. Crew's flight experience.

FLIGHT EXPERIENCE	
	PIC
Total	431:00
Total in the last 30 days	08:10
Total in the last 24 hours	02:17
In this type of aircraft	17:25
In this type in the last 30 days	07:23
In this type in the last 24 hours	02:17

RMK: data on the hours flown were obtained from records of the pilot's digital logbook (CIV), as well as from records of the aircraft's logbook and information relative to the day of the accident**.**

1.5.2. Personnel training.

The Pilot in Command (PIC) started his training in 2015, at the *Aeroclube de São José dos Campos*, State of *São Paulo*, and completed his PPR course (Private Pilot – Airplane) in 2019, at the Aviation School of *Pouso Alegre*, State of *Minas Gerais*.

1.5.3. Category of licenses and validity of certificates.

The PIC held a PCM License (Commercial Pilot - Airplane) and valid ratings for MNTE (Single Engine Land Airplane) and INVA (Flight Instructor - Airplane).

The passenger, who occupied the left-hand seat, had an ANAC Code (CANAC) registered in the Integrated Civil Aviation Information System (SACI) on 10 November 2018, but did not have any licenses, certificates, or ratings.

1.5.4. Qualification and flight experience.

The PIC had worked as a pilot for around 3 years and accumulated more than 431 hours of flight in C150, C152, C172M, Pelican 500BR, and *Europa* aircraft.

A large part of his operational background as a pilot was developed when he served as an INVA, accumulating a total of 134 hours and 22 minutes in that function.

The records of his digital CIV and of the PP-XDB logbook indicated that the PIC had been flying the accident aircraft on sporadic flights since July 2021.

The analysis of his flight hours confirmed that the PIC met the recent-experience requirements listed in the Brazilian Civil Aviation Regulation nº 91 (RBAC-91), Amendment nº 03, Subpart A, section 91.5(a)(3), as well as in the RBAC-61, Amendment No. 13, Subpart A, section 61.21(a)(1)(ii), both issued by the ANAC (National Civil Aviation Agency), and valid at the time of the occurrence. Therefore, he was qualified and experienced for the type of flight.

1.5.5. Validity of medical certificate.

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

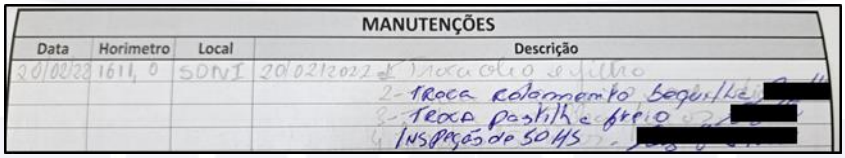
1.6. Aircraft information.

The SN E533 aircraft was a product built in 1999 from a complete kit manufactured by *Europa* Aviation. It was registered in the Amateur-Built Aircraft Registration Category (PET).

The CVA (Airworthiness-Verification Certificate) presented to the Investigation Committee was valid until 22 January 2023.

The latest record entered in the logbook (in pencil) dated from 23 February 2022. According to the said record, the aircraft had completed 1,612 hours and 48 minutes of flight on the aforementioned date.

The Investigation Committee did not have access to the airframe, engine, and propeller logbooks, and, thus, the investigators could not verify the conduction of inspections and maintenance actions prior to the date of the accident. Nonetheless, there was a record in the aircraft's logbook, dated 20 February 2022, of a 50-hour inspection, with oil and filter changes, replacement of the tail wheel bearing, and replacement of brake pads (Figure 2).


MANUTENÇÕES

Data	Horimetro	Local	Descrição
20/02/22	1611,0	SDNI	20/02/2022 [redacted]
			2- TROCA ROLAMENTO BEQUILHA [redacted]
			3- TROCA PASTILH e ATRITO
			4- INSPEÇÃO de 50 HS [redacted]

Figure 2 - Records of Maintenance Services in the aircraft logbook.

The Investigation Committee found that an aeronautical engineer had filled out a CVA Form, and approved the aircraft for flights on 22 January 2022, just over a month before the accident. The referred Committee did not have access to the tasks performed in the airworthiness verification.

The experimental-aircraft's Flight Authorization Certificate (CAVE) was issued on 25 June 2020, under the letter (g) of section 21.191 of the RBAC-21, in force at the time, which read the following:

> (g)-I operation of amateur-built aircraft. Operation of an aircraft whose largest portion has been built by individuals aimed solely at their own education or recreation. The certificate in question shall not be issued for aircraft built in series or imported ready-made.

From observation of aspects of the aircraft manufacture and of the parts composing the aircraft, the Investigation Committee identified that, despite the fact that the aircraft had being registered as a "*Europa Aviation*" model, it had elements characteristic of the "Liberty XL2" model, built by Liberty Aerospace (United States).

Although the *Liberty XL2* model derived from the *Europa XS*, these two models had marked differences in terms of propulsion, systems, and panel design. While the *Europa* models were fitted with variations of the Rotax 912 and 914 engines, or carbureted versions of the Teledyne Continental IOF-240B, the *Liberty* model had Teledyne Continental IOF-240B engines controlled by a FADEC system (Full Authority Digital Electronic Control).

The PP-XDB had an IOF-240B Teledyne Continental engine (SN 400086). It also had a FADEC system and the characteristic panel of the *Liberty XL2* line, besides carrying the inscription "*Liberty*" engraved on the back of its seats.

On the day of the accident, the AFM (Airplane Flight Manual) found onboard the aircraft corresponded to the *Liberty XL2* aircraft with SN 0053 and registration marks N568XL, approved by the FAA (Federal Aviation Administration) for that type of airplane, which in the United States had obtained type certification under Title 14 CFR PART 23 (equivalent to the ANAC's RBAC-23).

Also on board, was the original and complete logbook of the N568XL with its entire maintenance history until the year 2016 (Figure 3).

