

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 010/CENIPA/2021

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PT-LYG
MODEL:	95-B55
DATE:	24JAN2021



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 by taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document that 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 into the Brazilian legal system by 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 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 24JAN2021 accident with the 95-B55 aircraft model, registration PT-LYG. The accident was classified as “[LOC-I] Loss of Control in Flight”.

Shortly after taking off from the *Associação Tocantinense de Aviação* Aerodrome (SWEJ), Porto Nacional - TO, the aircraft lost lift, crashed into the ground, and caught fire.

The aircraft was destroyed.

The pilot and five passengers suffered fatal injuries.

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



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CAVOK	Ceiling and Visibility OK
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CIV	Pilot's Flight Logbook
CMA	Aeronautical Medical Certificate
CVA	Airworthiness Verification Certificate
IAM	Annual Maintenance Inspection
IFRA	Instrument Flight Rating - Aircraft
METAR	Meteorological Aerodrome Report
MLTE	Airplane Multi Engine Land Rating
NSCA	Aeronautics Command System Standard
NTSB	National Transportation Safety Board (USA)
OM	Maintenance Organization
PCM	Commercial Pilot License – Airplane
PIC	Pilot in Command
PMD	Maximum Take-off Weight
PPR	Private Pilot License – Airplane
SBGO	ICAO Location Designator - Santa Genoveva Aerodrome, Goiânia - GO
SBPJ	ICAO Location Designator - Palmas Aerodrome, Tocantins - TO
SIPAER	Aeronautical Accident Investigation and Prevention System
SWEJ	ICAO Location Designator - Associação Tocantinense de Aviação Aerodrome, Porto Nacional - TO
TPP	Registration Category of Private Service - Aircraft
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	Model: 95-B55	Operator: <i>Construtora Meirelles Mascarenhas Ltd.</i>
	Registration: PT-LYG	
Occurrence	Manufacturer: Beech Aircraft	Type(s): "[LOC-I] Loss of Control in Flight"
	Date/time: 24JAN2021 - 1030 UTC	
	Location: Luzimangues District	
	Lat. 10°11'02"S Long. 048°33'05"W	
Municipality – State: Porto Nacional – TO		Subtype(s): NIL

1.1 History of the flight.

The aircraft took off from the *Associação Tocantinense de Aviação* Aerodrome (SWEJ), Porto Nacional - TO, to the Santa Genoveva Aerodrome (SBGO), Goiânia - GO, at about 1030 (UTC), in order to perform a private flight, with a pilot and five passengers on board.

Shortly after the take-off, the plane lost lift, crashed to the ground, and caught fire.

The aircraft was destroyed.

The pilot and five passengers suffered fatal injuries.



Figure 1 - Aircraft after the occurrence.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	1	5	-
Serious	-	-	-
Minor	-	-	-
None	-	-	-

1.3 Damage to the aircraft.

The aircraft was consumed by fire, which started after the impact and was destroyed.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

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

N.B.: Due to the destruction of the pilot's CIV in the accident, it was not possible to obtain data on his hours flown.

Through surveys in the pilot's Digital CIV, about 370 total hours were identified, all carried out in fixed-wing aircraft, between 2006 and 2021.

1.5.2 Personnel training.

The PIC took the PPR course at the *Elite Escola de Aviação*, Goiânia - GO, in 1979.

1.5.3 Category of licenses and validity of certificates.

The PIC had the PCM License and had valid MLTE and IFRA Ratings.

1.5.4 Qualification and flight experience.

Through interviews with people who knew the PIC's operational career, it was found that he had been flying since 1989. However, as his CIV was destroyed in the event and the Digital CIV data were not updated, it was not possible to verify his experience and whether he was eligible on the date of occurrence.

1.5.5 Validity of medical certificate.

The PIC had a valid CMA.

1.6 Aircraft information.

The aircraft, serial number TC-2442, was manufactured by Beech Aircraft in 1982 and was registered in the TPP Category.

The aircraft CVA was valid.

The airframe, engines, and propellers logbook records were updated.

The last inspection of the aircraft, the "IAM" type, was carried out on 06MAY2020 by the OM CMA - *Centro-Oeste Manutenção de Aeronaves*, in Anápolis - GO.

1.7 Meteorological information.

The Palmas Aerodrome - TO METAR, 27 NM (50km) away from the place of the occurrence and the closest with a meteorological station, brought the following information:

METAR SBPJ 241000Z 11003KT CAVOK 24/23 Q1012

METAR SBPJ 241100Z 08003KT CAVOK 26/23 Q1013

As reported by observers, there was no presence of significant meteorological phenomena in the vicinity of the departure Aerodrome.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The SWEJ Aerodrome was private and operated under Visual Flight Rules during the day.

