COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 131/CENIPA/2017

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-MPE**
MODEL:	**208 AMPHIBIAN**
DATE:	**17OCT2017**

NOTICE

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

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

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

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

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

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

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

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

SYNOPSIS

This is the Final Report of the 17OCT2017 accident with the 208 Amphibian aircraft, registration PR-MPE. The accident was classified as “[ARC] Abnormal Runway Contact”.

During a ditching at the Negro River, in the area of Anavilhanas Fluvial Archipelago, the aircraft touched the river with its landing gear extended and it overturned.

The aircraft had substantial damage.

One passenger suffered fatal injuries. The pilot and three other passengers suffered minor injuries.

An Accredited Representative of the National Transportation Safety Board (NTSB) - USA, (State where the aircraft was designed and manufactured) and a specialist from the Swedish Accident Investigation Authority (SAIA) – Sweden (Origin State of the deceased occupant) were designated for participation in the investigation.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AGL	Above Ground Level
ANAC	Brazil's National Civil Aviation Agency
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
ECTM	Engine Condition Trend Monitoring
EOBT	Estimated Off Block Time
FAP	Pilot's Evaluation Sheet
FPL	Flight Plan
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IAM	Annual Maintenance Inspection
METAR	Aviation Routine Weather Report
MNAF	Seaplane or Amphibian Single Engine Rating
MNS	Designator of the VOR Manaus
MNTE	Airplane Single Engine Land Rating
NTSB	National Transportation Safety Board (USA)
ONG	Non-governmental Organization
OS	Service Order
PLA	Airline Pilot License – Airplane
POH	Pilot Operating Handbook
PPR	Private Pilot License – Airplane
SAIA	Swedish Accident Investigation Authority
SBEG	ICAO Locator Designator – Flores Aerodrome, Manaus - AM
SHP	Shaft Horse Power
SPECI	Selected Special Aeronautical Weather Report
STC	Supplemental Type Certificate
SWFN	ICAO Locator Designator – Eduardo Gomes Aerodrome, Manaus - AM
TMA	Terminal Control Area
TPP	Registration Category of Private Service - Aircraft
UTC	Universal Time Coordinated
VFR	Visual Flight Rules
VOR	VHF Omnidirectional Radio Range
VRef	Minimum Final Approach Speed

1. FACTUAL INFORMATION.

Aircraft	**Model:** 208 Amphibian **Registration:** PR-MPE **Manufacturer:** Cessna Aircraft	**Operator:** Greenpeace Brasil
Occurrence	**Date/time:** 17OCT2017 - 1540 UTC **Location:** Anavilhanas Fluvial Archipelago **Lat.** 02°45'54"S **Long.** 060°37'53"W **Municipality – State:** Novo Airão – AM	**Type(s):** "[ARC] Abnormal Runway Contact" **Subtype(s):** NIL

1.1 History of the flight.

The aircraft took off from the Eduardo Gomes Aerodrome (SBEG), Manaus - AM, to the Anavilhanas Fluvial Archipelago - AM, at about 1520 (UTC) to transport cargo and personnel, with one pilot and four passengers on board.

With about twenty minutes of flight, when ditching on the Rio Negro, the aircraft touched the water with its landing gear extended and it overturned.

The aircraft had substantial damage.

One passenger suffered fatal injuries. The pilot and three other passengers suffered minor injuries.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	1	-
Serious	-	-	-
Minor	1	3	-
None	-	-	-

1.3 Damage to the aircraft.

The aircraft had substantial damage. Due to the force of the impact against the water, there was damage to the propeller assembly, engine and breakage of the engine mount near the firewall. The engine was attached to the aircraft by cables and pipings.

The brackets of the floats broke, being attached to the aircraft only by the tension cables, which caused the fuselage to submerge.

The fuselage was relatively preserved. There was kneading on the right front part of the cabin structure, due to the impact of the engine against that structure as well as breaking of the windshield.

Figure 1 - View of the aircraft at the time of lifting.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	Pilot
Total	8,535:00
Total in the last 30 days	14:50
Total in the last 24 hours	00:00
In this type of aircraft	660:00
In this type in the last 30 days	03:00
In this type in the last 24 hours	00:00

N.B.: The data related to the flown hours were obtained from the pilot and through the records in the Manaus Air Taxi.

1.5.2 Personnel training.

The pilot took the PPR course at the Skylab School – RJ, in 1985.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PLA License and had valid MNAF and IFRA Ratings.

1.5.4 Qualification and flight experience.

The pilot was qualified and had experience in the type of flight.

The crewmember had been flying for more than 30 years, with experience in single-engine aircraft, amphibian single-engine, multi-engine and jet aircraft. He has been operating in the Amazon Region for more than 20 years. At Manaus Air Taxi, a company that he had been working since 1999, he had worked in several roles, including Chief Pilot and Operations Director.

At the time of the accident, he was not carrying out any administrative functions, he only regularly operated the 208B, 208 Amphibian, 650 and he was a Pilot Instructor of aircraft 208. Being the most senior pilot of the company and considered the most experienced pilot, he was designated to fly the PR-MPE aircraft, which was operated by the Non-Governmental Organization (ONG) Greenpeace.

In spite of being an employee of Manaus Air Taxi, for the accomplishment of the flights in the PR-MPE aircraft the pilot worked autonomously, because his contract with Greenpeace did not have any supervision of the company.

Regarding the experience with the crashed aircraft model, between 2009 and 2017 the pilot flew 525 hours at Manaus Air Taxi and about 135 hours at Greenpeace aircraft, totaling 660 hours flown on 208 Amphibian aircraft.

In 13SEPT2017, he carried out the periodic revalidation of the MNAF Rating, being disapproved, as it was stated in the FAP:

> "It was conducted oral examination with the Pilot. He presented knowledge compatible with the requirement. Flight canceled at runway 10 on SBEG. The commander did not perform the Before Start Checklist, the After Start Checklist, the Taxi Checklist, and the Takeoff Checklist. He made some memory items, but did not follow the checklist. It was evidenced to be the non-use of the checklist on this equipment the pilot's culture."

In view of the situations observed by the examiner of the ANAC, the pilot received at item 38 - Others (use of the checklist), the grade unsatisfactory, being disapproved in that periodic check.

On 28SEPT2017, the revalidation of the MNAF Rating was again performed, being considered approved, as extracted from the FAP:

> "Training performed at the TMA SBEG.
>
> Landings made on Rio Negro, right margin, Radial 060º - 5 NM.
>
> Operation of the aircraft and its systems performed with proficiency.
>
> Satisfactory flight. "

In 2015, he was the commander of the PR-PAZ aircraft, another 208 Amphibian, which crashed during takeoff, shortly after leaving the water. The pilot lost control of the aircraft and as a result of the low altitude, there was a touch of the left wing against the surface of the river, which caused the aircraft to spin and hit the water sharply.

The aircraft had substantial damage, but the crewmember and the passenger were unharmed. The Investigation of this 2015 event has already been completed with the issuance of the Final Report (A-105 / CENIPA / 2015) by the CENIPA.