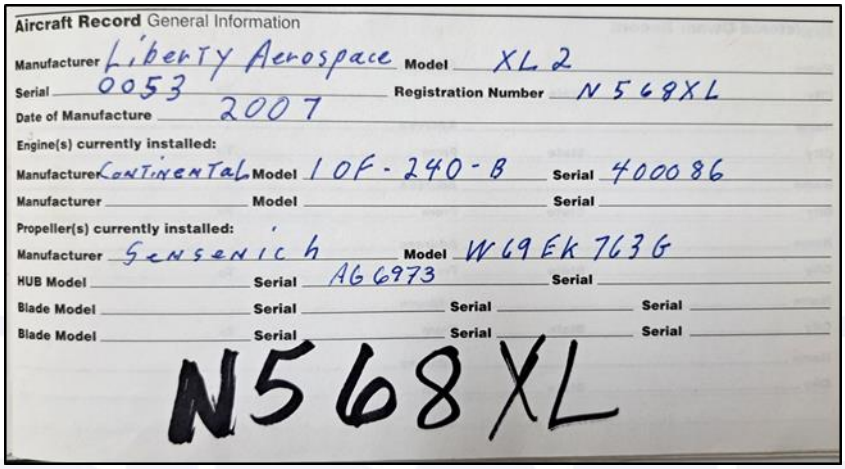

Aircraft Record General Information
Manufacturer Liberty Aerospace Model XL 2
Serial 0053 Registration Number N568XL
Date of Manufacture 2007
Engine(s) currently installed:
Manufacturer CONTINENTAL Model IOF-240-B Serial 400086
Manufacturer Model Serial
Propeller(s) currently installed:
Manufacturer Sensenich Model W69EK7636
HUB Model Serial AG6973 Serial
Blade Model Serial Serial Serial
Blade Model Serial Serial Serial
N568XL

Figure 3 - First page of the N568XL logbook found amid the wreckage of the PP-XDB.

On the FAA website, one identified that the aircraft with the registration number N568XL had a sales record dated 19 December 2016. After that date, there was no request for renewal of the pertinent airworthiness certificate, a fact that led to its cancellation on 30 May 2018.

While browsing the website of the NTSB (National Transportation Safety Board, accident investigation authority in the United States) one found an accident record of the N568XL dated 20 February 2016 (Figure 4). The documents used in the investigation were available in the "docket" (file repository) of the aforementioned authority. One verified that the engine of the N568XL aircraft was the same one installed in the PP-XDB (SN 400086).

Figure 4 – (Larger picture) Liberty XL2 aircraft (N568XL) after the 20 Feb 2016 accident. (Smaller picture), the same aircraft before the accident. Source: NTSB Docket - ERA16LA113.

Also, the documents showed that the aircraft had been manufactured in 2007, and had a total of 1,162 hours on the date of the occurrence in the United States. The PP-XDB logbook to which the Investigation Committee had access was opened on 01 July 2021, had as its first hour-meter record a total of 1,575 hours and 6 minutes.

Consulting with the ANAC, one verified that the registration marks "PP-XDB" of the *Europa* model airplane belonged to an aircraft manufactured in 1999, which suffered an accident on 08 December 2009, and had its CAVE regularized on 21 January 2010. The last flight of this aircraft recorded in the systems of the referred Agency had the date of 23 March 2010, originating in SNZO (*Fazenda Bebida Velha* Aerodrome, *Touros*, State of *Rio Grande do Norte*), and landing in SNEM (former ICAO designator of the *Aeroclube de Pernambuco* Aerodrome, *Recife*, State of *Pernambuco*).

The ANAC informed that the transfer of ownership of the PP-XDB aircraft to the same owner registered in the occurrence was done in 2019. However, the referred registration

was canceled due to *perishing*, under the terms of § 4 of art. 55 of Resolution nº 293/2013, which read:

> Art. 55. With the purpose of keeping the aircraft registry permanently updated, all public and private aircraft with Brazilian nationality and registration marks whose registry status has not been changed in the RAB in the last 60 (sixty) months must re-register preferably through the use of a specific form available on the ANAC's website. The following data must be provided on the form:
>
> [...]
>
> IV - aircraft data: name of the manufacturer, model, serial number, and aircraft registration category [...].

Finally, upon checking the documents and photographs sent to the ANAC in 2020 for the issuance of the PP-XDB's CAVE, one verified that the photographs received corresponded to the aircraft originally built in 1999 - and not the one involved in the accident (Figure 5, left–hand side). The photographs depicted an aircraft fitted with monowheel landing gear, a carbureted Teledyne Continental engine (SN A06EA069) and a number of other differences.

Figure 5 - Comparison between the Europa aircraft with registration marks PP-XDB (on the left - photograph sent to ANAC) and the Liberty XL2 aircraft involved in the accident in question (on the right).

Notwithstanding the inconsistencies observed between the model registered with the ANAC and the aircraft involved in the occurrence, one considered the elements and data listed in the AFM of the Liberty XL2 aircraft. In order to facilitate comprehension of the operational aspects described in this final report, the aircraft components and related systems are described below.

Powerplant

The aircraft was fitted with an IOF-240B four-cylinder, four-stroke reciprocating engine. It had horizontally opposed cylinders, with fuel injection, air-cooled and naturally aspirated. It included a wet sump with a high-pressure lubrication system, a suspended *plenum* intake manifold, and an accessory box mounted to its back.

It had 240 cubic inches in its cylinders, capable of generating approximately 125 hp. The recommended cruising power in the manual was 90 hp. The engine drove a two-bladed wooden fixed-pitch propeller.

The engine was managed by a FADEC system for the monitoring and continuous control of the performance, i.e. ignition, cylinder and oil temperature, injection, and fuel mixture.

FADEC system

This system works by receiving multiple data relative to the ongoing flight condition, including air density, throttle position, engine temperature, engine pressure, and several

other parameters. It performs continuous monitoring and control of the point of ignition, fuel injection, timing, and fuel mixture.

By means of a microprocessor, the system monitors the engine operating conditions and automatically adjusts the fuel mixture and ignition timing for any power setting. In the FADEC-controlled engine, the fuel in each cylinder can be changed or enriched individually without affecting the other cylinders.

The system controls the fuel delivered to each cylinder by means of solenoid-driven sequential port fuel injectors. Fuel flow and pressure vary directly with engine speed. The fuel passes through a filter into the distribution block and is sent to each injector. The electric boost pump is used to start the engine during low speed operation. The spark energy varies in relation to the engine load.

The FADEC system is electrically fed by the aircraft's primary electrical network, connected to the bus and to a secondary battery, which is used to supply power to the system independently of the aircraft's main bus.