The runway was made of asphalt, with 11/29 thresholds, dimensions of 1,026 x 20 m, with an elevation of 1,001 ft.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The impact occurred in a leveled attitude and with neutral inclination, 150 meters away from threshold 11, apparently causing the simultaneous collision of the fuel tanks, wings, central cone, and stabilizers against the ground.

The wreckage was concentrated and there was fire after the collision.



Figure 2- Sketch of the occurrence and location of the aircraft wreckage in relation to the runway.

The degree of destruction and carbonization of the aircraft made it difficult to verify equipment and instruments.

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.

The PIC was described by the interviewees as a careful and judicious professional with the flight conditions. According to the report of a pilot who had already flown with the PT-LYG commander, there were situations in which he chose not to take off, as he had evaluated the weather conditions as unsatisfactory for the flight.

According to the interviewees, the PIC had a good family relationship and his closest friends highlighted that he had recently been dissatisfied with the remuneration obtained

with the air activity, as he believed that the cost-benefit was not being satisfactory. A friend of the pilot reported that he was thinking about stopping flying, as he would be tired of the air activity.

Despite exposing to friends and other pilots his discontent with the air activity, the PIC described the PT-LYG as being a “very good” aircraft, being in full flight conditions.

The decision to hire the PIC was made by the aircraft owner and only he performed flights on the aircraft. The relationship between the contractor and the pilot was described as good, with mutual respect and trust in the commander's decisions and guidelines.

The PIC, according to information gathered, had arrived in Palmas on the eve of the accident. The initial planning consisted of returning on the same day. However, this was postponed to the next day (the flight that culminated in this accident).

On the day of the occurrence, it was reported by observers that the pilot performed routine procedures in preparing the flight and the aircraft.

1.14 Fire.

The fire started immediately after the aircraft hit the ground. The ignition source probably originated as a result of the strong friction of the impact against the ground, and the combustible material was the gasoline in the tanks.

The fire consumed the entire fuselage structure, as well as the objects inside, leaving only parts of the wings, engines, and tail cone.

1.15 Survival aspects.

There were no survivors.

1.16 Tests and research.

During the Field Action Investigation, it was observed that the engines and propellers showed signs that they were operating normally at the time of the impact.

According to reports from observers who witnessed the take-off, no abnormalities were noticed in the operation of the engines, such as strange noises or smoke.

One of the people who witnessed the take-off noticed that the auxiliary landing gear came off the ground and then came back into contact with the runway during the take-off run. According to this observer, despite this detail, the take-off appeared to have proceeded normally. However, when starting to retract the landing gear, there was a sudden change in the attitude of the aircraft, in the direction of pitching, giving the impression that it was entering an abnormal situation, with the subsequent leveling of the wings and the collision with the ground.

Given these statements and the fact that the powerplants showed signs that they were operational during the impact, the Investigation Team proceeded to analyze the situation of the weight and balance of the aircraft.

In simple terms, balance is affected by the position of the aircraft's CG, which is the point of application on aircraft, of all weights. In theory, a balanced aircraft, hanging from the CG, would be in equilibrium.

Thus, for example, luggage placed in front of the CG, in the nose of the aircraft, will tend to move forward, whereas the weight of luggage placed in the rear luggage compartment, that is, behind the CG, acts oppositely, taking it back.

The movement of the CG, depending on the application of weights, is calculated using the weight and balance sheet contained in the aircraft manual, in the performance part.

For every aircraft, there are two limits for this movement (front and rear), that must not be exceeded, which may make the aircraft longitudinally unstable during flight, that is, there may be a tendency to pitch up or down that will exceed the control capability through flight commands.

Several forces are acting at different positions on the aircraft (lift, baggage weight, fuel weight, etc.). The distance at which these forces act concerning the CG is called Arm (B). The vector product of a force (weight, lift) by the Arm (distance) is called Moment (M).

The landing gear assembly, for example, when lowered, creates drag and, because it is below the CG, it also creates a force in the direction of lowering the nose.

According to the aircraft specification, the landing gear retraction generates a moment of +623 in.lb in the nose-up direction of the aircraft.