1.5.5 Validity of medical certificate.

The pilot had valid CMA.

1.6 Aircraft information.

The aircraft, serial number 20800510, was manufactured by Cessna Aircraft, in 2009 and it was registered in the TPP category.

The aircraft had valid Airworthiness Certificate (CA).

The airframe and propeller logbook records were updated, but the engine and floats logbooks were not found.

The Amphibian Model 208 was a high wing aircraft, with metallic structure, non-pressurized cabin, single-engine turboprop with conventional empennage.

The aircraft was assembled on the 208 lander fuselage, with capacity for 9 passengers, but it was equipped with a PT6A-114A engine, which developed 675 Shaft Horse Power (SHP), about 12.5% more power compared to the engine PT6A-114 that equipped the land version.

This difference in motorization was necessary for the aircraft to have sufficient performance to operate in the water, compensating the drag and weight added by the installation of the floats and the amphibian landing gear system.

After the initial assembly in the land version, that is, with landing gear of the fixed tricycle type, the aircraft was transferred to the facilities of Wipaire Inc., where the Wipaire Wipline 8000 floats were installed, which, in the crashed aircraft version, had retractable quadricycle landing gear, which allowed the aircraft to operate both on land and on water.

This modification was described in Wipaire's Supplemental Type Certificate (STC) SA1311GL, which, in addition to guiding the necessary modifications, described the system and its limitations.

Landing gears installed with the Wipaire Wipline 8000 floats were retractable, the quadricycle type with two articulated gears on the nose or head of the floats and two double sets on the main landing gear.

Two air-oil dampers assembled on the main landing gears performed the impact absorption. Each main wheel was equipped with a disc brake, with hydraulic actuation.

Two hydraulic electric drive pumps and four hydraulic actuators (one for each landing gear) carried out the extension and retraction of the landing gear, in addition to the locking at the top or bottom.

The hydraulic pumps were located within the fuselage of the aircraft, behind the luggage compartment, inside the tail cone.

The hydraulic operation was started manually, with actuation on the landing gear lever. When the lever was repositioned, the hydraulic pressure in the system dropped below 500 PSI and the pressure switches automatically triggered the electric engines of the hydraulic pumps to keep the system pressure between 500 and 1,000 PSI.

The landing gear control lever controlled a hydraulic selector valve within the control unit on the instrument panel (Figure 2) and had two positions (UP WATER and DOWN LAND), providing a mechanical indication of the selected landing gear position.

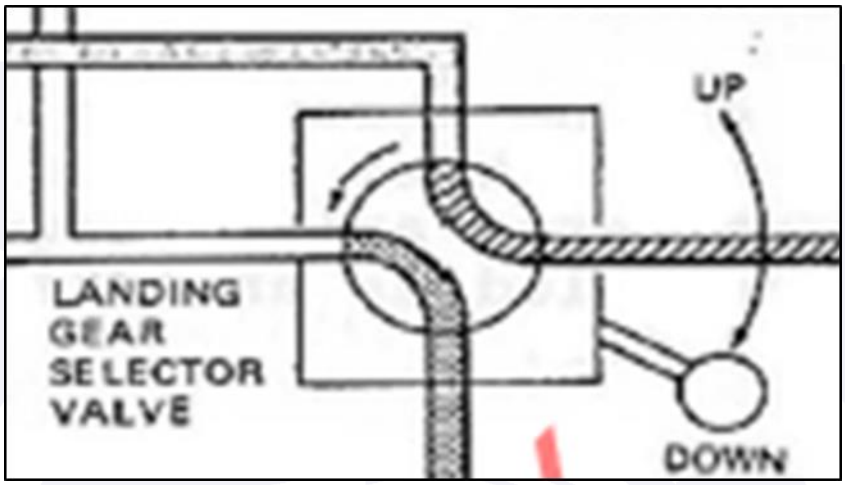


Figure 2 - Landing gear command lever layout.

From any position, the lever should be pulled toward the pilot to release the safety lock, before it could be repositioned.

Ten indicator lights were assembled on the landing gear control unit next to the landing gear lever.

The lights were tested by pressing the Lamp Test switch. Four blue lights, named NOSE and MAIN (lights from the left to the left float and lights from the right to the right float), indicated by their ignition that the landing gear was up and locked.

The four amber lights, named NOSE and MAIN (lights from the left to the left float and lights from the right to the right float), indicated by their illumination that the landing gear was down and locked. None of the lights remained ON when the landing gear was in transit (Figure 3).

Figure 3 - Amphibian landing gear control and light system.

Two red lights, named PUMPS ON 1 and 2, would light when electric current was being supplied to the engines of the hydraulic pumps.

If the engines continued to operate during flight or "cycled" repeatedly, it was provided in the manual that they should be turned off by manually disarming the AMPHIBIAN PUMP 1 and AMPHIBIAN PUMP 2 circuit breakers as their continued operation could lead to premature failure of the equipment. Before the landing, however, the circuit breakers should be reset to reactivate the system.

The indicator lights had adjustable brightness via the DAY-NIGHT switch. When the NIGHT position was selected, its intensity could be controlled by the ENG INST rheostat. The indicator light circuits were protected by the ANNUNCIATOR PANEL circuit breaker, which, by construction, was independent of the electric engine circuits of the landing gear hydraulic pumps.

To retract and extend the landing gear, the lever should be pulled toward the pilot and then moved to the desired position. When the lever reached the new position, the hydraulic pressure in the system fell to the point that the electric engines of the hydraulic pumps started to operate.

The engines provided the necessary force for the hydraulic pumps to move the hydraulic fluid and hydraulically activated the actuators of each landing gear.

During the engines operation, the red PUMP ON 1 and 2 indicator lights should be illuminated. Once the cycle was completed, the pressure in the system rose to the point that the engines were shut down automatically.

Each landing gear operated independently of the others, so that the position lights switched on separately and in a different way.

An emergency hand pump was located on the cabin floor, between the two front seats, for use in the eventual failure of the normal system. This manual pump could be used for both the lowering and the retraction of the landing gear.

Before using this pump, the AMPHIBIAN PUMP 1 and 2 circuit breakers should be disarmed to deactivate the electrohydraulic pumps and then select the UP or DOWN position with the landing gear control lever.

Then, the hand pump lever would be extended and activated, approximately 475 times for lowering and 500 times for retraction, as specified in the operation manual.

When the landing gear reached the selected position, its indicator light turned on. After all four landing gears position indicator lights were on; there was an increase in the resistance for the manual pump drive, because the system pressure is close to its limit.

The aircraft was equipped with an aural landing gear warning system. This system, described in the STC SA39CH, had the function of providing an additional indication through a sound message and an alarm light on the pilot panel.

The system monitored the speed of the aircraft and the position of the landing gear. When the aircraft entered a landing configuration, an aural message notified the pilot about the position of the landing gear and which type of landing (runway or water) was expected for the current position of the landing gear.

Sensors that detected the condition of the landing gear indication lights and read the airspeed in the pitot system operated the system. Thus, it alerted the pilot, through the GEAR ADVISORY button light, located on the panel (Figure 4), in a prominent position.

