COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-110/CENIPA/2021

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-BVB**
MODEL:	**1124A**
DATE:	**28SET2021**

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 28 September 2021 accident with the 1124A (Westwind II) aircraft, registration marks PR-BVB. The occurrence was typified as “[RE] Runway Excursion”.

It was an aeromedical transport flight (type “Air ICU”), with 05 POB (two crewmembers, two medical-team members, and a patient). The flight was due to take off from *Goiânia*, State of *Goiás*, bound for Miami, State of Florida, USA, with a planned technical stopover at TTPP (*Piarco* International Aerodrome, Port of Spain, Trinidad and Tobago), under the rules of the RBAC-135 (Brazilian Civil Aviation Regulation nº 135).

While the aircraft was taking off from the runway 14 of SBGO (*Santa Genoveva* International Airport), the takeoff was rejected, and the aircraft overran the longitudinal limits of the runway, coming to a stop within the aerodrome area.

None of the occupants of the aircraft were injured.

The aircraft sustained substantial damage.

An Accredited Representative of the Civil Aviation Authority - Ministry of Transport (CAA-MT) of Israel (State of aircraft manufacture), was designated for participation in the investigation of the occurrence.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AFM	Aircraft Flight Manual
ANAC	Brazil's National Civil Aviation Agency
CAA-MT	Civil Aviation Authority - Ministry of Transport - Israel
CAVOK	Ceiling and Visibility OK (base of clouds above 5,000 ft., horizontal visibility more than 10 km)
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CG	Center of Gravity
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
CVA	Airworthiness Verification Certificate
DECEA	Department of Airspace Control
FAR	Federal Aviation Regulation
FDR	Flight Data Recorder
FEW	Few clouds (1 - 2 oktas of the sky)
IFR	Instrument Flight Rules
IFRA	IFR Flight Rating (Airplane)
INFRAERO	Government-run Brazilian Airports Infrastructure Corporation
IS	Supplementary Instruction
ITT	Interstage Turbine Temperature
LABDATA	Cenipa's Flight Recorders Readout and Analysis Laboratory
METAR	Routine Meteorological Aerodrome Report
MLW	Maximum Landing Weight
NSCA	System Norm of the Command of Aeronautics
NVM	Non-Volatile Memory
OM	Maintenance Organization
PCM	Commercial Pilot License (Airplane)
PF	Pilot Flying
PIC	Pilot in Command
PMD	Maximum Take-Off Weight
PN	Part Number
PPR	Private Pilot License (Airplane)
PSI	Pound Force Per Square Inch
PSO-BR	Brazilian State Safety Programme
RBAC	Brazilian Civil Aviation Regulation
REDEMET	Brazilian Command of Aeronautics' Meteorology Network

SBBH	ICAO location designator - *Pampulha* (*Carlos Drummond de Andrade*) Aerodrome, *Belo Horizonte*, State of *Minas Gerais*
SBGO	ICAO location designator - *Santa Genoveva* International Airport, *Goiânia*, State of *Goiás*
SBNV	ICAO location designator - *Aeródromo Nacional de Aviação*, *Goiânia*, State of *Goiás*
SBRJ	ICAO location designator - *Santos Dumont* Airport, *Rio de Janeiro*, RJ
SBSP	ICAO location designator - *Congonhas* Airport, *São Paulo*, SP
SIC	Second In Command
SIPAER	Aeronautical Accidents Investigation and Prevention System
SN	Serial Number
SOP	Standard Operating Procedures
SPECI	Aviation Selected Special Weather Report
SSCVR	Solid State Cockpit Voice Recorder
TPX	Aircraft Registration Category (Non-Regular Public Air Transport)
TTTP	ICAO location designator - *Piarco* International Airport, Port of Spain, Trinidad and Tobago.
TWR-GO	Control Tower of SBGO
UTC	Universal Time Coordinated
UTI	Intensive Care Unit
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** 1124A **Registration:** PR-BVB **Manufacturer:** Israel Aircraft.	**Operator:** *Brasil Vida Táxi Aéreo Ltda.*
Occurrence	**Date/time**: 28SET2021 - 15:07 UTC **Location:** SBGO **Lat.** 16°38'17"S **Long.** 049°12'29"W **Municipality – State:** *Goiânia* - GO	**Type(s):** [RE] Runway excursion

1.1. History of the flight.

The aircraft would take off from SBGO (*Santa Genoveva* International Airport, *Goiânia*, State of Goiás), bound initially for TTPP (*Piarco* International Aerodrome, Port of Spain, Trinidad and Tobago), on an "Aerial ICU" flight, with two crewmembers, two medical-team members and one patient.

During the takeoff run, the takeoff was rejected, and the aircraft overran the longitudinal limits of the runway, coming to a stop within the aerodrome area.

The aircraft sustained substantial damage.

None of the occupants of the aircraft were injured.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	2	3	-

1.3. Damage to the aircraft.

The aircraft sustained substantial damage to the landing gear, left-hand flap, left-hand stabilizer, left-hand engine reverse rods, aircraft intrados, as well as to the right- and left-hand wingtips.

1.4. Other damage.

A pylon located at the threshold 32 of SBGO got broken on account of the runway excursion.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Flight Experience		
	PIC	SIC
Total	6.154:30	1.126:54
Total in the last 30 days	21:54	53:42
Total in the last 24 hours	00:00	00:00
In this type of aircraft	1.726:42	931:18
In this type in the last 30 days	11:24	27:54
In this type in the last 24 hours	00:00	00:00

N.B.: data obtained via records of the pilots' CIVs.

1.5.2. Personnel training.

The PIC (Pilot in Command) did his PPR course (Private Pilot - Airplane) in 2001, at the *AHV Escola de Aviação de Goiânia*, State of *Goiás*.

The SIC (Pilot Second in Command) did his PPR course in 2016, at the *Aeroclube de Goiás*, *Goiânia*, State of *Goiás*.

1.5.3. Category of licenses and validity of certificates.

The PIC held a PCM License (Commercial Pilot - Airplane), and had valid type aircraft AI24 (including the model 1124A) and IFRA ratings (IFR Flight - Airplane).

The SIC held a PCM License (Commercial Pilot – Airplane), and had valid type aircraft AI24 and IFRA ratings.

1.5.4. Qualification and flight experience.

The pilots had qualification and experience for the type of flight.

1.5.5. Validity of medical certificate.

The pilots held valid CMAs (Aeronautical Medical Certificates).

1.6. Aircraft information.

The SN 390 model 1124A Westwind II aircraft was a product manufactured by *Israel Aircraft* in 1983. The certification basis met, among others, the requirements established by the CAR 23 part 4b and FAR 25, both referring to aircraft of the Transport Category. The referred aircraft was registered in the Non-Regular Public Air Transport Service Registration Category (Air Taxi - TPX).

The CVA (Airworthiness Verification Certificate) of the aircraft was valid.

The records of the airframe and engine logbooks were up to date.

The last inspection of the aircraft (type “200 hours”) was carried out on 17 September 2021 by *Brasil Aviation OM* (COM 8103-01 ANAC), in *Goiânia*, State of *Goiás*. The aircraft flew just 36 minutes after the said inspection.

On 18 September 2021, the aircraft was ferried from SBNV to SBGO (both aerodromes located in *Goiânia*, State of *Goiás*) for verification of a small leak of oil in the left-hand engine. The aircraft returned to SBNV on 22 September 2021, having not flown between the said dates.

On 25 September 2021, the aircraft flew back to SBGO for verification of the Pressurization Dump, since it had only undergone a check on the ground.

The left-hand engine (Honeywell model TFE-731-3-1G, SN P-77530) had a total of 6,289 hours, with 5,116 cycles. Repairs were carried out to correct the oil leak, and the engine was released, after operational tests and leak checks, by *Dallas Airmotive do Brasil* (COM 0911-32 ANAC), at the headquarters of *Brasil Aviation*, in *Goiânia*, GO.

The right-hand engine (Honeywell model TFE-731-3-1G, SN P-77539) had a total of 6,444 hours, with 5,173 cycles.

The last comprehensive inspection of the aircraft (type “1,000 hours”) was carried out on 21 October 2020 by *Brasil Aviation* OM (COM 8103-01 ANAC), in *Goiânia*, State of *Goiás*. The aircraft flew 859 hours and 30 minutes after such inspection.