That said, some data were collected to support the analysis of the aircraft's CG calculations and its weight at the time of the accident:

- 1- Approximate weight of aircraft occupants;
- 2- Approximate weight of the occupants' luggage;
- 3- Arrangement of occupants inside the aircraft;
- 4- Basic aircraft weight; and
- 5- Constant fuel weight in the main and auxiliary tanks.

Since occupants and luggage were not weighed before the take-off, these values had to be estimated. For this, the Investigation Team interviewed the pilot's employer and also the employer of the passengers, who were athletes from a football team, in addition to their relatives and people close to them.

Also, it was possible to estimate that the weight of hand luggage was approximately 12.5 kg per occupant.

The basic weight of the aircraft, 1,710.94 kg, could be verified through the latest aircraft weight and balance sheet. The fuel weight was estimated at 368.46 kg in the extended tank, considering the information received that the aircraft had been fully fueled.

From these premises, two possibilities of configuration inside the aircraft were considered. Such configurations resulted from the analysis of a photo taken inside, by one of the passengers, which showed the position of the occupants, who were not carrying luggage.

- Row 1: left occupant (pilot) - 71 kg; right occupant - 75 kg;
- Row 2: left occupant - 81 kg; right occupant - 83 kg; and
- Row 3: left occupant - 79 kg; right occupant - 69 kg.

Considering that an observer reported that, after the arrival of the passengers, the aircraft's front luggage compartment was not opened, the Investigation Team inferred that all the occupants' luggage (pilot and passengers) were in the aircraft's rear luggage compartment.

Considering that the PMD of the aircraft was 2,313.32 kg, it is possible that it took off with at least 2,614.07 kg, that is, 300.75 kg above the maximum weight.

With this arrangement of passengers and luggage, after carrying out the calculations using the constant weight and balance map of the "Baron 55 Maintenance Manual, Section VI" (Weight and Balance), the CG value was reached at 92.95 inches, its variation being allowed between 81 and 86 inches (Figure 3), that is, about 7 inches beyond the rear limit.

TODAS AS BAGAGENS NO BAGAGEIRO TRASEIRO E PESEANDO 12.5 KG POR PASSAGEIRO				
	PESO (KG)	PESO (LB)	BRAÇO (in)	MOMENTO (LB x in)
PESO AERONAVE	1.671,66	3.686,00	85,14	313.825,10
ÓLEO	20,41	45,00	43,00	1.935,00
COMB NÃO UTILIZADO	18,60	41,00	82,00	3.362,00
PESO BÁSICO DA AERONAVE	1.710,94	3.772,00		319.124,10
PESO BÁSICO DA AERONAVE	1.710,94	3.772,00	84,60	319.124,10
COMBUSTÍVEL TANQUE ESTENDIDO	370,13	816,00	82,00	66.912,00
FILEIRA 1	146,00	321,87	85,00	27.359,33
FILEIRA 2	164,00	361,56	121,00	43.748,48
FILEIRA 3	148,00	326,28	150,00	48.942,56
BAGAGEIRO DIANTEIRO	0,00	0,00	0,00	0,00
BAGAGEIRO TRASEIRO	75,00	165,35	179,00	29.597,02
MOMENTO TOTAL				535.683,50
PESO TOTAL DE DECOLAGEM	2.614,07	5.763,03		
PESO MÁXIMO DE DECOLAGEM	2.313,32	5.100,00		
EXCESSO DE PESO NA DECOLAGEM	300,75	663,03		
VARIAÇÃO DO CG NO PMD (5.100 LB)	81 à 86 polegadas			
CG ESTIMADO NA DECOLAGEM	92,95			

Figure 3 - Calculations for the first hypothesis of aircraft weight distribution.

Calculating the CG movement, if the pilot's luggage had been placed in the front luggage compartment and the others in the rear luggage compartment of the aircraft and, considering the previously verified weights, it would have taken off with the same 300.75 kg excess, and its estimated CG would be 87.96 inches as shown in Figure 4, i.e., about 2 inches beyond the rear limit.