Figure 4 - Gear Advisory button installed on the PR-MPE aircraft.

In addition, the audio message sounded in the audio system (headphones or speakers) "GEAR IS UP FOR WATER LANDING" or "GEAR IS DOWN FOR RUNWAY LANDING".

Additionally, if the landing gear stopped at an intermediate position, such as one or more legs not fully lowered or retracted, the "CHECK GEAR" aural message would be announced on the aircraft audio system.

The system could be tested by pressing the GEAR ADVISORY warning button for 4 to 5 seconds. In this case, the button should light up and the audio messages "GEAR IS UP FOR WATER LANDING" and "GEAR IS DOWN FOR RUNWAY LANDING" would be heard on the audio system of the aircraft.

This system was activated automatically whenever it received electric current and armed, automatically, when a programmed speed was reached.

The warning system provided the aural warning according to the position of the landing gear and, at the same time, the GEAR ADVISORY button was illuminated when a speed below the programmed speed was reached.

Warnings were repeated every 3.5 seconds, until the pilot pressed the button to cancel them. In the event of a go-around procedure, when the programmed speed was reached again, the system was automatically reset.

Wipaire Inc.'s 9600-1A Installation Manual, in its May 2014 G inspection, described only two possible settings for the system, one for intensity of the aural message and one for setting the programmed speed.

The system consisted of a computer, located inside a control box, which received speed information from the pitot system and landing gear position lights.

On the side of this box, there were two control switches, necessary to adjust the volume intensity of the aural message and the programmed speed. These switches were named VOLUME and AIRSPEED respectively.

For the regulation, a small screwdriver was required to rotate these switches according to the user's need.

The VOLUME setting comes standard, already set at 60% and could range from 20 to 100% in intensity.

The AIRSPEED regulation was set to 80mph (70kt) and its value could be adjusted between 50mph (44kt) and 125mph (109kt).

The installation manual recommended that the programmed speed be set to values between 10 and 20mph/kt above the Minimum Final Approach Speed (VRef) and that the aircraft flight manual or manufacturer's supplement should be consulted for the recommended speeds .

> “The recommended airspeed threshold setting is final approach speed (VRef) plus 10-20mph/kt. Consult the aircraft flight manual or supplement for the aircraft manufacturer’s recommended V-speeds.”

To set the programmed speed, the AIRSPEED setting had side markers, which corresponded to a setting table that started at the "0" position, equivalent to the lowest possible setting (50mph / 44kt). At each new position, turning the adjustment clockwise increased the programmed speed by 5mph to the "F" position corresponding to the maximum setting (125mph / 109kt), as shown in Figure 5.

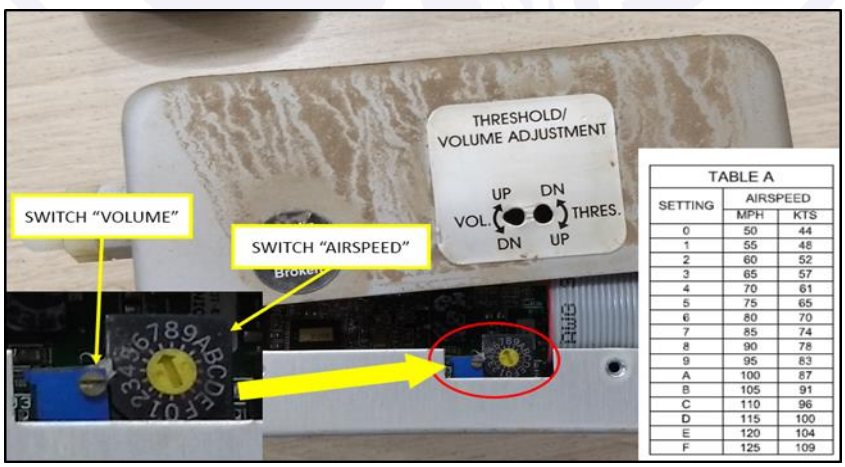


Figure 5 - Overview of the landing gear position warning system control box. In detail, the adjustment found in the control box.

The aircraft's landing gear position warning system control box was with the speed set adjusted to 85mph/74kt.

Manual No. 1002554 - Service Manual and Instructions for Continued Airworthiness for the Wipline model 8000 Amphibian and Seaplane Floats, revision K of 04DEC2015, stated in chapter 5.8 Cessna float re-installation instructions / procedures, page 41, item 19:

> "Perform gear check & ensure all lights agree with gear and gear advisory"

As the float logbook was not found, it was not possible to verify when the floats were last installed, at which time the speed and volume adjustments should be checked, as per item 19 above.

The last inspection of the aircraft, "Annual Floats", was held on 09OCT2017 by the maintenance organization Manaus Air Taxi, in Manaus, AM, being 20 minutes flown after the inspection.

The last revision of the aircraft, the "IAM/100hs" type, was carried out on 03AUG2017 by the maintenance organization Manaus Air Taxi, in Manaus, AM, being 25 hours and 50 minutes flown after the revision.

In reviewing the Service Orders (OS) for the last maintenance, it was verified that on 09OCT2017, OS CTM001833/2017 was terminated because the annual inspection of the floats was completed, according to maintenance manual no.1002554, revision K of December 2015, without any discrepancy being reported.

This manual also described the tasks to be performed during the 25h, 50h, 100h, 200h and annual inspections of the floats. It brought in chapter 5.6 Inspection Time Limits and Checklist, the time intervals for each type of inspection.

The manual prevised, among other tasks, the extending and retraction of the emergency landing gear. The procedure in which it was conducted was described on page 16, chapter 4, Amphibian Landing Gear System Operation & Maintenance, item 4.4 Emergency Pump Handle:

> "Prior to utilizing the emergency hand pump, pull the AMPHIB PUMP 1 and 2 circuit breakers to deactivate the electric hydraulic pumps."

In other words, before using the emergency hand pump, the AMPHIB PUMP 1 and 2 circuit breakers should be pulled to deactivate the hydraulic pumps.

In subsequent inspection actions, there was no further mention of the AMPHIB PUMP 1 and 2 circuit breakers in that maintenance routine.

1.7 Meteorological information.

The METAR of Eduardo Gomes Aerodrome (SBEG), 38 nautical miles away from the scene of the accident, had the following information:

> METAR SBEG 171500Z 15014KT 9999 TSRA BKN015 FEW025CB SCT080 25/23 Q1015=
>
> SPECI SBEG 171525Z 16002KT 7000 -TSRA SCT015 FEW025CB SCT100 24/23 Q1014=
>
> METAR SBEG 171600Z 10006KT 9999 SCT020 FEW025TCU 25/23 Q1013=

It was found that the conditions were favorable to visual flight with visibility over 7km with thunder and light rain and scattered clouds at 1,500ft. The wind had intensity between 2 and 6kt.

Despite the rain information in the area, the pilot reported that there was no influence on the flight, due to meteorological reasons, as well as the present weather conditions attended the visual flight rules.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place outside the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The floats remained on the surface and prevented the aircraft from sinking completely, being observed that the landing gear was down and locked (Figure 6).

