COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 140/CENIPA/2019

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-ETJ**
MODEL:	**SR20**
DATE:	**21OCT2019**

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 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. 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 21OCT2019 accident with the SR20 aircraft model, registration PR-ETJ. The accident was classified as “[LOC-I] Loss of Control in Flight” and “[F-POST] Fire/Smoke (post-impact)”.

After the take-off, the aircraft lost height and crashed into the ground and into vehicles, causing damage to third parties.

Then, the plane caught fire and was destroyed.

The pilot had injuries that led to his death in hospital two days later. One of the passengers also suffered fatal injuries.

The other two passengers suffered serious injuries.

Two people who were at the scene of the accident suffered fatal injuries.

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

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CA	Airworthiness Certificate
CAPS	Cirrus Airframe Parachute System
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
CVA	Airworthiness Verification Certificate
FAA	Federal Aviation Administration
IAM	Annual Maintenance Inspection
IPC	Illustrated Parts Catalog
MNTE	Airplane Single Engine Land Rating
PIC	Pilot in Command
PN	Part Number
PPR	Private Pilot License – Airplane
SACI	Integrated Civil Aviation Information System
SBIL	ICAO Location Designator - Jorge Amado Aerodrome, Ilhéus - BA
SBPR	ICAO Location Designator – Carlos Prates Aerodrome, Belo Horizonte - MG
SBPS	ICAO Location Designator – Porto Seguro Aerodrome, BA
SIPAER	Aeronautical Accident Investigation and Prevention System
TPP	Registration Category of Private Service
UTC	Universal Time Coordinated
VPD	Velocity of Parachute Deployment

1. FACTUAL INFORMATION.

Aircraft	**Model:** SR20 **Registration:** PR- ETJ **Manufacturer:** Cirrus Design	**Operator:** Private
Occurrence	**Date/time:** 21OCT2019 - 1115 UTC **Location:** Caiçara District, Belo Horizonte - MG **Lat.** 19°54'17"S **Long.** 043°58'35"W **Municipality – State:** Belo Horizonte – MG	**Type(s):** "[LOC-I] Loss of Control in Flight" and "[F-POST] Fire/Smoke (post-impact)" **Subtype(s):** NIL

1.1 History of the flight.

The aircraft took off from the Carlos Prates Aerodrome (SBPR), Belo Horizonte - MG, to the Jorge Amado Aerodrome (SBIL), Ilhéus - BA, at about 1115 (UTC), in order to transport personnel, with a pilot and three passengers on board.

After the take-off, the aircraft lost height and crashed into power poles on Minerva St., 980 m away from threshold 27 of SBPR.

It then hit vehicles parked on the road and another vehicle moving.

The aircraft caught fire, and the flames spread, reaching two other vehicles parked on the street, also destroying the facade of a fitness center.

The plane's ballistic parachute was found on the road, attached to a traffic sign.

After the fire, the aircraft was destroyed.

One of the passengers died at the crash site. The pilot died two days later in the hospital.

The occupants of the vehicle into which the aircraft collided died at the scene, and two other occupants of the aircraft suffered serious injuries.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft was destroyed.

1.4 Other damage.

Damage was found to a residential wall and two electrical power poles along the road. The power supply on the road was suspended.

Three vehicles caught fire as a result of the aircraft fire.

The glass facade of a fitness center and a traffic sign were damaged.

The hood of one car and the side of another were also damaged, hit by electrical cables and parts of the aircraft.

The awning of a shoe store was consumed by fire.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	PIC
Total	851:10
Total in the last 30 days	00:00
Total in the last 24 hours	00:00
In this type of aircraft	00:00
In this type in the last 30 days	00:00
In this type in the last 24 hours	00:00

N.B.: Data relating to hours flown were obtained through records in the Integrated Civil Aviation Information System (SACI) of the National Civil Aviation Agency (ANAC). The last launch of flight hours at SACI was carried out on 11JUL2019, with no new launches until the date of occurrence.

1.5.2 Personnel training.

The PIC took the PPR course at the *Escola de Aviação Civil* – EFAI, in 2011.

1.5.3 Category of licenses and validity of certificates.

The PIC had a PPR License and had a valid MNTE Rating.