TODAS AS BAGAGENS NO BAGAGEIRO TRASEIRO E PESEANDO 12.5 KG POR PASSAGEIRO				
	PESO (KG)	PESO (LB)	BRAÇO (pol)	MOMENTO (LB x pol)
PESO AERONAVE	1.671,66	3.686,00	85,14	313.825,10
ÓLEO	20,41	45,00	43,00	1.935,00
COMB NÃO UTILIZADO	18,60	41,00	82,00	3.362,00
PESO BÁSICO DA AERONAVE	1.710,94	3.772,00		319.124,10
PESO BÁSICO DA AERONAVE	1.710,94	3.772,00	84,60	319.124,10
COMBUSTÍVEL TANQUE ESTENDIDO	370,13	816,00	82,00	66.912,00
FILEIRA 1	146,00	321,87	85,00	27.359,33
FILEIRA 2	164,00	361,56	121,00	43.748,48
FILEIRA 3	148,00	326,28	150,00	48.942,56
BAGAGEIRO DIANTEIRO	12,50	27,56	31,00	854,29
BAGAGEIRO TRASEIRO	62,50	137,79	179,00	24.664,19
MOMENTO TOTAL				506.940,77
PESO TOTAL DE DECOLAGEM	2.614,07	5.763,03		
PESO MÁXIMO DE DECOLAGEM	2.313,32	5.100,00		
EXCESSO DE PESO NA DECOLAGEM	300,75	663,03		
VARIAÇÃO DO CG NO PMD (5.100 LB)	81 à 86 polegadas			
CG ESTIMADO NA DECOLAGEM	87,96			

Figure 4 - Calculation for the second hypothesis of aircraft weight distribution.

1.17 Organizational and management information.

The aircraft was for private use. According to reports, the pilot involved in the incident was the only one who flew it regularly.

1.18 Operational information.

According to the estimated calculations, the aircraft probably took off above the maximum take-off weight and with the CG displaced beyond its predicted rear limit.

According to reports, there were difficulties to rotate the aircraft at the time of the take-off.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a passenger transport flight between Porto Nacional - TO and Goiânia - GO.

Considering that the conditions of the engines indicated the occurrence of an impact with power and that the observers reported having witnessed an abnormal behavior of the aircraft during the take-off, the Investigation Team started to analyze the conditions of weight and balance, to try to explain the dynamics of the accident.

It was estimated that the aircraft was overweight by approximately 300.75 kg and that the weight distribution was out of the CG limits provided by the manufacturer.

The allowable variation of the CG, in the PMD of 2,312.93 kg, was from 81 to 86 inches, and the position of the CG calculated by the Investigation Team would be displaced at least 2 inches beyond the maximum rear limit established by the manufacturer, according to with the simulations.

The fact that one person reported that, during the take-off run, the auxiliary landing gear returned to the ground before the aircraft was able to perform the rotation, would indicate the possibility of problems in the pitch control.

Probably, due to the excess weight, the PIC was unable to get the aircraft off the ground on the first attempt, requiring more speed, which made him attempt a second rotation.

In this condition, it is inferred that the position of the CG caused a tendency to pitch up, which, possibly, was accentuated with the retraction of the landing gear.

This may have led the pilot to lose control of the plane, at low altitude, with the subsequent collision with the ground, in a manner consistent with the report of the observer who witnessed the accident.

This condition may have resulted from an inadequacy in the preparation work carried out for the flight or part of it, such as the lack of planning for the loading of the aircraft, which would have caused it to take off out of the weight and balance parameters.

The difficulty to "rotate" the aircraft during the race indicated a possible operational non-compliance. The possibility that the PIC took a while to realize that the aircraft was exhibiting an operational behavior different from what would normally be expected may have prevented him from taking appropriate action in the face of the situation.

3. CONCLUSIONS.

3.1 Facts.

- a) the PIC had a valid CMA;
- b) the PIC had valid MLTE and IFRA Ratings;
- c) the aircraft had a valid CVA;
- d) the aircraft was above weight and possibly balance limits;
- e) the airframe, engine and propellers logbook records were updated;
- f) the weather conditions were favorable for the flight;
- g) after retracting the landing gear, the aircraft started a pitch up flight attitude;
- h) loss of lift and control occurred;

- i) the aircraft crashed into the ground, in a leveled attitude;
- j) the aircraft was destroyed; and
- k) all occupants suffered fatal injuries.

3.2 Contributing factors.

- Attitude – undetermined.

The non-compliance with operational standards, such as excessive weight and its inadequate distribution, may have contributed to an unbalance that led to a tendency for the aircraft to pitch up soon after the take-off, causing a loss of lift.

- Flight planning – undetermined.

The preparation work performed for the flight, or part of it, may have been carried out without considering the correct planning for the loading of the aircraft, which would have contributed to the take-off out of the weight and balance limits.

- Decision-making process – undetermined.

The decision to continue the flight from the moment the aircraft stopped “running”, as expected, may have contributed to the conclusion of the event, since it lost lift shortly after the take-off and entered an abnormal attitude, then crashing into the ground.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation made intending to prevent 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 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”.

None.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On March 30th, 2023.