Figure 6 - View of the semi-submerged aircraft.

The aircraft was taken out of the water in the late afternoon of 18OCT2017, with the help of a truck crane and a ferry.

Most of the damage was concentrated on the front of the aircraft and fuselage, including the separation of the engine, broken windshields and impact marks from the engine hood against the fuselage, just above the right windshield (Figure 7).

Figure 7 - Aircraft wreckage.

The right wing presented impact damage from the float with its leading edge, while the left wing and the stabilizers were not damaged.

The propellers had low power impact marks.

The elevator trim tab was in the T.O range (Take Off), the aileron was trimmed to the left side and the rudder near the neutral position.

The power lever was advanced in the MAX POWER position, the propeller lever was advanced in the MAX RPM position and the fuel lever was advanced in about half course, close to the LOW IDLE position.

The left and right fuel selectors were in the ON position.

The flap lever was in an intermediate position, between UP and 10º, or approximately half the course.

The amphibian steering wheel was in the UP position and locked. The landing gear control lever was in the UP position (Figure 8).

Figure 8 - Position of the landing gear control.

The circuit breaker panel was intact and presented four disarmed circuit breakers (Figure 9).

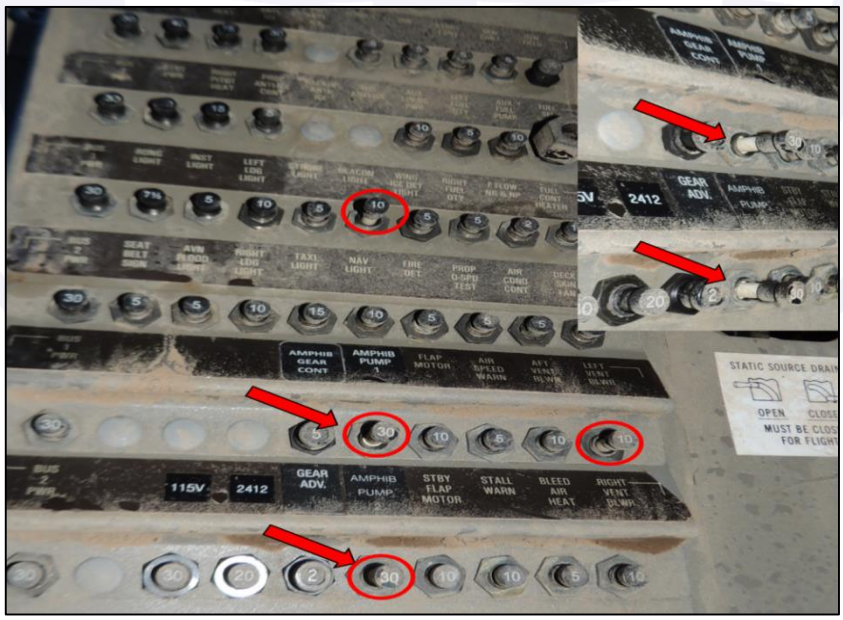


Figure 9 - Circuit Breaker Panel. In detail, the AMPHIB PUMP 1 and 2 circuit breakers are disarmed.

The highlighted circuit breakers provided power to the following systems:

- BEACON LIGHT - aircraft position light (red light on top of empennage);

- LEFT VENT BLWR - cabin ventilation system, electric fan on the commander's side;

- AMPHIB PUMP 1 - electrical supply of the hydraulic pump nº 1, of the amphibian landing gear system actuation; and

- AMPHIB PUMP 2 - electrical supply of the hydraulic pump nº 2 of the amphibian landing gear system actuation.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Not investigated.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot was considered, by people of his conviviality, as an experienced professional. Professionally, he had already flown in mining regions, which gave him familiarization with the air operation in places of difficult access.

In addition to perform flights to the aircraft owner organization, the pilot had a professional relationship with an Air Taxi company, where he was used to operate amphibian aircraft in the Amazon region.

Operations in this company involved both passenger flights and aircraft checking flights after maintenance services.

Usually, he carried out panoramic or verification flights of Greenpeace Brazil places of interest. According to reports, on the day of the accident, it was one of those panoramic flights in the region.

The pilot reported having held a briefing to advise passengers about the dynamics of the flight, which was scheduled to land on the Rio Negro.

The fact that the landing gear was down and the AMPHIB PUMP 1 and 2 breakers were unarmed surprised the pilot because he had not observed this condition when doing his check before takeoff. According to his account, he had performed the pre-flight check and, at the time, he had not identified any abnormalities.

According to the data collected during the investigation process, the pilot did not habitually make use of the checklist in his flights.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

After the impact, the pilot left the aircraft by the crew entrance door and the passenger who was sitting behind the commander left the aircraft through the main door, which opened with the impact.

When they were outside, they did not see the other passengers, returning to the interior of the aircraft, which was upside down and sinking.

At that moment, the commander was able to remove a passenger that was on a seat on the right side of the aircraft, near the front door and the other survivor removed a passenger sitting on the first seat just behind the copilot's position.

The three passengers were fastened to the seat of the aircraft by the seat belt, which was similar to the automotive model, with a release button. However, with the aircraft upside down and the weight of the occupant acting on the belt, the passengers were unable to release themselves, and a third-party action was required.

Regarding the passenger sitting on the right front seat (copilot position), after the removal of the other two passengers, the commander tried to return to rescue him, but the aircraft was almost completely submerged.

The passenger was only removed about 15 minutes after the accident, by people who passed on a boat, being no longer breathing at that moment.

The occupants were transported to Manaus - AM, on the boat that carried out the rescue.

1.16 Tests and research.

Tests were performed on the amphibian landing gear system in an aircraft similar to the crashed model, also equipped with the same float model, WIPLINE MODEL 8000. The objective was to visualize the operation of extending and retracting the amphibian landing gear.

In order to carry out the tests, the procedures described in the WIPLINE MODEL 8.000 SERVICE MANUAL 1002554, Rev. H were followed. The extending and retracting were performed by the normal system, using the available force of the hydraulic pumps or Power Packs, as well as checking the operation of the landing gear position warning system by actuating the GEAR ADVISORY button.

After the test of operation by the normal system, the activation by the emergency system was carried out, which included the disarming of the AMPHIB PUMP circuit breakers 1 and 2, as well as the activation of the manual pump.

During this test, it could be verified that if the AMPHIB PUMP 1 and 2 circuit breakers were disarmed, when the landing gear control was moved to the UP position, no action would be taken; the electric pumps would not operate and would not pressurize the retracting line, according to the position lever control.

At that time, the landing gear continued in the position down and locked.

Later, in the same aircraft, new tests were carried out on the operation of the landing gear system, but this time the landing gear of the crashed aircraft was installed.

In this new test, both the aural alert system and the landing gear system worked normally. However, the illumination of the landing gear lights and hydraulic pumps worked partially, as some lamps did not light up. However, it could not be stated whether this condition occurred before or after the impact.