The airframe had 6,645 hours and 54 minutes of operation.

The fuel received in the last refueling was Aviation Kerosene (QAv), type JET A1, as prescribed in the manual. The fuel had a density of 0.8 kg/L, according to the refueling voucher, which registered a supplied volume of 4,396 liters (7,736 lbs / 3,516 kg).

When consulting the aircraft Logbook with the aim of checking the penultimate flight leg flown on 25 September 2021 (three days earlier) between SBNV and SBGO, with a total flight time of six minutes, one found that the plane took off with 3,000 lbs (1,363 kg) of QAv, having also undergone a maintenance engine-run on the ground in order to test performance and pressurization on 27 September 2021 in SBGO.

The aircraft's maximum and usable fuel capacity was 8,910 lbs (4,050 kg / 5,062 liters of QAv), in accordance with the manual, considering four fuselage-tanks, two wing-tanks and two wingtip-tanks.

It is worth highlighting that there was a note specifying that: “the amount of remaining fuel, when the indicator shows zero, is not usable in flight”; that is, the amount of fuel available on the display represented the usable amount.

The Maximum Takeoff Weight (*MTOW*) certified for the model was 23,500 lbs (10,660 kg), and the Maximum Landing Weight (MLW) was 19,000 lbs (8,618 kg).

The maximum limit of the wind for landing and takeoff operations for the aircraft model was 30 kt (crosswind) and 10 kt (tailwind component).

1.7. Meteorological information.

The METAR of SBGO contained the following information:

METAR SBGO 281400Z 10005KT CAVOK 29/14 Q1019=

METAR SBGO 281500Z 09004KT CAVOK 32/13 Q1018=

SPECI SBGO 281513Z 04004KT 9999 FEW035 32/12 Q1017=

The 15:00 UTC METAR presented favorable conditions for the flight, wind 090º at 4 kt, visibility more than 10 km, sky clear, and temperature of 32°C.

The 15:13 UTC SPECI showed wind 040º at 4 kt, visibility more than 10 km, few clouds at 3,500 ft, and temperature of 32°C.

The threshold 14.was the one in use for landing and takeoff operations.

An aircraft that took off at 14:59 UTC (that is, eight minutes before the PR-BVB) had received clearance for takeoff from the threshold 14 with the Control Tower reporting the wind as 060º at 7 kt.

After takeoff, that aircraft reported on the Tower frequency a tailwind of 8 to 10 kt during the takeoff from the threshold of runway 14.

When the PR-BVB received clearance to align and take off from runway 14, the Control Tower reported wind calm, informing that the last aircraft (which had taken off minutes before) had reported a tail wind of 8 kt.

Figure 1 details the enhanced satellite image of 28 September 2021, generated at 15:10 UTC, showing the presence of scattered clouds (FEW) close to the location.

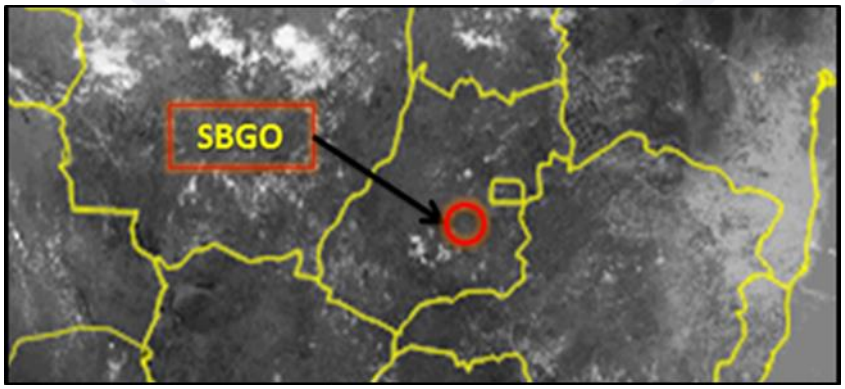

Figure 1 - Highlighted satellite image from 28SEPT2021, at 15:10 (UTC).

Source: REDEMET.

Figure 2 details the wind chart of 28 September 2021 for FL050, generated at 15:39 UTC, which allowed to identify inconsistency of the wind direction, however with an intensity of up to 10 kt in the area.

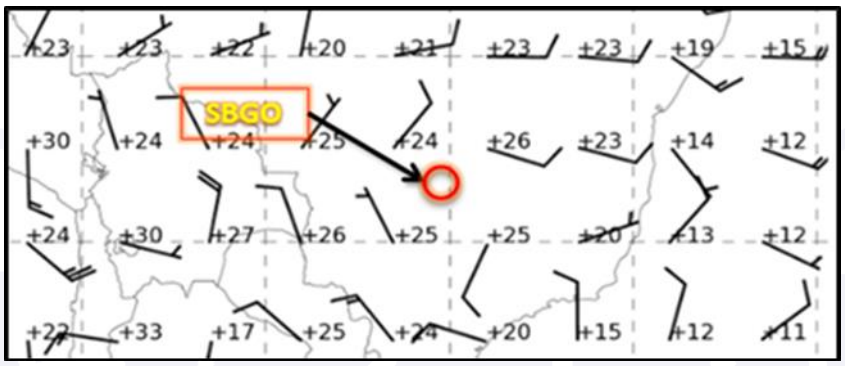

Figure 2 - Wind Chart of 28SEPT2021 for FL050 generated at 15:39 UTC.
Source: REDEMET.

Figure 3 allows to identify the weather observed on the day of the occurrence.

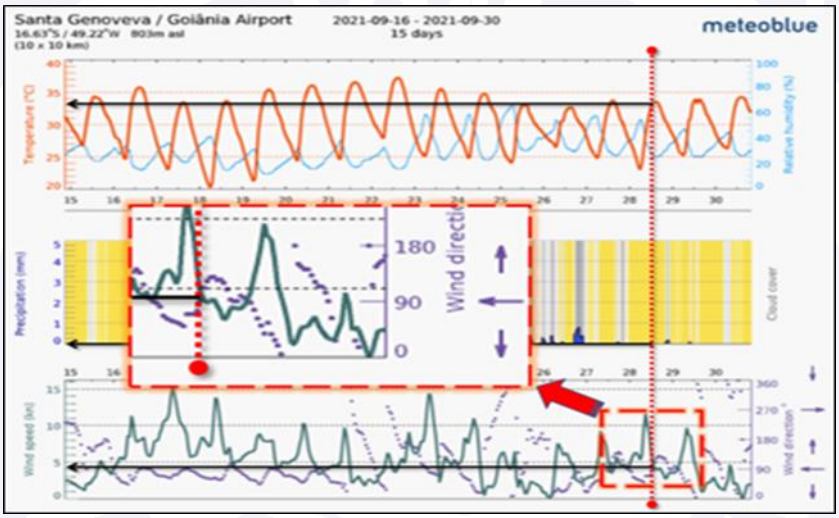

Figure 3 - Consultation of the meteorology in SBGO on 28SEPT2021, marked in red at 12:00 pm (local time), with detail for the wind direction. Source: http://www.meteoblue.com.

The upper part of the graph (Figure 3), for temperature and humidity, indicates 33°C and humidity of 25%. The middle part of the graph, for precipitation and cloud cover, indicates 0% precipitation and a cloud cover between 0 and 25%.

The lowest part of the graph, for wind speed and direction, indicates a decrease in the intensity of the wind presented in the morning, from 12 kt to 4 kt during the time of the occurrence, also indicating variable wind and a noticeable change in the direction of the wind presented in the morning, from 050° to 130° at the time close to the occurrence.

1.8. Aids to navigation.

NIL.

1.9. Communications.

According to the transcriptions of the audio obtained through the readout of the SSCVR (Solid State Cockpit Voice Recorder), one verified that no technical abnormalities occurred in the equipment during the communications between the aircraft and the ATC units.

The two-way communication between the crewmembers and the Control Tower was uneventful.

Upon giving clearance for the alignment and takeoff of the PR-BVB, the Control Tower (TWR-GO) reported that, as per their instruments, the wind was calm. The ATCO also informed that the last aircraft that had taken off minutes before had reported 8 kt of tailwind. The control tower requested the crew to pay attention to that piece of information.