Alarm system and FADEC panel

The aircraft had a specific panel for warnings and alarms, known as Health Status Annunciator (HSA), which allowed to identify, by means of lights, the systems managed by FADEC that could be malfunctioning (Figure 6).

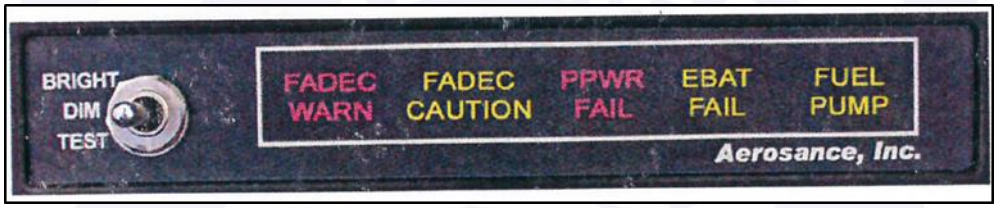


Figure 6 - HSA warning and alarm panel, extracted from the AFM.

As described in the sections of Emergency Procedures and Aircraft and Systems Description, the lights corresponded to the following indications:

- FADEC WARN light - would illuminate if more than one cylinder was failing. This light would also be preceded and/or accompanied by the illumination of the FADEC CAUTION light. On page 3-18, section 3 of the AFM, there was information that this light would indicate a potential threat of total or partial loss of engine power;

- FADEC CAUTION light - would illuminate if the temperature and pressure sensors were defective; if the temperature and pressure were abnormal or above the limit; and, also, if there was a misfire in any cylinder, or if one of the cylinders was not able to burn the mixture because the ignition key was in the OFF position or out of position “BOTH”;

- PPWR FAIL light – would illuminate to indicate that the FADEC was consuming energy from the secondary battery, should the main battery have its supply interrupted;

- EBAT FAIL light – would illuminate in a condition of failure of the secondary battery; and

- FUEL PUMP light – would illuminate in case of fuel pump failure.

1.7. Meteorological information.

SDBB did not have either a meteorological station or meteorological information services. The Terminal Area Forecast (TAF) of SBRP (*Leite Lopes* Aerodrome, *Ribeirão Preto*, State of *São Paulo*), located 40 NM away from the accident site, had the following information:

TAF SBRP 270900Z 2712/2724 11005KT CAVOK TX33/2716Z TN25/2724Z BECMG 2713/2715 33005KT SCT040 PROB40 TEMPO 2719/2722 VRB05KT VCTS SCT030 FEW040CB BECMG 2722 /2724 08005KT CAVOK RMK PGH=

The TAF of SBSR (*Professor Eriberto Manoel Reino* Aerodrome, *São José do Rio Preto*, State of *São Paulo*), located 50 NM away from the accident site, had the following information:

TAF SBSR 270900Z 2712/2724 10003KT CAVOK TX33/2717Z TN25/2724Z BECMG 2714/2716 35005KT SCT030 BECMG 2722/2724 00000KT FEW030 RMK PGH=

Images recorded by a surveillance camera of *Aeroclube de Bebedouro* confirmed that the visibility, at the time of takeoff, was consistent with VFR flights. There were few clouds, and the wind had an intensity between 5 and 7 kt., with a direction close to 130º (Figure 7).

Figure 7 – Video frame of the surveillance camera of Aerodrome of Bebedouro during the takeoff of the PP-XDB.

Taking into account the Area Meteorological Forecasts, the video recording of the takeoff, and the testimony of observers on site, one verified that the weather conditions were above the minima for the flight, with visibility of more than 10 km and few clouds.

1.8. Aids to navigation.

NIL.

1.9. Communications.

NIL.

1.10. Aerodrome information.

Under the administration of *Bebedouro* City Hall, the aerodrome was public and operated VFR during day-time.

The runway was asphalt-paved, with thresholds 13/31, measuring 1,500 m x 23 m, at an elevation of 1,942 ft. (592 m).

After the impact, the aircraft's final stop position was outside the physical limits of the aerodrome.

1.11. Flight recorders.

Not required and not installed.

1.12. Wreckage and impact information.

The wreckage was at a distance of 600 m from the runway threshold 31 of SDBB.

Accounts of witnesses who saw the aircraft take off, in addition to evidence found in the crash site, indicated that the aircraft began to lose height while still on the takeoff path, and then initiated a right-hand turn (which it kept) until colliding with the ground.

The impact occurred near a dirt road located between a sugar cane plantation and a row of tall trees. Few displacement marks were left in the terrain, and no marks on the plantation.

The torsion marks observed on the fuselage, and the final position of the wreckage indicated that a 180°-rotation relative to the takeoff path had been made (Figure 8). The presence of broken branches in the trees indicated that the aircraft's final trajectory was practically vertical.

Figure 8 - General view of the wreckage and of the impact dynamic.

The debris had a concentrated aspect, characterizing an impact at low speed and high angle, with barely any forward movement. Parts of the engine cowling and one of the propeller blades were projected toward the front of the aircraft at the impact.

Also, even though the cabin controls and indicators were severely damaged, one was able to identify that the power lever was fully advanced and that the fuel selector was in the “ON” position.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

There was no evidence that issues of physiological nature or incapacitation might have affected the pilot’s performance.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

NIL.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

Moments after the occurrence, the firefighters were called on by observers who were near the hangars of the aerodrome.

One of the Flying Club's employees rushed to the accident scene immediately after the occurrence, reporting afterwards that the pilot and the passenger seemingly no longer presented any vital signs.

The belts and suspenders remained intact after the impact, holding both occupants secured to their seats.

1.16. Tests and research.

Analysis of the oil and fuel

Fuel and oil samples were collected from the aircraft and analyzed for the identification of possible discrepancies or signs of contamination.

The two fuel samples were clean, clear, and free of water and solid materials.

One of the samples was provided by the *Aeroclube de Bebedouro* (sample 1), and the other one (sample 2) was collected by the investigation team at the initial action. Both samples were collected from the tank of fuel used for refueling the aircraft.

The sample 1 showed a value slightly above the one specified for the distillation analysis at 10% evaporated. While the ANP's Resolution nº 5/2009 specified a maximum of 75ºC in this distillation, the measured temperature was 79 ± 0.6ºC.