A test was carried out in order to observe the difference in the illumination intensity of the landing gear position indicator lamps between NORMAL and DIM (Figure 10).

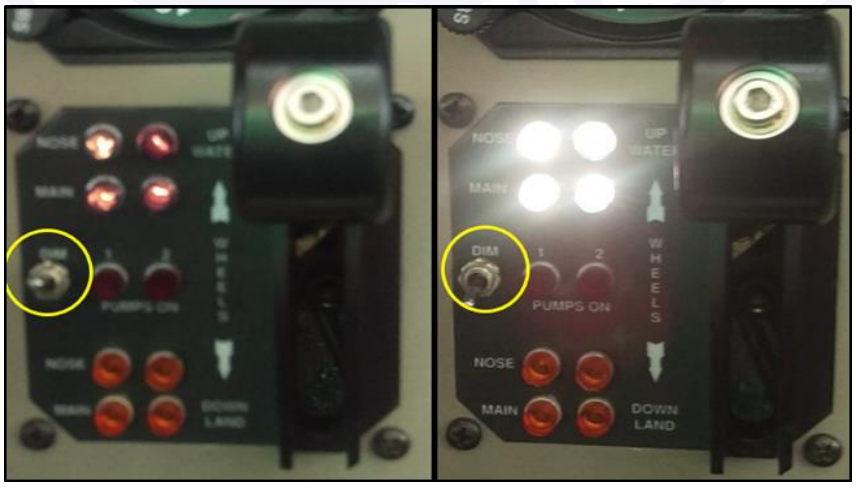


Figure 10 - Light intensity difference. DIM position to the left and NORMAL to the right.

During the field investigation, it was observed that the light switch was in the NORMAL position.

The test of the landing gear position warning system was not performed because the aircraft was submerged, which damaged its internal components.

However, the observation of the set position of the programmed speed of the warning system was considered enough to confirm to which speed the system was adjusted.

1.17 Organizational and management information.

Manaus Air Taxi has had a formal contract with the commander for 19 years. He has also served Greenpeace for 17 years, being responsible for making regular flights to places of interest to that ONG.

The management of the activities developed in each of these professional contexts was the responsibility of the pilot. Both employers were aware of these implications.

The maintenance of the aircraft was carried out by the same air taxi company in which the pilot worked, so he had freedom of access to the information and the mechanics that operated there.

The day before the occurrence, a maintenance service had been performed, related to the aircraft's air conditioning system, which was accompanied by the pilot, as reported.

In the maintenance, the control of the inspections was systematized with the aid of a spreadsheet. The procedures prevised a receiving check of the aircraft and another check, before delivery.

This procedure was justified by the fact that the maintenance team, when carrying out its activities, deconfigured and subsequently reconfigured the aircraft, as recommended by the manufacturer.

1.18 Operational information.

The flight intended to show some areas of operation of the Greenpeace to one of the passengers and was planned the day before.

At 1200 (UTC) the passengers and the pilot met in the hangar of the maintenance company to carry out the embarkation, and at that time, the Flight Plan (FPL) had already been approved.

The FPL submitted by the commander indicated an Estimated Off Block Time (EOBT) of 1300 (UTC) with SBEG takeoff. It would follow Visual Flight Rules (VFR), maintaining 140kt and 1.500ft AGL, in direct route to a point distant 50 NM, in the radial 270º of the VHF Omnidirectional Radio Range (VOR) Manaus.

The flight had estimated duration of two hours with expected return to SBEG, alternating the SWFN and an expected endurance of four hours.

With regard to the preparation of the aircraft for the flight, there was a "pre-flight" sheet, which listed in an orderly and sequential manner all items to be checked before takeoff.

This condensed list, which included the Pre-Flight Inspection Sheet, had been translated from the POH for the 208B Land aircraft, equipped with the G1000 system, and had 8 pages.

Pages 1 and 2 are complete in Annex A of this report.

At the inspection, there was a sequence that started from the cabin and continued clockwise from the outside of the aircraft (Figure 11).

Figure 11 - Walk around diagram.

For the inspection of the cabin, it was prevised in the Pre-Flight Inspection Form to comply with item 7 - Circuit Breakers - IN. This action required the operator to check the breaker panel and check if all circuit breakers were in the IN position, that is, armed.

Wipaire Inc. has issued, through supplement POHSA1311GL-A-6, operation information that has been modified, as a result of the installation of Wipaire Wipline Model 8000 floats.

It was stated in that document, section 1 - General, that the information contained in the POH of the Land Caravan were the same as those of the amphibian and were therefore not repeated in that supplement.

In addition, in section 4 - Normal Procedures, it was stated that the checklist and amplified procedures of the basic POH should be followed and that the modifications related to the operation with the floats were present in that section.

With that said, it was found that the guidelines for the normal operation of the aircraft, in the items that were common to the land aircraft and the amphibian aircraft, should follow what was prevised in the 208 Land manual.

Section 4 - Normal Procedures, from the 208 G1000 Model Operating Manual, page 4-17, Before Starting Engine, item 11, Circuit Breakers - Check IN required the pilot-in-command to check all the circuit breakers in the IN position, (Figure 12).

9. Switches	OFF
10. IGNITION Switch	NORM
11. Circuit Breakers	CHECK IN
12. FUEL TANK SELECTORS	BOTH ON
13. VENTILATION FANS/ AIR CONDITIONING	OFF

Figure 12 - Before Starting Engines Checklist - item 11.

According to the supplement POHSA1311GL-A-6, on page 30, landing gear retraction was prevised in the procedures to be performed on Takeoff on Land (item 9 - Landing Gear - RETRACT).

Therefore, at the beginning of the landing gear retracting cycle, the pilot should observe the landing gear down and locked lights off and the hydraulic pump lights on. At the end of the retracting cycle, the hydraulic pump lights should be off and the landing gear up and locked lights should be on, as shown in Figure 10.

For the preparation of the aircraft for landing in the water, the supplement POHSA1311GL-A-6 indicated that the check to be performed would be Before Landing - Before Landing on Water (Figure 13).

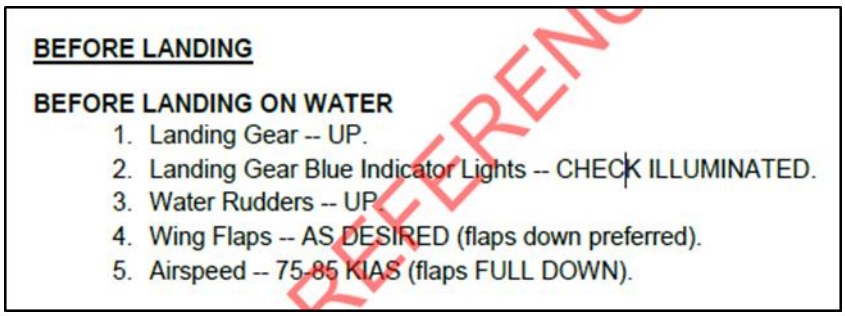


Figure 13 - Before Landing - Before Landing on Water.

The next check was the Landing - Landing on Water, which was to be carried out during the final approach, before the touchdown. This check was included in the same supplement, page 31, according to Figure 14.