Shortly after the occurrence, at 15:09 UTC, TWR-GO reported that the aerodrome was impracticable due to an aircraft having crashed at takeoff.

1.10. Aerodrome information.

The aerodrome was public under the administration of INFRAERO. It operated VFR and IFR, both during day- and night-time.

The runway was paved with asphalt, with thresholds 14 and 32, and measured 2,286 m x 45 m, at an elevation of 2,453 ft.

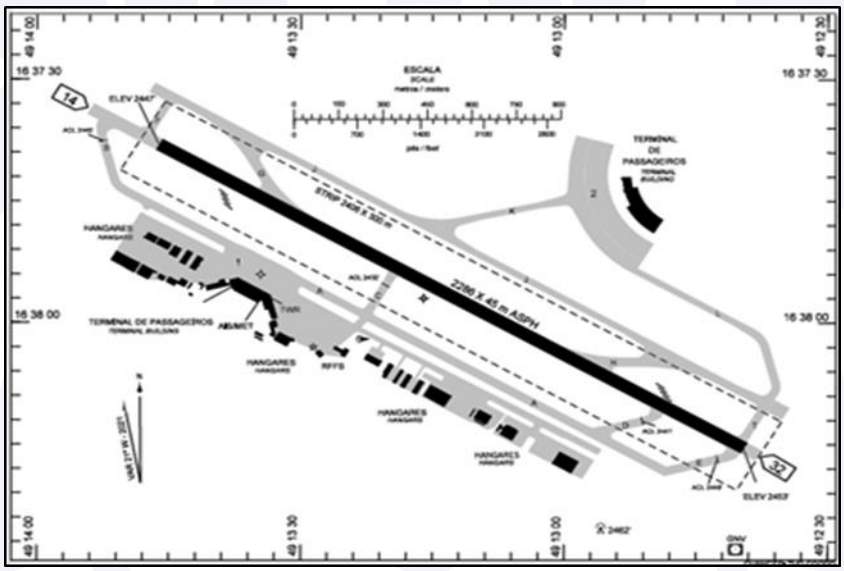

Figure 4 - SBGO Aerodrome Chart.

On 20 August 2020, the airport administration received a document from the ANAC (Brazil's National Civil Aviation Agency) bestowing SBGO with the status of International Aerodrome, allowing the terminal to process international operations for both scheduled and non-scheduled public air services, including air taxi, general aviation, and cargo flight services.

1.11. Flight recorders.

The aircraft was equipped with a stand-alone L3HARRIS SSCVR cockpit voice recorder (model FA 2100, PN 2100-1020-50 and SN 001215503) with a four-channel recording capacity of 120 minutes.

The SSCVR was sent to the facilities of the CENIPA's LABDATA (Flight Recorder Data Readout and Analysis Laboratory) for the readout of the communications of the crew in the cockpit, as well as the communication between the crew and the ATC units.

The aircraft did not have an FDR (Flight Data Recorder), but its engines had an NVM (Non-Volatile Memory), which made it possible to collect pieces of information related their functioning.

1.12. Wreckage and impact information.

The aircraft overran the longitudinal limits of the runway, traveling a distance of approximately 300 meters outside the runway, before coming to a complete stop still within the area of the aerodrome.

Upon exiting the runway, the aircraft collided with a pylon at the threshold 32.

Figures 5 and 6 show the croquis of the occurrence and the final position of the aircraft.

Figure 5 - Croquis of the aircraft's trajectory in the occurrence.
Source: Adapted from Google Earth.

Figure 6 - Final position of the aircraft.

The occurrence was filmed by security cameras of the airport.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

NIL.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

NIL.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

After the complete stop of the aircraft and shutdown of the engines, the PIC commanded evacuation of the aircraft, and assisted the passengers in the evacuation process.

1.16. Tests and research.

The NVM data of both engines were collected and sent to the LABDATA facilities, for verification of possible readings of the parameters in the moments preceding the occurrence.

The available parameters were presented in table columns and rows, with some of the rows being corrupted (no recorded data), and the time data (hour reference) between the engines not corresponding.

They were apparently out of phase in one or two parameter lines on both modes of capture.

There was capture in *Events Slow Scan*, with recording of the last 4 minutes and 25 seconds, with an event every 5 seconds, and in *Events Fast Scan*, with recording of the last 30 seconds, with an event every tenth of a second.

The parameters available in the *Events Slow Scan* allowed monitoring, during the takeoff and with some accuracy, the indications of N1 (Low Pressure Turbine Rotation - %), N2 (High Pressure Turbine Rotation - %), PLA (Power Lever Angle - in degrees), TT2 (Engine Air Temperature Sensor / Total Air Temperature - ºF), PT2 (Engine Air Pressure Sensor / Total Air Pressure - PSI), ITT (Inter-Turbine Temperature - ºF), and Fuel Ratio.

The parameters available in the *Events Fast Scan* were not helpful in monitoring the parameters during takeoff, due to the short time of recording.

However, the data was accessible and presented information on the indications of N1 (%), N2 (%), PLA (in degrees, and Fuel Ratio.

In order to verify the precise thrust generated by the engines for the takeoff at SBGO (2,453 ft Density Altitude), one analyzed the static takeoff diagram for the obtainment of N1.

The result was 98.3%, as shown in Figure 7.

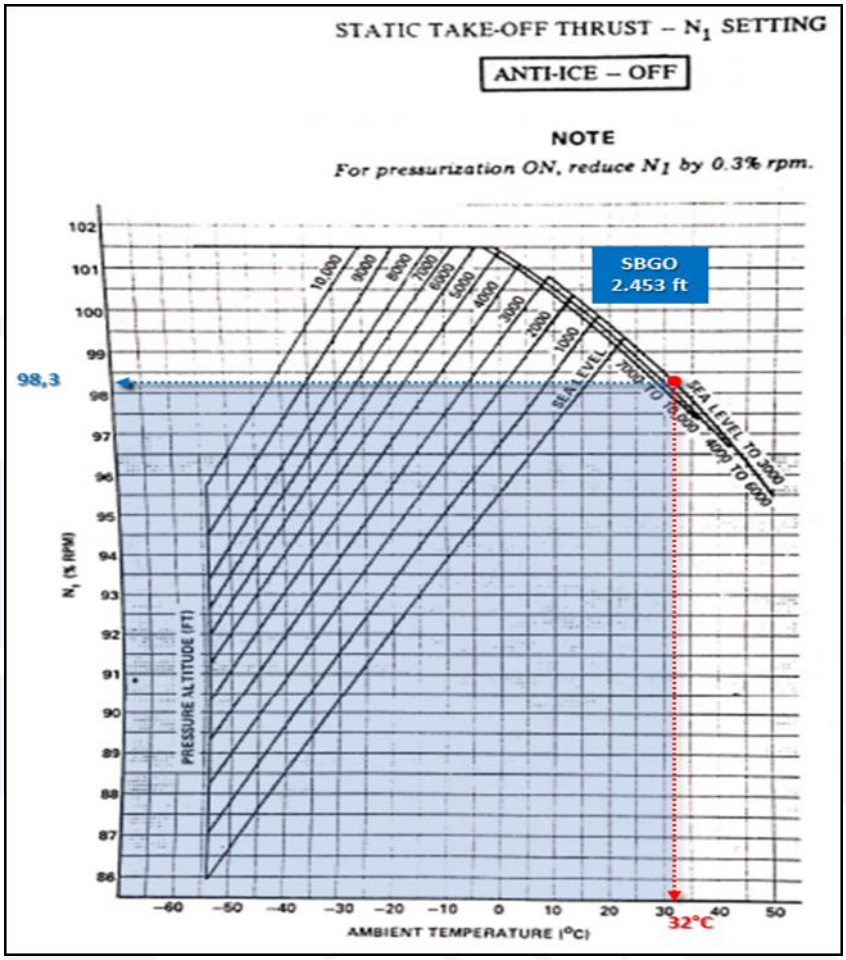

Figure 7 - Thrust diagram for static takeoff (Maximum Power).

Figure 8 allows visualization of the moment at which the engines were demanded at their maximum thrust, corresponding to 98% of N1 for the beginning of takeoff, and their maintenance of the parameters throughout the procedure.