1.5.4 Qualification and flight experience.

The PIC was qualified, but it was not possible to prove whether he had recent experience in the aircraft model.

1.5.5 Validity of medical certificate.

The PIC had a valid CMA.

1.6 Aircraft information.

The aircraft, Serial Number (NS) 1804, was manufactured by Cirrus Design in 2007, and was registered in the TPP category.

The aircraft, in accordance with Type Certificate Data Sheet No. A00009CH, issued by the FAA for the SR20 model, was equipped with a Continental engine model IO360-ES (6).

The IO360-ES (6) engine NS 360360, should conform to Type Certificate Data Sheet No. E1CE, issued by the FAA.

The CA was valid. The last CVA was issued on 08AUG2019.

The airframe, engine, and propeller logbook records were not updated.

Cirrus Airframe Parachute System (CAPS) features

The Cirrus aircraft, models SR 20 and SR 22, had a parachute triggering system called Cirrus Airframe Parachute System (CAPS), whose actuation was done by activating a red lever located above the pilot's shoulder.

As stated in the CAPS guide, available on the manufacturer's website: "Cirrus pilots need to train so that they are capable and conditioned to use the parachute when necessary."

According to the manufacturer's manual, the device could be deployed in an emergency, but required the aircraft to be below its VPD, which in the SR 20 would be 133 kt, and a minimum height of 400 ft. This guide contained the following information about possible CAPS triggering situations:

The CAPS should be activated in the event of a life-threatening emergency, where its use is recommended as being safer than attempting to hold the flight to land.

Loss of control:

A loss of control is a situation in which the aircraft does not respond as the pilot expects and may be the result of a control or system failure, turbulence, disorientation, icing or loss of situational awareness on the part of the pilot. If a loss of control occurs, the CAPS must be activated immediately.

Engine failure (out of runway range):

If a forced landing is required on any surface other than a runway, activating the CAPS is highly recommended. So also, in situations of forced landing in terrains such as: mountains, water, under fog, at night, or in IMC conditions.

Engine failure (within runway range):

In the event of an engine failure within a glide distance to a runway, the pilot must continually assess the situation. At 2,000 ft AGL, if the landing is guaranteed, the pilot can proceed to the runway. Otherwise, the pilot must activate the CAPS. At 1,000 ft AGL, if landing is still guaranteed, the pilot can continue to recognize that the risks of getting too high or too low or losing control of the aircraft at low altitude are likely to outweigh the risks of a CAPS activation at the right time. If landing is not guaranteed until at least 400 ft AGL, the pilot must trigger the CAPS immediately.

Pilot Incapacitation:

Pilot incapacitation can occur for a variety of causes, ranging from a pilot's medical problem to even a bird strike that injures the pilot. If such a situation arises and no passenger has been trained to land the aircraft, the use of the CAPS is highly recommended.

Collision in the air:

A mid-air collision will likely cause the aircraft to become uncontrollable, due to damage to the control cables or the aircraft structure. Unless it is evident that neither the controls nor the structure of the aircraft have been affected, the use of the CAPS is highly recommended.

Structural failure:

A structural failure has never occurred on a Cirrus aircraft. However, if it does occur, activating the CAPS is highly recommended.

Regarding the speed and altitude to activate the CAPS, that guide mentions that:

The maximum speed shown for the parachute activation is not meant to be a limitation, just as, for example, the maximum crosswind speed is not. The VPD is the speed at which the CAPS was demonstrated during its homologation. The parachute proved to withstand being deployed at 165 kts during extreme drop tests. These tests were carried out with 125% of the aircraft's maximum take-off weight, that is, it is possible that the parachute can support activations at even higher speeds. There have been several cases of successful CAPS activation at speeds above VPD.

No minimum or maximum altitude has been defined for activating the CAPS. This is because the actual loss of altitude during any activation depends on the aircraft's attitude, altitude and speed, as well as other meteorological factors.

The altitude loss during the CAPS opening depends primarily on the direction the aircraft is maintaining at the time of activation. If the parachute is deployed in a leveled attitude, much of the deceleration occurs over a horizontal distance, minimizing the loss of altitude. If the parachute is activated on a vertical descent, deceleration occurs over a vertical distance, when altitude loss is maximum.