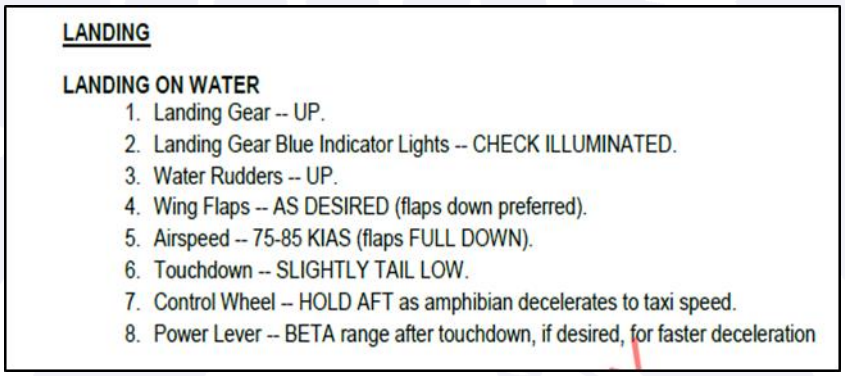


Figure 14 - Landing - Landing on Water.

In both checks, it is noted that the landing gear should be in the up position and that the pilot should check the blue landing gear indication lights.

The same supplement, in section 2 - Limits, page 12, also had the following information:

> "OTHER LIMITATIONS
>
> Amphibian Operation
>
> Landing on water is prohibited unless all four landing gears are fully retracted."

This same information was present in the form of a warning, placed on the side of the autopilot panel, clearly and visible to the pilot, as shown in Figure 15.

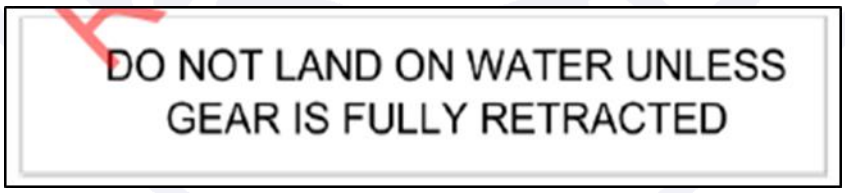


Figure 15 - Placard of warning about the landing gear for landing on the water.

In spite of several information, alerts and instructions contained in the operation manuals, during an interview, the pilot reported not remembering the condition of the landing gear indication lights, whether on takeoff or landing.

Regarding the landing procedures, the manual POHSA1311GL-A-6, page 36, described how the landing should be carried out, stating that this is usually made with 30º of flaps and power required to maintain the desired approach slope. However, there was a provision for landing with any flap adjustment.

> "Landings are normally made with 30º flaps and power as required for the desired approach path; however, they may be made at any flap setting…"

For landing on calm waters, it was recommended that the approach be performed with power and landing performed with flaps at 20º and a small descent rate (approximately 200ft / min).

> "With glassy water, it is recommended that a power approach and landing be made with 20º wing flaps at a low rate of descent (approximately 200 feet per minute)…"

Regarding normal operating speeds, the POHSA1311GL-A-6, Revision C, of 22DEZ2016, Section 4 - Normal Procedures - Speeds for Normal Operation, page 28, reported that the normal approach, with flaps 30°, should be performed between 75 and 85 kt (Figure 16).

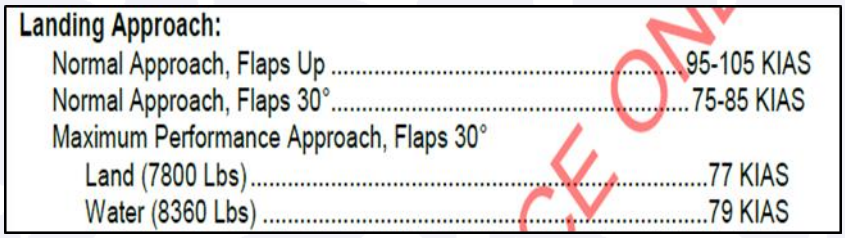


Figure 16 - Speeds for normal operation.

In an interview, the pilot informed that he has made an approach with flaps 20º at approximately 80kt, speed and configuration considered acceptable by the operating manual.

In addition to the performance information, at the time of the accident, the aircraft carried the pilot, four passengers and 1.900 lbs of fuel, being considered within the limits of weight and balance specified by the manufacturer.

1.19 Additional information.

An observer, who was also an Amphibian Rated pilot, said he observed the crashed aircraft flying over the city of Manaus with the landing gear extended at the same day of the accident.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a flight with the objective of presenting some areas of the Greenpeace operation to one of the passengers and was planned the previous day.

The last maintenance intervention recorded on the aircraft was an Annual Float Inspection, according to OS CTM001833/2017, completed on 09OCT2017.

On this intervention, services were performed on the Wipaire Wipline 8000 float and the amphibian landing gear system. These services included extending and retracting the landing gear by the emergency system.

In order to perform this procedure, it was necessary to disarm the AMPHIB PUMP 1 and AMPHIB PUMP 2 circuit breakers, which cut off the power supply to the pump engines of the hydraulic system. The landing gear control lever was then positioned (up or down) and, after the selection, the manual hydraulic pump was activated for the landing gear to start moving.

According to OS CTM001833/2017, all tests described in the maintenance manual related to the annual check of floats were performed without any discrepancy being reported.

There was no mention in the maintenance routine for the AMPHIB PUMP 1 and 2 circuit breakers to be reset after the service termination.

On the day of the occurrence, the pilot received the aircraft from the maintenance and performed the pre-flight inspection. In this check, the item Circuit breakers - Check IN should have been made, ensuring that no circuit breaker was disarmed.

The circuit breakers should be checked once more, in the armed position, in the Checklist - Before Start Engines.

The commander informed that he carried out all the checks prevised in the manual, but he did not remember the position of the AMPHIB PUMP 1 and 2 circuit breakers, thus indicating the inadequate fulfillment of the checklist items.

The aircraft took off from runway 10 of SBEG. After take-off, the landing gear retraction was commanded, but the situation of the warning lights on the amphibian landing gear control panel was not verified.

The flight proceeded without any incident. At the time of landing on the water, on the right bank of the Rio Negro, the commander informed that he had selected flaps 20º and adjusted to a final speed of approximately 80kt.

During the approach to land on the water, the Before Landing on Water, item Landing Gear – UP checklist procedure should be accomplished. Following, the pilot should check the landing gear warning lights on (Landing Gear Blue Indicator Lights - Check Illuminated).

When stabilized on the final approach to land on the water, the pilot had to perform Landing on Water procedure, which again featured the “Landing Gear – UP” and “Landing Gear Blue Indicator Lights - Check Illuminated” items.

Nevertheless, the aircraft operation checklist reinforced twice the need to make sure that the landing gear was in the up position and locked, there was still a second warning on the aircraft panel, alerting for the prohibition of ditching without the landing gears being retracted.

Similarly, the supplement to the POHSA1311GL-A-6 operation manual contained in its limitations section that landing on the water was prohibited unless all four landing gears were fully retracted.