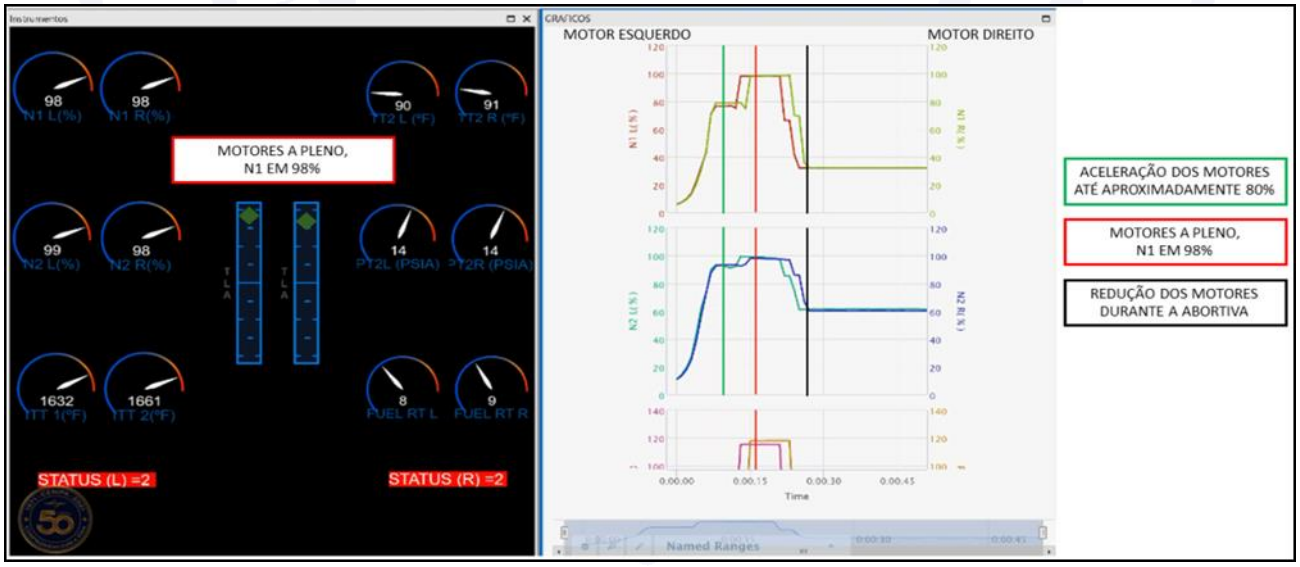

Figure 8 – Representation of the takeoff parameters, detailing the specific moment of N1 at 98% (Maximum Power).

The reduction of thrust corresponding to the pulling of the power levers took place as expected. No discrepant parameters were observed in the functioning of the engines at takeoff.

1.17. Organizational and management information.

NIL.

1.18. Operational information.

A survey was carried out on the aircraft payload (cargo, passengers and luggage), as well as on the fuel necessary for completion of the flight segment between SBGO and TTPP.

In accordance with the crew and with the cargo manifest presented, the aircraft was fueled with 8,300 lbs; the zero fuel weight was 14,526 lbs, totaling a ramp weight of 22,826 lbs, and a takeoff weight of 22,526 lbs (300 lbs for taxiing); such value was below the maximum one certified for the aircraft, i.e. 23,500 lbs (Figure 9).

DESCRIÇÃO DO ÍTEM	PESO (LBS)	BRAÇO (IN)	MOMENTO (LBS.IN)	% MAC
PESO VAZIO BÁSICO	15.501	288,93	3.533.089,46	
PILOTO E CO-PILOTO	360	60	21.600	
PASSAGERO OCUPANDO ASSENTO DO LAVABO	–	252	–	
PASSAGEIRO POLTRONA 1 E 2	330	219	72.270	
PASSAGEIRO POLTRONA 3 E 4	—	177	—	
PASSAGEIRO POLTRONA 5	–	146	—	
PASSAGEIRO POLTRONA 6	—	126	—	
PASSAGEIRO POLTRONA 7	–	106	—	
PASSAGEIRO POLTRONA 8	—	130	—	
PACIENTE MACA/INCUBADORA (AEROMÉDICA 1)	165	158	26.070	
PACIENTE MACA/INCUBADORA 1 (AEROMÉDICA 2)	—	140	—	
PACIENTE MACA/INCUBADORA 2 (AEROMÉDICA 2)	–	203	—	
GABINETE DIANTEIRO	—	89	—	
COMPARTIMENTO CARGA BANHEIRO	–	252	—	
BAGAGEIRO DIANTEIRO (MÁXIMO: 820 LBS)	80	358	28.640	
BAGAGEIRO TRASEIRO (MÁXIMO: 250 LBS)	—	458	—	
PESO ZERO COMBUSTÍVEL (MÁXIMO: 16.500 LBS)	14.526	274,10	3.981.669,46	
COMBUSTÍVEL (MÁXIMO: 8.910 LBS)	8.300	287	2.382.100	
PESO DE RAMPA (MÁXIMO: 23.650 LBS)	22.826	278,79	6.363.769,46	
COMBUSTÍVEL PREVISTO PARA PARTIDA E TÁXI	- 300	282	- 87.600	
PESO DE DECOLAGEM (MÁXIMO:23.500 LBS)	22.526	278,62	6.276.196,46	27,23
COMBUSTÍVEL CONSUMIDO NA ETAPA	6.000	287	1.722.000	
PESO DE POUSO (MÁXIMO: 19.000 LBS)	16.526	275,67	4.554.196,46	23,96

LIMITES DE PESO E C.G. DA AERONAVE

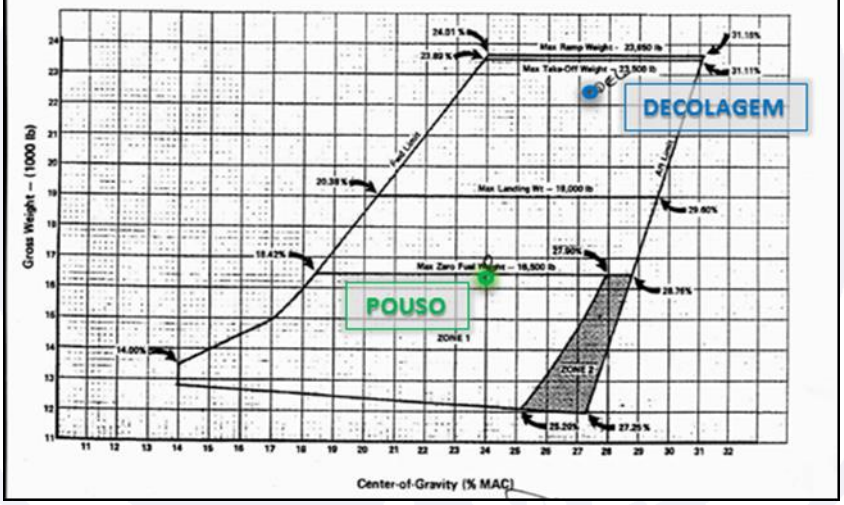

Figure 9 – Cargo manifest presented.

Relatively to record keeping requirements, the RBAC-135 (Brazilian Civil Aviation Regulation nº 135) - “Public Air Transport Operations with Airplanes with a Maximum Certified Passenger Seating Configuration of up to 19 Seats”, in its Section 135.63 “Record Keeping Requirements”, letter C, item 3, prescribed the following:

> (c) The certificate holder is responsible for the preparation and accuracy of a duplicate cargo manifest containing information concerning the loading of the aircraft. The manifest must be prepared before each takeoff, must be signed by the pilot in command and must include:
>
> [...]
>
> (3) the maximum takeoff weight allowed for the flight;
>
> [...]

An extract from the AFM (Aircraft Flight Manual) contained the following information concerning the takeoff performance (Figure 10).

TAKE-OFF PERFORMANCE

MAXIMUM ALLOWABLE TAKE-OFF WEIGHT

Maximum take-off weight (weight at brake release) is lowest value determined by either of following requirements:

1. Maximum take-off weight for altitude and temperature, permitted by climb performance.
2. Maximum take-off weight determined from take-off distance chart.
   Under some operating conditions (high altitude and tailwind), take-off weight may be limited by Brake Energy and Tire Groundspeed limits.