If possible, the pilot should activate the CAPS with sufficient time and altitude for a successful activation; thus, the decision to activate must be taken as soon as possible. The pilot must have a minimum altitude in mind to activate the CAPS. If the CAPS is activated too close to the ground, the chances of a successful activation decrease dramatically. Whenever the pilot is in a situation where there is no alternative for survival, the CAPS must be used regardless of altitude.

The manufacturer made available to pilots, on its website (https://learning.cirrusapproach.com/learning-catalog), free training on the CAPS.

1.7 Meteorological information.

The weather conditions were favorable for the flight.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place out of the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The first impact occurred in a pitched down attitude (approximately 10°) and with leveled wings, causing the right-wing tip to collide with an electrical power pole on the road (Figure 1).

Figure 1 - Point of the first impact of the aircraft.

The second impact occurred against the cables of the electrical power of the road where the forced landing took place.

After the second impact, the aircraft collided with the asphalt of the same road, dragging for about 100 meters until it collided with the back of a vehicle that was circulating on the road (Figure 2).

Figure 2 - Marks on the asphalt from the aircraft collision.

After this collision, the aircraft was at 90° to the road axis.

The aircraft caught fire after coming to a complete stop, and the structure was consumed by fire.

The degree of destruction and carbonization of the aircraft made it difficult to verify equipment and instruments (Figures 3 and 4).

Figure 3 - Aircraft wreckage after the fire was extinguished.

Figure 4 - Close-up view of the wreckage after the fire has been extinguished.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

No evidence was found that problems of physiological nature could have affected the flight crew performance.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

No evidence was found that problems of physiological nature or incapacitation could have affected the flight crew performance.

1.14 Fire.

After the aircraft collided with a vehicle on the roadway, both caught fire.

The fire completely consumed the vehicle and hit another one that was parked on the road, in addition to consuming a large part of the aircraft structure (engine assembly, cabin and wings).

1.15 Survival aspects.

After the impact, the pilot and passengers who were in the back seat managed to leave the aircraft and were helped by people who witnessed the forced landing.

These three occupants had burns over much of their bodies from the fire. Due to the injuries sustained, the pilot died in the hospital two days after the occurrence.

The front seat passenger (right side) was thrown forward, and his skull collided with the aircraft's dashboard.

This passenger was unable to leave the aircraft and had his body charred, dying on the spot.

1.16 Tests and research.

In 2013, the PR-ETJ aircraft had a serious incident in the city of Jundiaí - SP, causing damage to the engine. This occurrence generated the need for a general engine overhaul in 2014.

As identified during the investigations, this general engine overhaul, carried out in 2014, resulted in the replacement of items in the aircraft's fuel system, through a kit sent by the manufacturer, which includes the fuel distributor valve.

In all the documentation that was presented referring to the maintenance of the aircraft, it was not possible to identify the Part Number (PN) that made up this kit, nor the maintenance records referring to its application in the engine.

In this context, it was also not possible to verify the real compatibility of this engine with its specification type due to the absence of documentation and the degree of destruction resulting from the accident.

In the course of the investigations, the engine was opened by the investigation team, when it was found that the PN of the fuel distribution valve was not the one expected for the type of engine, the PN installed was: R-646508-10A7.

According to the Illustrated Parts Catalog for the IO-360-ES engine (6), the distributor valve planned was the PN 646508-10A5.

In contact with the manufacturer's commercial representative, he was questioned about the effects related to the engine's performance with the installation of the unforeseen PN. The representative reported that there were no adverse effects with installing the alternate component.

This information, however, was not included in the aircraft maintenance records.

The aircraft engine was opened and, considering the information from the execution of a general overhaul carried out in 2014, there were signs of early degradation.

Analysis of the engine's internal components inferred to investigators that the overall condition of the engine was not consistent with the operating time that had elapsed since the overhaul and the occurrence.

On the cylinders and pistons, based on their coloration, there were indications that the engine was being operated with a lean mixture.

In the crankcase half housings, it was found that the bearing shells showed signs of non-uniform wear and evidence that they were moving radially and axially.

This bearing condition would result in abnormal vibration operation.