In addition to the checklist, the aircraft was equipped with an amphibian landing gear position warning system.

This system received information on the speed and position lights of the landing gears so that during the approach to landing on land with the landing gear down and locked, when crossing the programmed speed, a warning GEAR IS DOWN FOR RUNWAY LANDING should be heard in the cabin, as well as the GEAR ADVISORY button would light up and blink.

The pilot could only cancel this warning by pressing the GEAR ADVISORY button or by accelerating the aircraft to a speed above the previously set limit.

The installation manual recommended that this programmed speed be set to a value between 10 and 20mph/kt above VRef.

It was found in the supplement to POHSA1311GL-A-6 that the highest predicted VRef was 105kt, to be used for a normal approach without flaps. As lowest speed, 75kt for a normal approach with flaps at 30º.

The amphibian landing gear position warning system control computer had two control switches required to adjust the volume intensity of the aural message and the programmed speed. This speed was set to 74kt.

There were no notes in the aircraft documentation referring to the maintenance operations in the control box that could indicate the last time that this component was serviced.

Considering that the approach was performed with flaps 20° and speed of 80kt, it is inferred that the aircraft did not reach the programmed speed of 74kt for the warning system to be activated, which prevented the activation of the GEAR IS DOWN FOR RUNWAY LANDING aural alarm.

At this point, the accident reached its point of irreversibility, since there were no more systemic barriers to the pilot's observation that the landing gear was not up and locked.

As the circuit breakers were unarmed, there was no retraction of the landing gear, which remained down and locked, situation that was corroborated by another pilot, who observed the aircraft flying over the city of Manaus with the landing gear in the down position.

Although he reported that he performed the checklist procedures, the pilot did not detect that the AMPHIB PUMP 1 and 2 circuit breakers were unarmed and similarly did not identify that the landing gear had not been retracted after takeoff.

According to the data obtained, the pilot was not accustomed to make use of the checklist in his operations. This failure to comply with a procedure prevised in the context of aviation may have been motivated by the crewmember's self-confidence, due to his familiarization during his career with that type of operation.

This hypothesis is also supported by the fact that the pilot was disapproved in his penultimate operational revalidation by the ANAC for not using the checklist.

In this case, therefore, the non-compliance of the checklist made it difficult to perceive the conditions of the aircraft, culminating in ditching without the landing gear being correctly configured.

It should be noted that the checklist is an important tool to help the flight, as it prevents important steps being suppressed or forgotten. By failing to use it, conditions conducive to lowering the level of situational awareness of the pilot are created.

Even with the circuit breakers unarmed and the pilot not properly performing the relevant checks, landing on the water with the landing gear down and locked should have been warned by the landing gear position warning system.

The installation manual recommended that the programmed speed to be set to values between 10 and 20mph / kt above VRef.

Considering that the programmed speed was set to 74 kt and the VRef prevised for flaps at 20° was 80 kt and that an adjustment between 10 and 20 mph/kt above the VRef prevised for the landing was recommended. It has been observed that the pilot performed the approach for landing on the water without the prediction of the activation of the alarm corresponding to the position of the landing gear, which in the situation of a ditching should be "GEAR IS UP FOR WATER LANDING".

It was not clear in the investigation why the programmed speed setting was set at 74kt.

Upon touching the water with the landing gear down and locked, the floats were ripped off. The aircraft overturned and stopped upside down inside the water.

The pilot and a passenger were able to leave the aircraft. Three other passengers remained attached to seat belts. The pilot and passenger returned to the interior of the aircraft and removed two other occupants. However, the third passenger, who was sitting on the seat next to the pilot, could not be rescued.

Few minutes later, with the help of some people from a boat that was passing through the place, the passenger who was still inside the aircraft, stucked to the seat belt, was removed, but already dead.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had valid Aeronautical Medical Certificate (CMA);

b) the pilot had valid MNAF and IFRA Ratings;

c) the pilot was qualified and had experience in that kind of flight;

d) the aircraft had valid Airworthiness Certificate (CA);

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

f) the airframe and propellers logbooks records were updated;

g) the engine and floats logbooks were not found;

h) weather conditions were favorable for the flight;

i) the AMPHIB PUMP 1 and AMPHIB PUMP 2 circuit breakers were found disarmed;

j) the landing gear position warning system was set at a programmed speed of 74kt;

k) the landing gear control was in the UP WATER position;

l) the aircraft landed on the water with the landing gear in the down position;

m) the aircraft overturned after touching the water;

n) the aircraft had substantial damage;

o) the pilot and three passengers suffered minor injuries; and

p) one passenger suffered fatal injuries.

3.2 Contributing factors.

- **Attitude – a contributor.**

Failure to comply with the checklist during the pre-flight inspection and the flight itself favored the landing with inadequate configuration. This attitude may have been triggered by the pilot's confidence in his operational capability, because of his long experience in aviation.

- **Flight indiscipline – a contributor.**

Failure to comply with the checklist indicated, in addition to the low level of situational awareness, a low level of concern for the safe conduction of the flight by failing to follow basic procedures set forth in the manufacturer's manuals and current regulations.

- **Piloting judgement – a contributor.**

The pilot's choice not to use the checklist during the flight phases revealed an inadequate evaluation of parameters related to the operation of the aircraft.

Improper compliance with the items in the Pre-Flight Inspection Sheet prevented the AMPHIB PUMP 1 and 2 circuit breakers from being rearmed.

- **Aircraft maintenance – a contributor.**

After performing the test of landing gear extension and retraction by the emergency system, the AMPHIB PUMP 1 and 2 circuit breakers were not rearmed, being the aircraft delivered to fly in this condition.

The setting recorded on the AIRSPEED switch of the landing gear position warning system computer demonstrated that the scheduled speed of 74kt was not in accordance with the recommended in the 9600-1A installation manual of Wipaire Inc. in its revision G.

- **Memory – undetermined.**

The AMPHIB PUMP 1 and 2 circuit breakers were found disarmed after the occurrence, indicating that, after the completion of the maintenance service, the executor of the tasks probably forgot to comply with the procedures for reconfiguring the aircraft.

In addition, it is possible that the pilot's automatism in relation to his way of carrying out the air operations, without the use of the checklist, has prevented the correct perception of the circuit breakers condition and the erroneous positioning of the landing gear.

- **Perception – a contributor.**

The accomplishment of the landing on the water with the aircraft in inadequate configuration for the situation denotes a decrease in the level of situational awareness of the pilot, considering that the necessary factors and conditions for the safety of the operation were not observed.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 "Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State".

Recommendations issued at the publication of this report:

To the Brazil's National Civil Aviation Agency (ANAC):

A-131/CENIPA/2017 - 01 **Issued on 06/28/2019**

Work with Manaus Air Taxi (COM N ° 0701-02/ANAC) to ensure that the maintenance procedures performed by that company on the Wipaire floats, and in the systems related to the operation of this equipment, are in accordance with the manufacturer's services manual, in particular with regard to the annual inspections and configurations of the amphibian landing gear position warning system.