Figure 10 - Extract from the Westwind Airplane Flight Manual (AFM) - 1124/1124A, Section 5, Performance - page V-9.

One observes that the aircraft manufacturer specified that the maximum take-off weight (at the time brakes' release) should be the lowest value between:

- (1) the maximum takeoff weight for the altitude and temperature, allowed by the climb performance (second segment);

- (2) the maximum takeoff weight determined by the takeoff distance chart.

Under certain operating conditions (such as high altitude or tailwind), the maximum takeoff weight was limited by the braking energy or tire ground-speed.

Upon checking the diagram of the maximum takeoff weight limit, the following data was obtained (Figure 11).

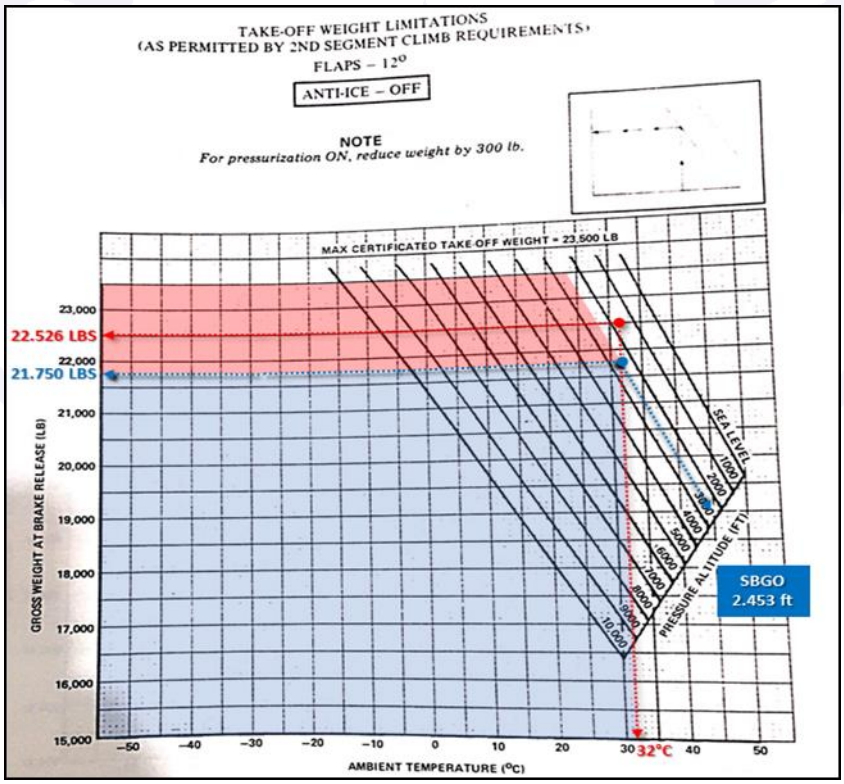

Figure 11 - MTOW diagram for 12° flaps, considering density altitude and temperature.

Thus, for an aircraft configured with flaps at 12°, considering compliance with the requirements of the second climb segment, considering the density altitude of SBGO (2,453 ft), the temperature of 32°C, Anti-Ice Off, pressurization on, and assuming that the weights

of crew, passengers, "*Aeromedica 1*" configuration, and luggage carriers are correct; one concluded that the weight limit for local conditions at 15:00 UTC would be 21,750 lbs (blue), below the weight declared on the load manifest of 22,526 lbs (red), for the requirements of the second climb segment .

The MTOW, limited by the takeoff distance diagram, allowed one to verify that for the same conditions, using the length of SBGO runway 14 of 2,286m (7,543 ft), slope 0, Anti-Ice Off, Anti-Skid and Lift Dumpers On, and analyzing the results for zero wind or 10 kt tail-component, the conclusion was that, for zero wind, the aircraft's certified MTOW would not be a limiting factor, however for a 10-kt tail component, the MTOW would be limited to 22,500 lbs (Figure 12).

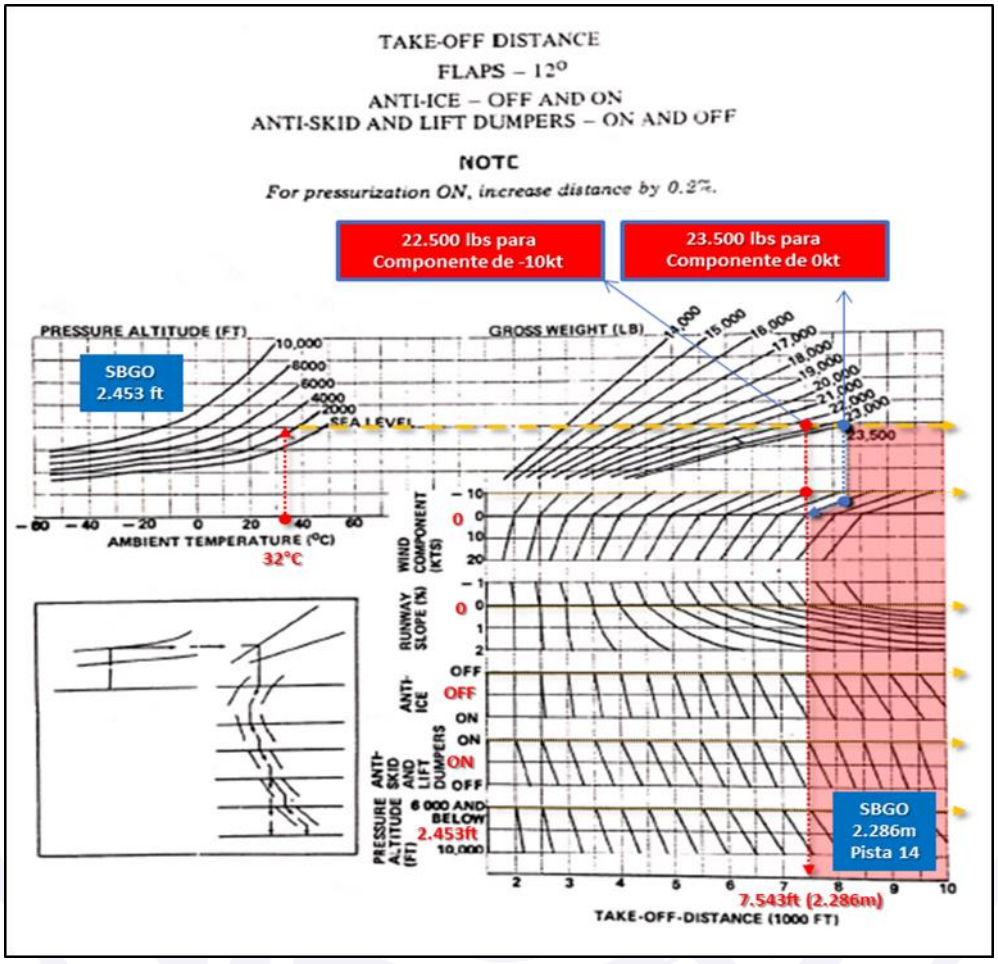

Figure 12 - MTOW diagram for 12° flaps, runway length limiting criterion.

The MTOW diagram for braking energy requirements or tire ground-speed was not a limiting factor for the field altitude and temperature. For the maximum certified weight (23,500 lbs), one concluded that with a 10-kt tailwind, the speed would be lower than the maximum tire ground-speed, which was 174 kt (Figure 13).