Considering the fuel used by the aircraft, aviation gasoline, an analysis of a sample taken from the supply truck was carried out, in order to verify evidence that could have compromised the performance of the engine.

The results obtained from this analysis of the fuel sample were in accordance with the specifications, with no evidence of contamination that could compromise the engine performance.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

Information about the pilot's flight hours was obtained from the ANAC website, which had no recent updates regarding the register of flight hours.

Information was obtained from the pilot who operated the aircraft, prior to the event, who was on board during the event and was sitting in the back seat of the aircraft, participating in the flight as a passenger.

According to information from this pilot, the flight was being carried out with the purpose of taking him to the city of Ilhéus - BA, where he would transfer a helicopter to Belo Horizonte - MG.

The crashed aircraft was involved in a commercial transaction between the occupants on board, so the future owner was participating in the flight for the purpose of its purchase.

The buyer was seated in the front right seat of the aircraft next to the pilot.

According to investigations, the aircraft was out of the weight and balance limits specified by the manufacturer, and found itself with weight above the established limit.

According to research, carrying out the planned route between the Carlos Prates Aerodrome - MG, and the Ilhéus Aerodrome - BA, with the Porto Seguro Aerodrome (SBPS) - BA, as the closest alternative to the destination location, would require the use of the aircraft near its maximum range of 528 NM, being necessary to supply it with the maximum fuel capacity.

Thus, adding up the weight of the aircraft, the fuel and the passengers, it was observed that the value reached would exceed by at least 100 kg the maximum take-off weight established by the manufacturer, which was 1,360 kg.

The value informed only took into account the declared weight of the passengers, not taking into account luggage and other objects on board.

According to information from the surviving pilot, the occupants of the aircraft boarded with few belongings and light backpacks (it was not possible to specify the weight of the luggage during the investigations carried out), but it was added to the total weight on board, which, as mentioned previously already exceeded by at least 100 kg the maximum weight limit of the aircraft.

According to the surviving pilot's, the PIC had a great deal of flying experience and flew regularly, although he had not operated the aircraft in the days before the accident.

The passenger reported that the aircraft had made a flight the week before the occurrence, performing the round trip between the cities of Belo Horizonte - MG and Rio de Janeiro - RJ, in which he was responsible for flying the aircraft.

According to the account of the surviving pilot, the take-off run took place without any abnormality, and he was positioned in the right rear seat, behind the aircraft buyer. He also reported the following events after the rotation of the aircraft:

- stall alarm was heard until ground impact;

- the PIC started a left turn during which the pilot, positioned in the back seat, asked the PIC what was happening;

- the PIC replied that he did not know what was happening, and at that moment, the pilot observed that the aircraft was not ascending and that the speed was decreasing;

- observing the situation, with the aircraft losing altitude, stall horn sounding and speed not increased, the pilot, who had knowledge of the aircraft's systems, activated the aircraft's emergency parachute (CAPS);

- the pilot informed that the aircraft collided with some obstacles on the public road where the forced landing took place and, after that, it crashed with the ground, coming to travel about 100 meters, dragging itself along the road;

- during this trajectory, the aircraft collided with a vehicle that was traveling in the same direction as the aircraft's fall; and

- after the aircraft stopped, the pilot reported that he abandoned the aircraft with the other occupant, who was also in the rear seat.

The trajectory of the aircraft can be seen in Figure 5, below:

Figure 5 - Sketch of the occurrence. Source: Google Earth.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a passenger transport flight between the cities of Belo Horizonte - MG and Ilhéus - BA.

The PIC was qualified, had the PPR License and had a valid MNTE Rating. He had about 850 total flight hours. However, it was not possible to confirm his recent experience in the aircraft model.

The meteorological conditions were favorable for the flight and did not contribute to the occurrence.

Despite the aircraft having a valid CA, the airframe, engine and propeller logbook records were outdated. Also, the plane was out of weight and balance limits.

Analyzes were carried out on the powertrain and on the fuel sample taken from the aircraft supply truck, in order to find evidence that could have compromised the engine's performance.

The results obtained from the analysis of the fuel sample were in accordance with the specifications, with no evidence of contamination that could compromise the engine's performance.