The sample 2 was in accordance with specifications, and showed no signs of contamination.

Visual inspection of the airplane's Powerplant

The aircraft was fitted with a model IOF-240B Teledyne Continental engine (SN 400086). A visual inspection was carried out for identification of possible signs of malfunction or loss of power.

The analysis began with a checking of the ignition system installations, in which one observed that the spark plug wires had the following identification: ACCEL 8.8 SILICONE PLUS - STAINLESS STEEL 8.8 mm (Figure 9). Subsequent study revealed that those components were proper for automotive applications.

Figure 9 – Spark-plug cables used in the aircraft engine.

Upon observing other components of the aircraft, one found that the battery was also for automotive applications (Figure 10). According to writings on its label, the battery was certified in accordance with the norms of the Brazilian Association of Technical Standards (ABNT) NBR 15914 and 15940, which referred to lead-acid batteries for use in motor road-vehicles with four wheels or more.

Figure 10 - Main battery installed on the aircraft.

The aircraft was fitted with two Electronic Control Unit modules (ECU), part of the FADEC system, which were installed in the cell and connected to the engine by cables. They had capacity to store data on ignition, injection, and fuel mixture parameters, however, such modules had been lost track of, making it impossible to verify the information possibly contained in them.

1.17. Organizational and management information.

NIL.

1.18. Operational information.

On the morning of the accident day, the aircraft took off from SDNI (*Nascimento I* Aerodrome, *Vargem Grande Paulista*, State of São Paulo), and proceeded to SDBB, where it would get refueled for the continuation of the flight.

According to reports, the pilot's intention was to fly VFR from SDBB to SBIT.

Observers in the hangars near the runway reported that after the pilot refueled the aircraft, he made a first attempt to take off from the runway 31 of SDBB. In that attempt, the observers reported having heard unusual variations of the engine noise, which resembled intermittent failures. The takeoff was aborted with the aircraft already airborne. The aircraft returned to the runway, and was repositioned for a new takeoff from the opposite threshold (runway 13).

In that second takeoff attempt (with a tailwind component), observers reported having heard abrupt engine noise variations, with a takeoff performance that seemed deficient to them. After the aircraft crossed the opposite threshold (31), the witnesses reported that the aircraft no longer had a rate of climb.

Still according to the reports, when approaching the trees located along the take-off path, the PP-XDB began a slight turn to the right, in what appeared to be a possible maneuver to return to the runway.

In the moments that followed, the aircraft lost lift, and fell amid the trees, rolling over its right-hand wing.

The Investigation Committee obtained access to the images recorded by a sports camera positioned at the back of the cockpit. The recorded images included the preparations for the takeoff from SDNI, which began at approximately 06:30 am (local time) on the day of the accident. The videos totaled 27 minutes and 39 seconds, and ended with the aircraft already en route to SDBB, maintaining an altitude of approximately 4,500 feet.

The video recordings showed that the PIC had been occupying the right-hand seat since the first flight, with the passenger occupying the left-hand seat, which, in accordance with the AFM was to be occupied by the PF (Pilot Flying). The configurations of the aircraft's instruments, the memory checklist items, and the startup of the engine were also carried out by the passenger.

In none of the videos analyzed, did one find any reading or use of the checklists. Instead, there was prevalence of the execution of memory items.

The aircraft's first departure took place shortly after 06:40 am (local time). The PIC, sitting in the right-hand seat, gave instructions to the passenger in the left-hand seat, in a situation that resembled a flight instruction, detailing how the plane should be operated during the takeoff, besides other piloting aspects.

As can be seen from the images obtained by the camera positioned in the back of the cabin (Figure 11), the weather in SDNI was below the VFR minimums, a situation that was also included in the briefing given to the passenger, when the PIC mentioned his expectation to reach VMC during the climb.

Figure 11 – Video frame of the moment the PIC was giving the briefing for the takeoff from SDNI.

Moments after accelerating the engine and releasing the brakes, the first takeoff attempt was interrupted by the passenger, acting as the PF at that time. It was not possible to distinguish what was discussed between the passenger and the PIC, but both of them performed several tests on the flight controls, moving them repeatedly before deciding to perform a backtrack on the runway. The PIC untied himself, opened his side door, and the engine was shut down.

The PIC got out of the aircraft and started performing external checks. The video features “knocking” noises, in response to the PIC's request for the passenger to check the pedals, with complementary information stating that they “were good”. Upon returning to the cabin, the PIC reported that “there was nothing stuck”, referring to the control surfaces checked. The passenger added that the problem could just be “roughness”, something that was understood by the Investigation Committee as relating to the engine.

After returning to his seat in the cabin, the PIC authorized the passenger to start up the engine. After four start-up attempts, the PIC suggested “*letting the starter motor get cool*.” The fifth attempt was made by the PIC, to no avail.

After another four attempts, the possible cause of the problem was discussed by the two occupants of the aircraft. The PIC mentioned that the start-up failure was added to the failure in the flight controls which had occurred shortly before.

In total, eleven start-up attempts were made. The passenger performed tests on the FADEC system panel, mentioning that the EBAT FAIL light was remaining illuminated, and that such condition had to do with the auxiliary battery. The PIC asked whether the aircraft had an auxiliary battery and whether it had already been changed, to which the passenger answered affirmatively.

The Section 4 of the AFM - *Normal Procedures*, when describing the procedures for starting up the engine, specified a preheating action for the cases in which the aircraft had been exposed to temperatures below -7ºC (not applicable to the flight in question), in addition to a 2-minute interval to cool the starter motor after an unsuccessful startup attempt (Figure 12).

STARTING ENGINE

If the aircraft has been exposed to temperatures below -7°C / 20°F for more than 2 hours, preheating is required. If engine does not start on the first try, allow 2 minutes for the starter to cool before trying again.

Figure 12 - Extract from the AFM Normal Procedures section, related to engine start-up.

Out of the eleven start-up attempts, only in two of them was there a wait longer than one minute.

The PIC performed the closure and reopening of the fuel selector. After that, the engine started successfully. The takeoff was made by the passenger, with the runway still showing restricted visibility conditions ahead.