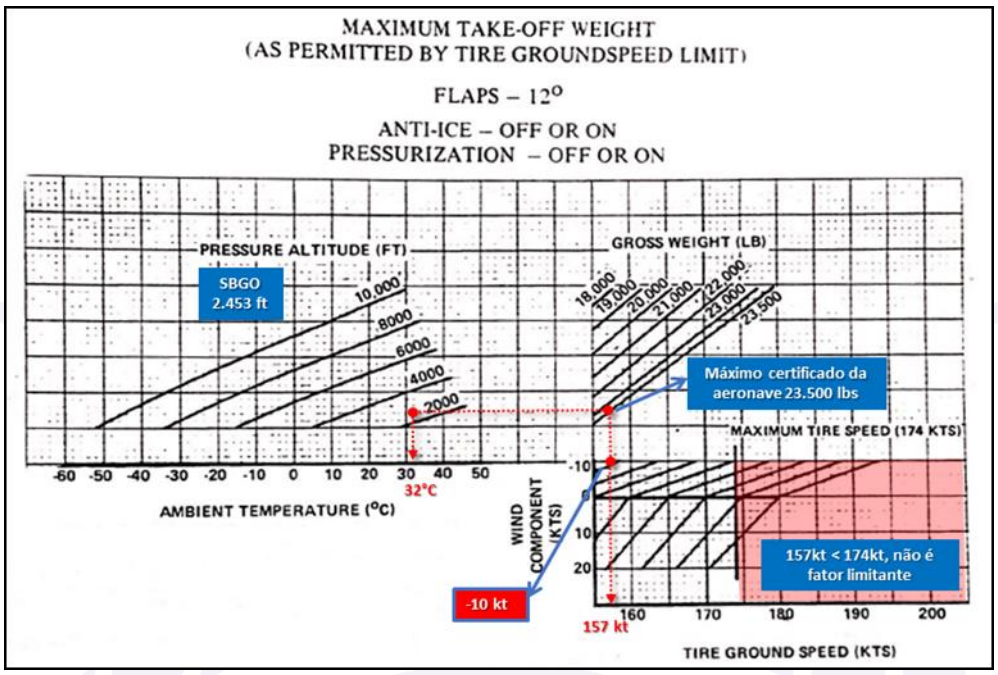

Figure 13 – MTOW diagram for 12° flaps,
tire ground-speed limiting criterion.

After consulting the three items of information, and selecting the lowest value for the MTOW, one concluded that the weight limit for takeoff was 21,750 lbs (under the local conditions at 15:00 UTC, following all certification parameters and specific regulations), with limiting factors being the temperature and the altitude of the field. Such value was lower than the weight declared in the cargo manifest (22,526 lbs), which corresponded to 776 lbs (352 kg) above the limit specified.

As established in the RBAC-01, any aircraft with an approved maximum takeoff weight exceeding 5,670 kg (12,500 lbs) is defined as a “large aircraft”. With regard to takeoff limitations, the RBAC-135, Section 135.379 “Large Transport Category Airplanes with Turbine Engines: Takeoff Limitations”, prescribed the following:

> (a) In the case of a large airplane of the transport category with turbine engines, takeoff with such airplane is forbidden with a weight greater than the one indicated in the airplane's flight manual for the altitude of the aerodrome and for the ambient temperature existing at takeoff.
>
> [...]
>
> (c) In the case of a large airplane of the transport category with turbine engines, of a type certified in its country of origin after 25 September 1959, takeoff is forbidden with a weight greater than the one indicated in the flight manual of the aircraft in order to meet the following requirements:
>
> [...]
>
> (3) the takeoff run distance cannot be longer than the length of the runway.
>
> [...]
>
> (d) In the case of a large airplane of the transport category with turbine engines, takeoff is forbidden with a weight greater than the one listed in the airplane flight manual:
>
> [...]
>
> (2) for an airplane of a type certified after 30 September 1958 (SR422A, 422B), allowing a network of takeoff flight paths providing clearance of all other obstacles with a vertical separation of at least 35 feet, or a horizontal separation of at least 200 feet within the boundaries of an airport, and at least a 300-feet horizontal separation beyond such boundaries.

> (e) In determining the maximum weights and minimum distances from the paragraphs (a) through (c) of this section, corrections must be made for the altitude of the aerodromes, the effective gradient of the runways, the ambient temperature, and the existing wind component at takeoff.

In the takeoff briefing conducted by the PIC while taxiing to the holding point of runway 14, one verified that the crew was aware that they were operating the aircraft above the maximum takeoff weight, and that the aircraft's "trim" was at 25, as per the SSCVR transcript.

> PIC: Yes... we are going to take off above the maximum weight, I am aware, with bleeds off, 132, 142, 155, 99.5, with 88.9 maximum, 2,000, dry runway, trim 25, flaps 12... adjusted. In case of failure up to 80 kt we reject, from 80 to V1 it's... only under my command... okay?
>
> SIC: Okay.
>
> PIC: After V1, we continue with takeoff... in case of engine failure after takeoff, the first action is to fly the plane and to jettison fuel.

The crew worked the *before-takeoff checklist* and the *line-up checklist*, and initiated the takeoff run.

The aircraft rotated and left the ground as shown in Figure 14.

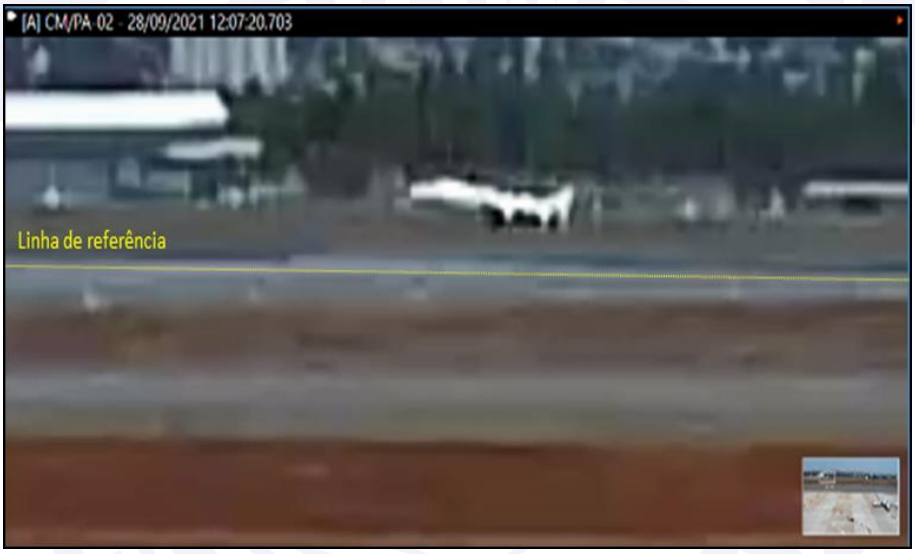

Figure 14 - Video frame from the airport administration, allowing view of the aircraft in takeoff attitude, off the ground.

Nine seconds later, the sound of a probable touchdown and return to the runway was heard (Figure 15).

Figure 15 - Video frame from the airport administration, allowing view of the aircraft returning to the ground, with approximately 400 m of runway ahead.

At that time, it was possible to identify the following callout, as per the SSCVR data:

"SIC: Speed brake, speed brake, speed brake!"

Five seconds later, it is possible to hear a more distinct sound of a collision against the ground.

The crew reported that, after the rotation, the aircraft "fell" with its wing to the right-hand side, returning to the runway direction anew, with the PIC choosing to discontinue the flight, as there was still "some runway" ahead, besides an open area of land for stopping the aircraft further beyond.

Upon returning to the ground, the takeoff rejection was initiated and the brakes were applied. The crew reported not having heard any noise and not having noticed any abnormalities, except for their inability to continue the flight.

However, the prescribed procedure was to continue takeoff after reaching V1 since, as recommended by the manufacturer, successful results were more likely when takeoff was continued rather than rejected.

On the occasion of the occurrence in question, there was the following concept for V1 established by the RBAC-01:

> *Takeoff decision speed (V1) means the maximum takeoff speed at which the pilot must take the first action (e.g., apply brakes, reduce power, open airbrakes) to stop the airplane within the acceleration and stopping distance. It also means the lowest takeoff speed, following a critical engine failure at VEF, in which the pilot can continue takeoff and reach the required height above the takeoff surface within the takeoff distance.*

The concept was established so that the aircraft could stop safely within the distance required by performance calculations for acceleration and takeoff rejection.

By means of the SSCVR, it was possible to identify the aircraft's "trimming", which was at 25% (red). However, for the calculated Center of Gravity (CG), the correct option would be 27.3% (blue) or -1.7°, as shown in Figure 16.