Engine analysis followed the methodology provided for the type, analysis and extent of engine damage. On that occasion, premature wear conditions of internal components were observed, incompatible with the time elapsed between the general engine overhaul and the date of occurrence.

It was found that the PN of the fuel distribution valve installed in the engine was not the expected one, and there was no record of the application of this part in the maintenance records. In addition, there was no technical instruction from the manufacturer, or document issued by the certifying agency which supported such a configuration.

In this context, the engine did not meet the requirements to be in operation.

The analyzes carried out in the powertrain group indicated that the maintenance was not performed properly.

Although the state of destruction of the components did not allow a conclusive answer about the performance of the engine, it was possible to infer, from the information obtained during the investigation, that this component presented a performance below the predicted for the accomplishment of the flight in the conditions observed in this occurrence.

In this way, the engine operation below the expectations for its performance, associated with the context of excess weight during the take-off, contributed to putting the aircraft in an inadequate operating condition after the take-off.

The analysis of this situation was corroborated by the available images of the occurrence and by the statement of the survivor, who claimed to have observed the stall alarm sounding right after the rotation, remaining in this condition throughout the aircraft's trajectory until the impact with the ground.

With the aircraft losing altitude and out of a stabilized flight condition, the parachute (CAPS) was activated by the passenger located in the rear seat, who was a pilot and had previously operated the aircraft, which caused a degradation of the aircraft speed with the consequent loss of lift, which led to its fall and collision with obstacles on the ground.

The opening of the parachute did not have the desired result due to the low altitude at which the aircraft was at the moment of activation, not allowing the proper functioning of this emergency equipment, which, according to the manufacturer's manual, could be activated in the event of an emergency but required the aircraft to be below its VPD, which in the case of the SR 20 would be 133 kt, and at a minimum height of 400 ft.

Thus, the operational conditions involved during the take-off, with the engine operating below its maximum performance in an aircraft with the operating weight above the maximum take-off weight established by the manufacturer, may have favored the occurrence of the sequence of events that culminated in the entry of the aircraft in a stall condition, resulting in its crash, after opening the emergency parachute at low height.

It is possible that the PIC's lack of experience in the equipment, associated with an operational flight condition out of the weight limits established by the manufacturer, and a limited performance of the powerplant, have led the aircraft to a condition of irreversibility in this event, making its inevitable fall.

3. CONCLUSIONS.

3.1 Facts.

a) the PIC had a valid CMA;

b) the PIC had a valid MNTE Rating;

c) the PIC was qualified, but it was not possible to confirm his recent experience in the aircraft model;

d) the aircraft had a valid CA;

e) the aircraft was out of the weight and balance limits;

f) the airframe, engine and propeller logbook records were not updated;

g) based on the documentation presented, it was not possible to verify the engine's compatibility with its type specification;

h) the weather conditions were favorable for the flight;

i) the opening of the parachute was performed below the minimum recommended height, after activation made by a pilot who was there as a passenger and occupied the back seat of the aircraft;

j) the aircraft collided with obstacles on the public road near the take-off location and a fire started;

k) after the collision with obstacles on the public road, the aircraft collided with the asphalt of the road and dragged for about 100 m until it collided with a vehicle that was transiting on the site;

l) the aircraft caught fire after the collision with the ground and was destroyed;

m) the PIC died two days after the accident, in the hospital;

n) one aircraft passenger died on the spot and two other aircraft passengers suffered serious injuries.

3.2 Contributing factors.

- **Attitude – a contributor.**

The performance of the flight, being in conditions of weight in disagreement with what was foreseen for the aircraft, corroborated for its atypical performance.

Thus, the weight above the prescribed limits contributed to the aircraft not obtaining enough power to remain in flight.

Aircraft maintenance – undetermined.

The performance of the engine maintenance services, with the use of components not prevised in the manufacturer's manual, combined with an eventual continued operation with disproportionate levels of vibration and mixture of air and fuel, may have contributed to the decrease in the operation of the powertrain, in a condition in which a maximum performance is required from this equipment.

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

It is possible that the pilot's recent experience in the equipment has made it impossible to adopt adequate measures that could avoid the conditions of loss of control of the aircraft given the operational circumstances presented, contributing to the worsening of the situation and the consequences arising from this condition.

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".

NIL.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On November 3th, 2022.