A-131/CENIPA/2017 - 02 **Issued on 06/28/2019**

Work with Manaus Air Taxi (COM N ° 0701-02/ANAC) to ensure that the procedures for the preparation of the aircraft performed prior to its release to flight are in accordance with the operating manuals for each equipment, which refers to pre-flight inspections and post-inspection checks or maintenance services.

A-131/CENIPA/2017 - 03 **Issued on 06/28/2019**

Work with the representative of Wipaire Inc. in Brazil, in order for the company to analyze the pertinence of updating the service and the installation manual of the Wipline 8000 floats, so that this document brings a routine check the AMPHIB PUMP 1 and 2 circuit breakers in

the IN position after executing the extending and retracting check for landing gear emergency.

A-131/CENIPA/2017 - 04 **Issued on 06/28/2019**

Disseminate the lessons learned in this investigation, in order to alert Brazilian civil aviation pilots and operators about the risks arising from the non-use of the checklist, especially in critical flight phases such as landings and take-offs.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On June 28th, 2019.

ANNEX A

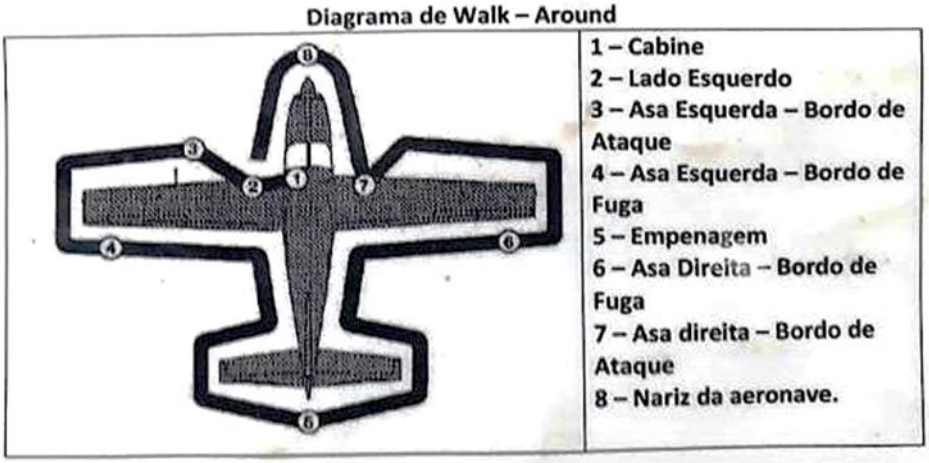
Pre-Flight Inspection Sheet 208B G1000 – MAP

MAP AVIAÇÃO	MAP AVIAÇÃO FICHA DE INSPEÇÃO DE PRÉ-VÔO CESSNA 208B G1000

ALERTAS PARA INSPEÇÃO DE PRÉ-VÔO

- ✓ Visualmente cheque a aeronave quanto à condição geral durante o "Walk-Around" e remova todos os bloqueios e/ou coberturas. Se a aeronave possuir um compartimento de carga instalado (CARGO POD), cheque esta instalação quanto à segurança durante o "Walk-Around". Use uma escada, se necessário, para ter acessoa asa para inspeção visual, reabastecimento, cheque do "Stall Warning" e Tubo do Pitot e para alcalçar o dreno do tanque esterno.
- ✓ A Responsabilidade do piloto é assegurar-se de que a aeronave foi reabastecida de acordo com o solicitado, porém a Manutenção deverá efetuar este cheque antes de entregar a aeronave à tripulação. Qualquer indício de contaminantes sólidos, como ferrugem, areia, resíduos, sugeira, microbios, crescimento de bactéria ou contaminação de combustível causada por água, tipo de combustível inapropriado ou aditivos não compatíveis com o combustível ou com os componentes do sistema de combustível tem que ser considerado perigoso. Drene o combustível durante cada inspeção de Pre-Vôo e após cada reabastecimento.
- ✓ Cuidados com ambiente onde há situação de formação de gelo não são aplicáveis à operação na Região Norte do Brasil.
- ✓ Antes de Vôo com condições meteriológicas adversas (Gelo), cheque o aquecimento dos tubos de PITOT/STATIC e do Stall Warning, tocando os referidos componentes após ligar o aquecimento dos Tubos de PITOT/STATIC e STALL Warning por 30 segundos e depois desligá-los. Assegure-se de que as coberturas dos tubos de PITOT/STATIC foram removidas antes de se ligar o aquecimento dos mesmos.
- ✓ Se for planejado algum vôo noturno, cheque a operação de todas as luzes e asseguresse de que as lanternas estão operacionais, disponíveis e adequadamente armazenadas.

Diagrama de Walk – Around



1 – Cabine
2 – Lado Esquerdo
3 – Asa Esquerda – Bordo de Ataque
4 – Asa Esquerda – Bordo de Fuga
5 – Empenagem
6 – Asa Direita – Bordo de Fuga
7 – Asa direita – Bordo de Ataque
8 – Nariz da aeronave.

"Walk – Around"

1. CABINE

Item Número	Descrição da Tarefa	AÇÃO
1	Coberturas dos Tubos de Pitot Estático	Remova
2	Pilot's Operation Handbook	Acessível ao Piloto
3	GARMIN G 1000 CRG	Acessível ao Piloto
4	Travamento dos comandos	Remova – Desarme a Trava do Leme
5	Freio de Estacionamento	SET
6	Todos os Switches	OFF
7	Circuit Breakers	IN
8	ALT STATIC AIR	OFF
9	SEPARADOR INERCIAL Punho – T	NORMAL
10	Switch STBY FLAP MOTOR	NORM (GUARDADED)
11	OYIGEN SUPPLY	N/A
12	OXYGEN MASK	N/A
13	Válvulas FUEL TANK SELECTOR	AMBAS EM ON
14	FANS DE VENTILAÇÃO	OFF
15	Switch BLEED AIR HEAT	OFF (down)
16	EMERGENCY POWER LEVER	NORMAL
17	TRIM (Controles)	SET
18	Knob FUEL SHUTOFF	ON (push in)
19	Controle do CABIN HEAT FIREWALL SHUTOFF	CHECK IN
20	Switch da BATERIA Verifique os o barulho dos FANs e o fluxo de AR	ON
21	Switch AVIONICS N° 1	ON
22	PFD 1	CHECK (Verifique PFD 1 – ON)
23	Switch AVIONICS N° 2	ON
24	PFD 2 e MFD	CHECK (Verifique PFD 2 e MFD – ON)
25	Quantifade de combustível	CHECK A QUANTIDADE
26	ENGINE Softkey	SELECIONE O SISTEMA
27	SYSTEM Softkey Reset FUEL TOTALIZER se desejado. Selecione ENGINE softkey para retornar a página principal.	RST FUEL (se desejado)
28	Alavanca de FLAPS	TOTALMENTE ABAIXADO
29	Switches de PITOT STATIC e STALL HEAT	ON por 30 segundos, depois OFF
30	Switch de AVIONICS N° 1 e N° 2	OFF
31	Switch da BATERIA	OFF