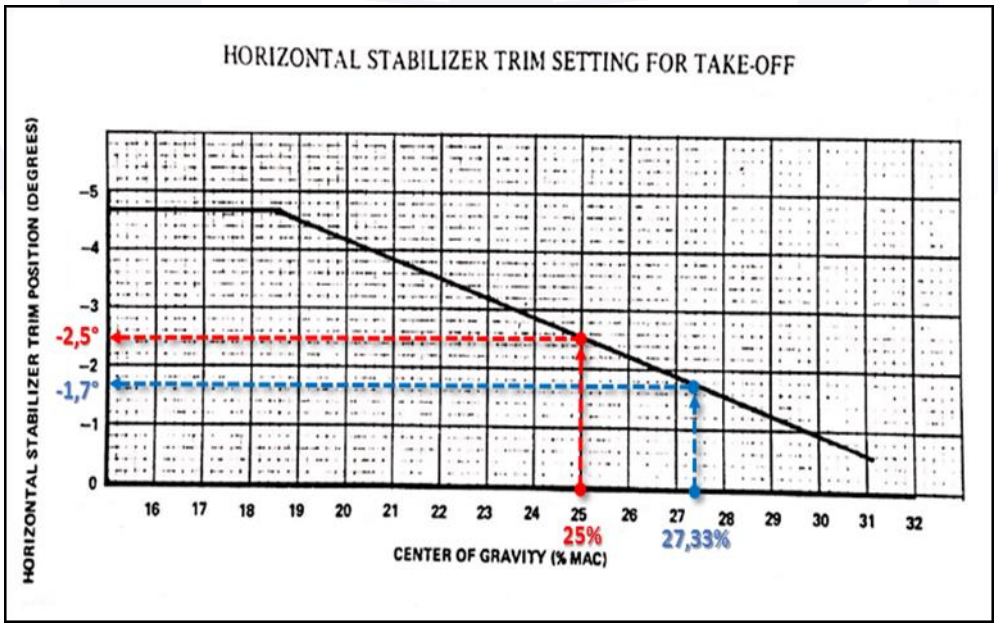

Figure 16 - "Trimming" diagram of the horizontal stabilizer for takeoff.

Figure 17 depicts the "trimming" display of the aircraft's horizontal stabilizer, with the external scale indicating the center of gravity in percentage values, with measures from 19% to 31% (one percentage-point variation). The internal scale has the indication in degrees, varying from 0° to -4.7° (1º-variation, with 4.7º being the last mark).

Figure 17 - Display of the Horizontal Stabilizer “trimming”.

The yellow arrow highlights the pilot's view and the takeoff selection. The blue arrow highlights the correct selection for the calculated center of gravity.

In accordance with the SOP (Standard Operating Procedures) of the Westwind aircraft - 1124/1124A REVISION 4 - 28NOV2019, of *Brasil Vida Táxi Aéreo Ltda*., the checks and callouts prescribed for the Line-Up and Take-Off phases were as follows (Figure 18):

LINE UP	
PF	**PM**
I Have Controles, you Have Comunications, Runway 14, Heading 142, 142, 142. O check deve ser feito no HSI do PF, PM e Bussóla.	**Check**

TAKE OFF	
PF	**PM**
Takeoff Power Set **Check**	**Check** Efetua pressão a frente no mache. **Takeoff Power Set**
Inicio da Rolagem	
Check	**Speed Alive Both Sides**
Quando 90Kts	
Check – My Yoke	**90 Kts Crosscheck** **Check**
Quando V1	
Check – Mova mão da mante de potência para o mache	**V1**
Quando na Vr	
	Rotate

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Figure 18 - Westwind SOP Extract - 1124/1124A REVISION 4 – 28NOV2019 of *Brasil Vida Táxi Aéreo Ltda*., page 199.

The SOP of *Brasil Vida Táxi Aéreo Ltda*., letter (g), item 5.3.1 “Duties of the Captain”, defined the PIC as the person responsible for the briefings related to Planning, Before Taxi, Before Take-Off, and Descent.

The Item 5.4 “Briefings” defined that the PF (Pilot Flying) was the one responsible for conducting such briefings.

The letter (a) of the item 5.4.1 “Planning Briefing” contained the division of work with regard to the execution of a certain specific procedure for the flight.

1.19. Additional information.

With regard to the Safety Management System, the RBAC-135, Section 135.707 “safety risk management”, recommended the following:

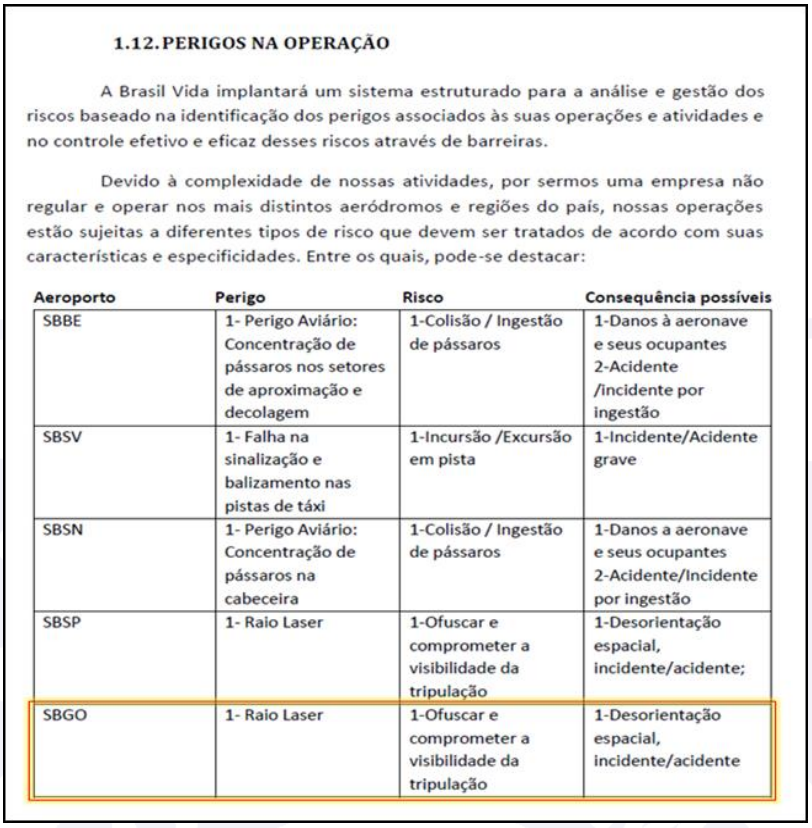
> (a) Hazard identification process.
>
> (1) The certificate holder must develop and maintain a process that ensures that hazards associated with its products or services are identified.
>
> (2) The process of hazard identification should be based on a combination of reactive and proactive methods of collection of safety data.
>
> Process of assessment and control of risks.
>
> (1) The certificate holder must develop and maintain a process that ensures the analysis, assessment and control of safety risks associated with the identified hazards.

Furthermore, within the Safety Management System, with regard to the assurance of safety, the RBAC -135, Section 135.709 “Safety Assurance”, recommended the following:

> (a) Safety performance monitoring and measurement process.
>
> (1) The certificate holder must develop and maintain the means necessary for the monitoring and measurement of the organization's safety performance, and for validation of the effectiveness of its safety risk controls.
>
> (2) The certificate holder's safety performance must be monitored and measured relatively to safety performance indicators and targets of its SMS.
>
> Change-management process.
>
> (1) The certificate holder must develop and maintain a process for identification of changes that may affect the level of risk to safety of its products or services, and for identification and management of risks to safety that may arise from the said changes.
>
> SMS continuous improvement process.
>
> (1) The certificate holder must monitor and evaluate the effectiveness of the SMS processes in order to allow continuous improvement of the system's overall performance.

There was management of risk in the manuals of the operator. Specific briefings (Airport Briefings) were identified in the SOP, in its annexes 1, 2 and 3, for the SBBH, SBRJ and SBSP Aerodromes, chosen because they are specific operation locations with important information for airmen.

The company's Safety Management Manual provided for risk management by identifying operational hazards for certain aerodromes, including SBGO, as shown in Figure 19.



1.12. PERIGOS NA OPERAÇÃO

A Brasil Vida implantará um sistema estruturado para a análise e gestão dos riscos baseado na identificação dos perigos associados às suas operações e atividades e no controle efetivo e eficaz desses riscos através de barreiras.