Approximately 13 seconds after the release of the brakes, the FADEC CAUTION light on the annunciator panel illuminated (Figure 13). It remained illuminated for 2 seconds, then came on after eight seconds, remaining lit for 1 minute and 20 seconds. A third episode of illumination of the referred warning light with duration of 10 seconds was observed when the aircraft was approximately 2 minutes into the flight.

Figure 13 - Takeoff run in SDNI. The red circle highlights the "FADEC CAUTION" light illumination on the HSA panel.

The flight proceeded inside clouds in Instrument Meteorological Conditions (IMC) for around 4 minutes. The aircraft then reached the top of the cloud layer (at an altitude just above 4,000 ft.) while still climbing. The aircraft was not certified for IFR flights and did not have an Attitude Directional Indicator (ADI), so the occupants used tablet-type equipment that had an application to simulate the ADI.

The flight continued to SDBB. The cruise phase lasted around 1 hour and 50 minutes (only 3 minutes of the referred phase was recorded on video). There were no recordings of the landing in (or takeoff from) SDBB.

A warning in the section 4 of the AFM (Normal Procedures), also advised that takeoff was prohibited if an abnormal indication appeared on the FADEC HSA panel during any operational checks (Figure 14). The manual recommended aborting the flight and notifying maintenance, pointing out that the flight must not be attempted until the discrepancy was corrected.

WARNING

If an abnormal HSA indication is observed during any operational check, takeoff is prohibited. Abort flight and notify maintenance. Do not attempt flight until the discrepancy has been corrected.

Figure 14 - Extract from the AFM prohibiting takeoff in case of abnormal indication on the FADEC HSA panel.

As highlighted above, all five HSA panel lights came on before and after the engine started up. The FADEC CAUTION and EBAT FAIL lights illuminated more frequently. After the engine started up, the EBAT FAIL, PPWR FAIL, and FADEC CAUTION lights illuminated on several occasions.

If the FADEC CAUTION light illuminated in flight, the manual prescribed checking the power supply of the units A and B of the FADEC system, placing the ignition in the position “BOTH”, monitoring the engine instruments and, should the condition persist, one was required to land the aircraft as soon as practicable (Figure 15).

HSA Yellow “FADEC CAUTION” Annunciator Illuminated

1. FADEC PWR A and B Switches ..... CHECK ON
2. Ignition Switch ..... CHECK BOTH
3. Engine Instruments ..... MONITOR

If condition or annunciation persists:

4. LAND ..... AS SOON AS PRACTICAL

WARNING

Illumination of the yellow FADEC CAUTION annunciator indicates a fault in the FADEC system has occurred. A second fault could result in partial or total loss of engine power.

Figure 15 - Emergency procedure in case of FADEC CAUTION light illumination, extracted from the AFM.

The notice (*verbatim* WARNING) following the 4 steps of the procedure reads that illumination of the yellow FADEC CAUTION light is an indication that a “first” failure of the FADEC system has occurred, and that a second failure could result in total or partial loss of engine power.

The Section 3 of the AFM, when addressing *System Malfunctions*, included warnings relative to the illumination of the EBAT FAIL and PPWR FAIL lights, informing that the engine could be operated normally with the emergency battery for up to 60 minutes, if such battery had been properly maintained and fully charged. The warning reiterated that the landing was planned to take place within 60 minutes with those lights illuminated (Figure 16).

HSA FAULT LIGHT INDICATIONS
Both HSA "EBAT FL" and "PPWR FL" Annunciators Illuminated

1. FADEC PWR A and B Switches.....CHECK ON
2. FADEC PWR A and B Circuit Breakers .....CHECK IN

If annunciators remain ON:

3. LAND ..... AS SOON AS PRACTICAL

WARNING

Engine may continue to operate normally from the emergency battery for up to 60 minutes if the emergency battery is properly maintained and fully charged. Plan to land well within 60 minutes from illumination of EBAT FL and PPWR FL annunciators.

Figure 16 - Emergency procedure for simultaneous illumination of the EBAT FL and PPWR FL lights, extracted from the AFM.

The powerplant limitations section in the AFM reinforced that flight was prohibited if any lights on the FADEC HSA panel were illuminated (Figure 17).

WARNING

Flight is prohibited if any FADEC HSA annunciators are illuminated.

Figure 17 - Extract from the AFM regarding flight prohibition in case of FADEC HSA panel lights illumination.

From the video recordings of the operation, one found that the aircraft's occupants did not pay attention to the illumination of the lights, nor did they mention any actions in response to such lights.

The aircraft also had a liquid crystal display on its panel dedicated to readings of the powerplant parameters; however, due to the low resolution of the filming equipment, it was not possible to record such data with clarity, thus hindering a more accurate analysis of the engine performance during that flight.

As for the takeoff from SDBB, images from a camera installed at the *Aeroclube de Bebedouro* made it possible to observe that, at approximately halfway down the runway, the PP-XDB was off the ground but had not yet reached the height of the neighboring trees, which were approximately 10 m tall. (Figures 18 and 19).

Figure 18 – Video frame of the aircraft taking off from SDBB, moments after passing by the windsock, and close to the central intersection of the runway.

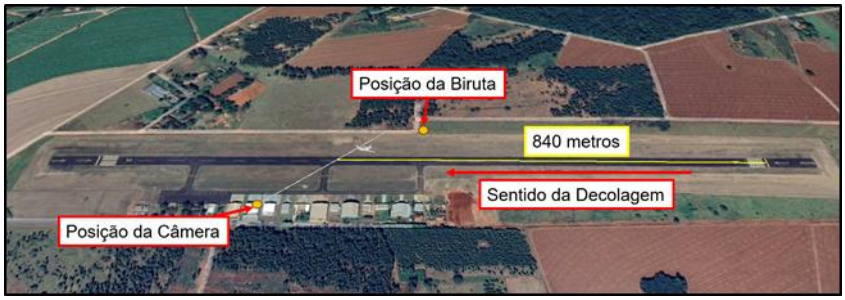


Figure 19 - Estimated distance traveled by the aircraft as per the anteceding Figure 18 (adapted from Google Earth).