Devido à complexidade de nossas atividades, por sermos uma empresa não regular e operar nos mais distintos aeródromos e regiões do país, nossas operações estão sujeitas a diferentes tipos de risco que devem ser tratados de acordo com suas características e especificidades. Entre os quais, pode-se destacar:

Aeroporto	Perigo	Risco	Consequência possíveis
SBBE	1- Perigo Aviário: Concentração de pássaros nos setores de aproximação e decolagem	1-Colisão / Ingestão de pássaros	1-Danos à aeronave e seus ocupantes 2-Acidente /incidente por ingestão
SBSV	1- Falha na sinalização e balizamento nas pistas de táxi	1-Incursão /Excursão em pista	1-Incidente/Acidente grave
SBSN	1- Perigo Aviário: Concentração de pássaros na cabeceira	1-Colisão / Ingestão de pássaros	1-Danos a aeronave e seus ocupantes 2-Acidente/Incidente por ingestão
SBSP	1- Raio Laser	1-Ofuscar e comprometer a visibilidade da tripulação	1-Desorientação espacial, incidente/acidente;
SBGO	1- Raio Laser	1-Ofuscar e comprometer a visibilidade da tripulação	1-Desorientação espacial, incidente/acidente

Figure 19 - Extract from the operator's Safety Management Manual REVISION 7 – 30 July 2021, pages 28 and 29, with adaptations.

With regard to weight and balance, the movement of the Center of Gravity (CG) is known to affect the longitudinal stability of the aircraft. As the CG moves forward, the stability increases, and, as it moves backward, the stability decreases.

With the CG displaced forward, although the aircraft's stability increases, elevator control will be more required in order to raise the nose of the aircraft.

A backward position of the CG results in an increase in the sensitivity of the elevator actuation, which may lead to loss of control of the aircraft.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was an aeromedical flight for patient transport, type “Air ICU”, with two crew members, two medical-team members, and a patient, from *Goiânia*, State of *Goiás*, bound for Miami, Florida, USA, with a planned technical stopover at TTPP (*Piarco* International Aerodrome, Port of Spain, Trinidad and Tobago), under the rules of the RBAC-135.

The PIC and SIC had the necessary licenses for the flight, besides having valid qualifications and experience in the type of flight.

The aircraft had flown 36 minutes after a “200-hour” inspection, having sustained an oil leak issue on the left-hand engine and returned for inspection four days after being received at headquarters. Once the problem was solved, verification of the Pressurization Dump remained pending, as the airplane had only undergone a check on the ground. The day before the occurrence, the aircraft was subject to another check for verification of the leakage and pressurization condition, once again on the ground.

The facts analyzed were not decisive for the occurrence, but they allow the perception of some degree of concern on the part of the operator with the situation of the aircraft, which

would shortly be engaged on an international flight. Nevertheless, the in-flight check of the Pressurization Dump was not performed, and was to be carried out later on.

On the day of the accident, meteorological information was available and was accessed by the crew. According to weather reports, at the time of takeoff, SBGO was operating VFR, with a wind of 090º at 4 kt, visibility more than 10 km, sky clear, and a temperature of 32°C.

The runway 14 was the active runway for landing and takeoff operations. An aircraft that had taken off before the PR-BVB reported a tailwind of 8-10 kt at takeoff. Such information was relayed to the PR-BVB before it took off.

There was a change in the wind direction at the aerodrome for the time in question, however, with little variation in intensity and within the aircraft's operating limit for the tail component (10 kt).

With regard to the duties of the crew described in the SOP, although the fact *per se* apparently did not contribute to the occurrence, there was a contradiction between the items 5.3.1 and 5.4, since the responsibility for the conduction of the briefings was alternately attributed either to the Pilot in Command or to the Pilot Flying.

In relation to the take-off weight limits, the following three criteria should have been consulted: MTOW for altitude and temperature; MTOW for the takeoff distance chart; and MTOW limited by the braking energy or tire ground-speed. Thus, the lowest value among the three criteria would be defined, aiming to comply with all certification parameters and specific regulations for the model and type of flight to be performed. In this way, the MTOW would be defined as 21,750 lbs, with the temperature and altitude of the field as limiting factors.

The aircraft took off with 776 lbs (352 kg) above the correct weight for the existing conditions. During the planning of the flight segment, when calculating the MTOW limit for the location in view of maintaining the desired payload, it would be necessary to reduce the amount of fuel. Therefore, it would be mandatory to make an intermediate landing for refueling, on the flight leg bound for TTPP.

As for the aircraft's balance, one concluded that the real CG was behind the CG of the “trim” selected for takeoff. Thus, there was a decrease in stability and an increase of the sensitivity in the actuation of the elevator, which, associated with the takeoff above the MTOW for the location, did not allow the flight to climb within the expected distance.

The analysis of the engines’ data allowed the investigation commission to verify that both engines operated as expected in the moments before the occurrence, generating the correct thrust for the location, and, thus, were not considered as a contributing factor.

Risk management was present in the company's manuals. It was identified in the SOPs, in the specific briefings (Airport Briefings) for some locations, but it did not include the SBGO altitude characteristics in relation to other aerodromes considered critical by the company.

Monitoring the maximum takeoff weight for different locations and establishing specific, predetermined routes, with intermediate landings, would probably allow barriers to be established, even still during the planning briefing.

3. CONCLUSIONS.

3.1. Findings.

a) the pilots held valid CMA’s (Aeronautical Medical Certificates);

b) the pilots held valid AI24 type aircraft and IFR Flight (Airplane) ratings;

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

d) the aircraft had a valid CVA (Airworthiness Verification Certificate);

e) the aircraft was outside of the prescribed weight and balance limits;

f) the airframe and engine logbooks were up to date;

g) the meteorological conditions were suitable for the flight;

h) before takeoff, a tailwind was reported, with intensity of 8 - 10 kt;

i) the engines developed thrust consistent with the operation in that location;

j) after the rotation speed, the aircraft got airborne;

k) the PIC chose to return to the runway and decelerate the aircraft;

l) the aircraft returned to the runway in excess of the maximum landing weight;

m) the aircraft overran the longitudinal limits of the runway;

n) the aircraft sustained substantial damage; and

o) none of the occupants of the aircraft were injured.

3.2. Contributing factors.

- **Attitude – a contributor.**

Taking off outside the prescribed parameters indicated a complacent attitude in relation to the limits established by the manufacturer and, therefore, contributed to the condition of risk that resulted in the occurrence in question.

- **Piloting judgment – a contributor.**

Although being qualified for the operation, the crew did not assess the situation in an accurate manner when they decided to proceed with the flight with the aircraft above the maximum takeoff weight.

- **Flight planning – a contributor.**

The attempt to take off with the aircraft above the maximum takeoff weight characterized inadequacy of the preparation work done by the crew.

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

The decision to attempt takeoff with the aircraft above the maximum takeoff weight revealed difficulties in perceiving the risks involved in that condition, which resulted in takeoff rejection after V1 and overrunning of the longitudinal limits of the runway.

- **Managerial oversight – a contributor.**

There was a failure on the part of the administration related to the supervision of the planning and execution of the activities at a technical and operational level with regard to the mission being carried out on the occasion of this accident.

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-110/CENIPA/2021 - 01 **Issued on 12/29/2023**

Work with *Brasil Vida Táxi Aéreo Ltda*., aiming to verify whether the operator of the aircraft complies with the instructions and procedures established by the Supplementary Instruction (IS) nº 135-005, dealing with "Aeromedical Operation Performed by Air Operators Governed by the RBAC-135", particularly in regard to specific instructions on aircraft weight-and-balance aspects described in the referred IS.

A-110/CENIPA/2021 - 02 **Issued on 12/29/2023**

Work with *Brasil Vida Táxi Aéreo Ltda.* so that the company updates the layout of its cargo manifest, inserting the field ORIGIN ADRM MTOW, specifying the takeoff limiting factor.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

On 25 March 2022, the ANAC (Brazil's National Civil Aviation Agency) published the Supplementary Instruction (IS) nº 135-005, establishing instructions, procedures and authorization for the conduction of aeromedical operations by an air operator certified in accordance with the RBAC nº 119, and operating under the requirements established by the RBAC-135.

On December 29th, 2023.