The images collected allowed one to observe just part of the takeoff. It was possible to notice that the aircraft maintained a low rate of climb after rotating. External observers, who also watched this video, described that the aircraft gained little or no height at all after passing over the left lateral limit of the image captured by the camera (Figure 20).

Figure 20 - Last image (in highlight) of the aircraft captured by the surveillance camera of *Aeroclube de Bebedouro*.

One verified the existence of several areas both to the right and to the left of the aircraft that could have been used for an emergency landing, had the flight controls of the aircraft been applied in time to maintain its speed above the limit at which the loss of lift would occur.

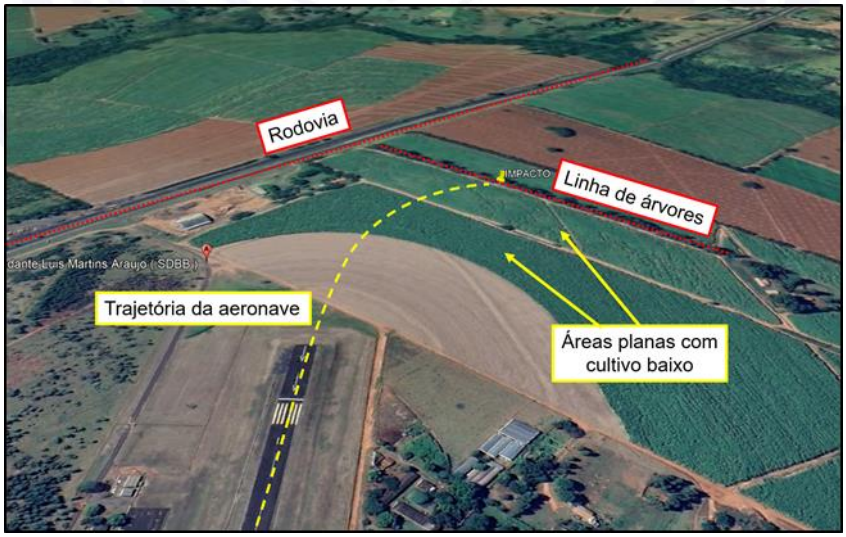


Figure 21 - Aircraft trajectory to the point of impact, highlighting the areas in which an emergency landing could have been made.

1.19. Additional information.

Aeronautical Certification

Aeronautical certification is a process of attesting compliance with the airworthiness requirements established by the local Civil Aviation Authority or by the authorities of the States in which one intends to operate.

The process of aeronautical certification entails the evaluation of the product, by verifying its qualities and reliability.

Upon successful completion of the certification process, aircraft will receive an Airworthiness Certificate (CA) bestowed by the ANAC. Experimental aircraft will be granted an Experimental Flight Authorization Certificate (CAVE).

Aircraft authorized to operate with a CAVE do not need to have demonstrated compliance with requirements. On the other hand, they have operational limitations. The Supplementary Instruction No. 21.191-001 - "Amateur Construction Aircraft", issued by the ANAC on 04 June 2012, reads, in its item 5.2.1, that "an amateur constructor does not need to demonstrate compliance with airworthiness or production requirements corresponding to any aircraft category".

The Civil Aviation Authority, despite requiring some technical verifications, would not attest to the safety or reliability of the project. The experimental flight authorization was to be based on the responsibility of the operator, the builder, and the engineer responsible for monitoring the manufacture of the product.

Another point to be considered is that, in the production of an experimental model, the use of certified aeronautical products was not mandatory. Therefore, there was little or no traceability of the parts or components used.

With respect to the limitations of the aircraft's CAVE, part 6, *Operational Limitations and Concessions*, in items 6 and 7 contained the following:

> 6. This aircraft must be operated by a pilot qualified in accordance with RBAC-61.
>
> 7. The incorporation in this aircraft of any changes having an appreciable effect on weight, balance, structural strength, reliability, operational characteristics, and other characteristics affecting airworthiness must be approved by an aeronautical engineer and informed to SAR/GTAI. An irregular incorporation invalidates this Experimental Flight Authorization Certificate.

Licenses, ratings, and certificate for pilots

Considering that the PP-XDB was an experimental aircraft which had a CAVE, the piloting of the aircraft was conditioned on the PIC having, at least, an Aerosports Pilot Certificate, in accordance with section 61.2.(a)(7) of the RBAC-61 - "*Licenses, ratings, and certificate for pilots*", amendment 13, issued by the ANAC and in force at the time:

> 61.2 Abbreviations and definitions
>
> a) For the purposes of this Regulation, in addition to the applicable definitions contained in section 01.1 of RBAC-01, the terms, expressions and acronyms presented below have the following meanings:
>
> […]
>
> (7) Aerosports Pilot Certificate - CPA means the evidential document, with a status lower than a license, which proves that the holder meets the requirements to operate an aerosports aircraft, as defined in RBAC-01, with a maximum takeoff weight of up to 750 kg, except balloons and gliders, with the limitations and prerogatives established for the aforementioned certificate. (Wording given by Resolution nº 475, of 06/July/2018).

In accordance with the section 61.293 of the RBAC-61, pilots who still held *the Recreational Pilot Certificate* or the *Sport Pilot Certificate* should transition to the *Aerosport Pilot Certificate* (*CPA*) when renewing their respective certificates.

> 61.293 Transition rules for obtainment of the CPA
>
> (a) Sports Pilot Certificates (CPD) and Recreational Pilot Certificates (CPR) are considered valid as long as at least one of their corresponding ratings remains within the period of validity.
>
> (1) On a transitional basis, for CPD or CPR holders to receive additional instruction and obtain the CPA, their Sports Pilot Certificates (CPD), Recreational Pilot Certificates (CPR) and respective ratings that have expired for up to one year from the date of publication of this amendment will be considered as valid. (Wording given by Resolution nº 705, of 02/Sept/2023)
>
> (b) The transition to the CPA will take place at the time of revalidation of a rating linked to CPD or CPR, provided that the relevant aircraft is classified as a light sport aircraft or aerosport aircraft with a CAVE, in accordance with the requirements established in RBAC-01 and RBAC-21.
>
> (1) CPD holders must prove, at the time of revalidation, that they have received additional air navigation instruction from a qualified instructor of an accredited association or from a certified CIAC.
>
> (c) Aircraft classified in a category higher than light sport aircraft, in accordance with the requirements established in RBAC-21, may only be operated by a duly licensed and qualified pilot, in consonance with the transition rules established in paragraphs (a) and (b) of this section.

Additionally, section 61.289(a) of the RBAC-61 had the following provision concerning flight instruction requirements for being granted the CPA:

> (a) The candidate for a CPA must have received flight instruction from a duly qualified flight instructor of an association accredited in accordance with the RBAC-183 or of a CIAC certified by the ANAC. At the end of the instruction, the flight instructor is responsible for endorsing the student's Digital CIV, declaring that the student is competent to safely perform all the maneuvers necessary to pass the proficiency exam for being granted the CPA. Such declaration will be valid for 30 (thirty) days, counted from the date of the last preparation flight for the proficiency exam. The flight instruction must be, at least, the following: (Wording given by Resolution nº 705, of 02/Sept/2023).

<u>Aircraft nationality and registration marks in Brazil</u>

The nationality and registration marks of aircraft registered in Brazil are granted by the Brazilian Aeronautical Registry (RAB), and with respect to the use of an aircraft's registration marks by another aircraft, the ANAC Resolution nº 293, of 19 November 2013, read the following:

> Article 2. With regard to civil aircraft, the RAB is responsible for the following activities:
>
> I- registering aircraft;
>
> II - granting and controlling nationality and registration marks;
>
> NI - issuing certificates of registration marks;
>
> IV - issuing certificates of airworthiness;
>
> V - issuing certificates of experimental aircraft;
>
> […]
>
> Art. 49. Each aircraft has its own registration number, which is inscribed on the occasion of the first registration in Brazil, and which must be individualized with:
>
> I- name of the manufacturer;
>
> II - model;

III - serial number; and

IV - nationality and registration marks.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was a private flight between SDBB and SBIT.

After takeoff, the aircraft sustained loss of power, followed by loss of lift and collision with the ground, which caused fatal injuries to its occupants.

Being an experimental aircraft, it was not required to be fitted with products certified for aeronautical use. Therefore, one was not able to verify the airworthiness conditions or even the traceability of some components used in the construction of the aircraft.

Nonetheless, with the purpose of understanding the aircraft model and its history, research conducted by the Investigation Committee showed that the registration number PP-XDB was inscribed with the ANAC as a *Europa* aircraft model with the SN E533, built in 1999, while the accident aircraft was a *Liberty XL2* model manufactured in 2007 in the United States, having the SN 0053 and the registration marks N568XL.

After analyzing the items listed in the PP-XDB archives, including its powerplant, systems, panels, finishing, and even the occupants' seats (which had the inscription “Liberty”), in addition to the fact that the aircraft had a manual and a notebook on board corresponding to the N568XL airplane, the Investigation Committee concluded that the accident aircraft was brought to Brazil after its accident and sale in 2016.

Such fact was confirmed after verification of the photographs and documents sent to the ANAC for renewal of the CAVE in 2020. Even though the referred Agency did not find irregularities in the documents which could curb the issuance of the CAVE, and the received photographs were considered authentic, the certificate was being requested for the *Liberty XL2* aircraft with registration marks N568XL and SN 0053 brought from the United States.

Taking advantage of the similarities between the *Europa* and the *Liberty XL2* aircraft models, one is likely to have resorted to making use of the PP-XDB’s registration marks, which were still active in the RAB, in order to facilitate the airplane’s operation in Brazil on an experimental basis.

According to information collected in the investigation, the use of an aircraft’s registration marks by another aircraft was not in accordance with the regulations in force. Furthermore, the operation of the PP-XDB was in contrast with the provisions of the section 21.191 (g) of the RBAC-21, which allowed experimental operation for aircraft “whose largest portion had been built by individuals whose intention was to build it solely for their own education or recreation”, and the provision did not apply to “aircraft built in series or imported ready-made”, which, in the end, was the case.

Moreover, even if only the engine had been imported, and other systems (such as the FADEC and landing gear) had been modified, this would have represented a major modification compared to the original model (*Europa*), which would have invalidated the aircraft's CAVE, as stated in its part 6, *Operational Limitations and Concessions*, item 7.

With regard to the operation of the aircraft, the CAVE also prescribed that it had to be operated by a pilot qualified in accordance with the RBAC-61.

By means of videos of the operation recorded on the day of the occurrence, one verified that an unqualified individual occupied the left-hand seat, and performed all the Pilot Flying’s tasks.

Even though the aircraft had "*dual-command*" capability, and the fact that a qualified crewmember was on board, the aircraft's main instruments and controls were positioned for operation by the pilot sitting in the left-hand seat. The very AFM prescribed that the seat on the left corresponded to the pilot, while the seat on the right was intended for a passenger.

The fact that the passenger was sitting in the left-hand seat and acting on the controls on the occasion, were factors that may have contributed to the PIC having a shorter reaction time available after noticing the failure occurring during the takeoff from SDBB, and this would have impaired a timely response on the part of the PIC.

In any case, the action on the controls, whether having been executed by the passenger or by the PIC, was not adequate for preventing the loss of control in flight and the catastrophic result that followed.

Another aspect to be noted is that the takeoff of the aircraft was made in a downwind direction. Despite the low intensity of the wind (around 5 to 7 kt.), good piloting practices recommend selecting the runway threshold favoring an upwind takeoff.

Taking into account that the PIC was licensed and qualified for the operation of the aircraft, and that the last event was related to a loss of lift, one observed an inadequate assessment of the attitude and speed parameters that, otherwise respected, would allow for an emergency landing after takeoff in the open areas available nearby.

Despite the lack of sufficient data to confirm the reason for the aircraft's loss of performance, the warning lights in the FADEC system, observed in the recordings of the previous flight, indicated that a first failure in the system had already occurred and, according to the AFM, a second failure would result in total or partial loss of engine power.

Considering that the FADEC CAUTION warning and other lights on the HSA panel were already indicating failures of the system, the most likely hypothesis is that they worsened during the takeoff from SDBB, leading to the loss of power that preceded the loss of control in flight.

The video recordings allowed perceiving that the occupants had little knowledge of the aircraft's systems and their peculiarities, as well as of abnormal conditions and emergencies.

Several sections of the manual warned that flying the aircraft was prohibited if any of the lights on the FADEC HSA panel illuminated. Even though the lights came on during the flight to SDBB, they neither attracted the attention of the crew nor made them resort to the AFM available on board.

Such state of affairs prompted the Investigation Committee to conclude that the crew's ability in relation to the unacceptable risk of operating the aircraft in those circumstances contributed to their low situational awareness and led to the outcome of the occurrence.

In addition, it is worth mentioning that the video recordings also showed operation below VFR minimums during the first flight on the day of the occurrence, contrasting with Part 6 (*Operational Limitations and Concessions*) of the CAVE issued for the aircraft, which prescribed operation during daylight time under VFR. Furthermore, the PIC was not qualified for IFR flights, nor was the Aerodrome in SDNI entitled for IFR operations.

Thus, the adoption of actions such as, operation of the aircraft in meteorological conditions below VFR minimums; failure to comply with the AFM prescriptions for discontinuance of the flight in case the FADEC warning lights came on, and operation of the aircraft with an unqualified individual on the controls, served to demonstrate postures of complacency, overconfidence, improvisation, and non-compliance with operations and procedures, contributing to the outcome of the occurrence in question.

The inadequate judgment as to whether or not operate in those marginal safety conditions resulted in incorrect choices, demonstrating that a faulty decision-making process also contributed to the occurrence.

In relation to the fuel used to fill up the tanks of the aircraft in SDBB, it is worth mentioning that the sample (collected by the *Aeroclube* after the occurrence) showed a value slightly above the one specified in the distillation analysis at 10% evaporated. However, since the sample proved to be compliant with all the other tested parameters, one cannot affirm that such discrepancy contributed to the accident.

As for the maintenance of the aircraft, the investigation revealed that an aeronautical engineer filled out the CVA and approved the aircraft for flights on 22 January 2022, just over a month before the accident. The Investigation Committee did not have access to the services performed in the inspection, but the logbook records indicated that a 50-hour inspection was carried out on 20 February 2022, with changes of oil, filter, tailwheel bearing, and brake pads.

The existence of automotive components in the aircraft, as well as the occurrence of malfunctions related to the flight controls and FADEC system, raised the hypothesis that the inspections carried out were not sufficient to guarantee the safe operation of the equipment.

Considering that the model of the aircraft did not even correspond to the one inscribed on its registration plate, the CAVE issued by ANAC was no longer valid.

Therefore, the operation of the aircraft was in disagreement with the aeronautical regulations in force, resulting in safety levels below the minimum acceptable levels established by the Brazilian State.

From the arrival of the aircraft to the application of inadequate maintenance procedures, in addition to the operation in contrast of the prescriptions of the AFM, one found that the accident involving the PP-XDB aircraft could have been prevented by compliance with the existing regulations.

3. CONCLUSIONS.

3.1. Findings.

a) the PIC held a valid CMA (Aeronautical Medical Certificate);

b) the PIC held valid ratings for MNTE (Single Engine Land Airplane) and INVA (Flight Instructor - Airplane);

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

d) the passenger did not have any licenses, certificates or ratings for piloting aircraft;

e) the passenger occupying the left-hand seat on the accident flight, had also occupied the left-hand seat on the previous flight;

f) the lack of specific documentation made it impossible to verify whether the aircraft operated within its specified weight and balance limits;

g) the Investigation Committee did not have access to the records of the airframe, engine, and propeller logbooks;

h) the meteorological conditions were above the minimums for the conduction of visual flights;

i) the PP-XDB registration marks belonged to the Serial Number E533 *Europa* aircraft, manufactured in 1999;

j) the accident aircraft was a Liberty XL2 (SN 0053), manufactured in the United States in 2007, which had operated in that country with the registration number N568XL;

k) examinations of the aircraft's powerplant and cell revealed the existence of spark-plug cables and batteries for automotive use;

l) prior to the takeoff from SDNI, the occupants noticed problems that could be related to the aircraft's flight controls, and had difficulty starting up the engine;

m) during the flight between SDNI and SDBB, the FADEC CAUTION and EBAT FL lights illuminated on the FADEC HSA panel;

n) after the refueling in SDBB, there was a first takeoff attempt from the runway 31, but the takeoff was aborted;

o) in the second attempt, the aircraft took off from runway 13 with a tail-wind component;

p) the aircraft was already off the ground, when loss of performance occurred;

q) after the takeoff, the aircraft made a slight turn to the right, losing lift, and rolled over the right wing, something typical of loss of control in flight;

r) the impact occurred close to a line of trees transverse to the aircraft's direction of travel;

s) the aircraft was destroyed; and

t) the PIC and the passenger suffered fatal injuries.

3.2. Contributing factors.

- **Attitude – a contributor.**

The actions taken denoted difficulties in the way of thinking, feeling, and reacting, which led to inadequate postures that contributed to the outcome of the occurrence in question.

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

Despite the aircraft’s loss of performance after takeoff, a slight turn to the right was made, with the aircraft maintaining a positive attitude until losing lift, a fact that resulted in loss of control in flight.

- **Aircraft maintenance – undetermined.**

Although a CVA, which would have certified the aircraft's airworthiness, had been completed approximately five weeks prior to the accident, the possibility was raised that the maintenance work had not been sufficient to guarantee safe operation of the aircraft, since there were repeated failures signaled by the FADEC system, in addition to the perception, on the part of the crew, of the failure affecting the aircraft flight controls.

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

There was a loss in the ability to analyze and choose alternatives that would have prevented the outcome of the incident, evidencing a faulty decision-making process.

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-028/CENIPA/2022 - 01 **Issued on 05/16/2024**

Reassess the Agency's internal processes, in order to refine the inspection criteria for experimental aircraft after issuance of the CAVE, especially in the cases involving the occurrence of accidents, with the aim of ensuring the safety of such aircraft, in accordance with the criteria under which the referred Certificate has been issued.

A-028/CENIPA/2022 - 02 **Issued on 05/16/2024**

Disseminate the lessons learned from this investigation at events held by the Agency and aimed at promoting aviation safety, in order to contribute to the increase of awareness on the part of civil aircraft operators and pilots with respect to the need of compliance with the requirements established by the Civil Aviation Authority

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On May 16th, 2024.