COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-040/CENIPA/2014

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-VPI**
MODEL:	**T-210L**
DATE:	**19FEB2014**

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 19FEB2014 accident with the T-210L aircraft, registration PR-VPI. The accident was classified as “Engine Failure in Flight”.

After takeoff, the aircraft presented an engine failure in flight. The pilot performed a forced landing in a residential neighborhood.

The aircraft suffered substantial damage.

The pilot suffered serious injuries.

There were injuries to third parties. A youngster and three children were hit by the leading edge of the left wing. One child died in site, another suffered severe injury and the others suffered minor injuries.

There was damage to the residence hit by the aircraft.

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

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	National Civil Aviation Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
DCTA	Aeronautics' Science and Technology Department
IAE	Aeronautics and Space Institute
IAM	Annual Maintenance Inspection
IFR	Instrument Flight Rules
IFRA	Instrument Flight License - Airplane
MLTE	Qualification Type – Airplane Multi Engine Land
MNTE	Qualification Type – Airplane Single Engine Land
PPR	Private Pilot License - Airplane
RS	Safety Recommendation
SBCI	ICAO location designator – Carolina Aerodrome - MA
SWGN	ICAO location designator – Araguaína Aerodrome - TO
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accidents Investigation and Prevention System
TPX	Aircraft Registration Category of Non-Regular Public Air Transport
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** T-210L **Registration:** PR-VPI **Manufacturer:** Cessna Aircraft	**Operator:** Talla Air Taxi Ltd.
Occurrence	**Date/time:** 19FEB2014 - 1921 UTC **Location:** Araguaína **Lat.** 07°13'28"S **Long.** 048°14'22''W **Municipality – State:** Araguaína - TO	**Type(s):** "Engine Failure In-Flight" **Subtype(s):** Nil.

1.1 History of the flight.

The aircraft took off from the Araguaína Aerodrome - TO (SWGN), at 04:18 pm, to conduct a local flight with a pilot on board.

After takeoff from runway 09, according to the pilot, with the aircraft between 400 and 500ft, near the vertical of threshold 27, the engine failed.

The pilot performed the starting procedures on the engine and made a left turn. After almost a curve of 180°, having no success in the restarting the engine, he proceeded to a forced landing in a residential neighborhood with the aircraft at low altitude. The landing occurred in the backyard of a residence, damaging it and hitting four people.

The aircraft suffered substantial damage.

The pilot, suffered serious injuries. One child suffered fatal injuries. The second child suffered serious injuries. A young man and the third child suffered minor injuries.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft had substantial damage in the front section, wing structure, landing gear, engine and propeller.

1.4 Other damage.

The impact caused by the aircraft affected the structure of a residence, breaking down the sidewalls and damaging furniture and objects.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	1.500:00
Total in the last 30 days	16:40
Total in the last 24 hours	02:00
In this type of aircraft	280:00
In this type in the last 30 days	06:50
In this type in the last 24 hours	02:00

N.B.: The Data on flown hours were obtained from the Pilot.

1.5.2 Personnel training.

The pilot took the Private Pilot course - Airplane (PPR) at Aeroclube Encanta Moça, PE, in 1998.

1.5.3 Category of licenses and validity of certificates.

The pilot had the Private Pilot License – Airplane (PPR) and had valid Airplane Multi Engine Land (MLTE) and Airplane Single Engine Land (MNTE) Licenses.

1.5.4 Qualification and flight experience.

The pilot was qualified and had experience in that kind of flight.

1.5.5 Validity of medical certificate.

The pilot had valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information.

The aircraft, serial number 21060995, was manufactured by Cessna Aircraft, in 1975, and was registered at the Non-Regular Public Air Transport category (TPX).

The aircraft had valid Airworthiness Certificate (CA).

The airframe, engine and propeller logbooks records were updated.

The last inspection of the aircraft, "Annual Maintenance Inspection" (IAM) type, was carried out on 25OCT2013, by Pipes Maintenance of Aircraft Ltd. shop, in Carolina - MA, having flown 02 hours and 50 minutes after the inspection.

On 19DEC2013, the aircraft was fuelled with 268 liters of aviation gasoline for the performance of two flights and then it remained parked in the maneuvering yard of the Araguaína Aerodrome (SWGN) until the date of the flight in which the accident occurred.

On 18FEB2014, it was found that the battery of the aircraft was inoperative. On 19FEB2014, the aircraft battery was changed.

1.7 Meteorological information.

The conditions were favorable for the visual flight, with visibility over 10km, temperature around 24° C and calm wind.

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 impact occurred about 310 meters North of Araguaína Aerodrome (SWGN), on a residential neighborhood, at the approximate bow of 290°, according to the trajectory described in Figure 1.

Figure 1 - Site of the forced landing in relation to the Aerodrome SWGN. Trajectory made based on pilot's information.

Shortly before touching the ground, the aircraft hit a small tree, breaking it, at approximately 3 meters high, according to Figure 2.

Figure 2 - Obstacle hit by the aircraft before touching the ground.

The aircraft hit the side of a residence, breaking down part of the walls and destroying the furniture inside two rooms, according to Figure 3.

Figure 3 - Damage to the residence.

After the touch of the main landing gear on the ground, there was a displacement of less than 2 meters until the total stop of the aircraft. In this dynamic, the leading edge of the left wing hit the victims and the entire wing structure collided against the residence, according to Figure 4.

Figure 4 - Damage to the front section and the wings.

There were perforations in the wings and leakage of fuel after impact. There were only signs of significant fuel leakage from the wings on the ground.

The wreckage were concentrated. The landing gear was lowered and locked. The flaps and their control lever were in position 10º.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

There was no evidence that physiological or incapacitation weights affected the performance of the crewmember.

1.13.2 Ergonomic information.

The pilot informed that after the engine failure, there was difficulty in visualizing the terrain in the front quadrant, to the right of the aircraft, because the aircraft panel covered that area.

1.13.3 Psychological aspects.

The pilot carried out activities outside the scope of aviation as an agribusiness professional. Despite having the Private Pilot License for 16 years, he flew as a freelancer in the period leading up to the accident.

In the ambit of the aeronautical community of his region, the pilot mentioned that he had a harmonious coexistence and that he was popular. Professionally, however, some have described him as a stranger to certain standardizations. To clarify these settings, situations were exemplified in which he maintained a sequence of flights with another aircraft, without forwarding it for maintenance, in spite of continuous engine failures in flight, with successful restarts.

According to reports, the pilot used to have a self-confidence greater than normal for someone who had to deal with the risks involved in aviation and sometimes showed joking behavior in relation to the flight experience, seeming to treat them as something unimportant.

According to information, the flight in which the crash originated would not have been the first situation in which the pilot had to deal with a malfunction of the engine in flight. According to reports, in all of them, the pilot would have implemented procedures with successful results. This fact has been mentioned by some people as a possible

contributing factor to an increasing confidence of the pilot in relation to his ability to reestablish flight in areas associated with the engine's shutdown in-flight.

The flight that culminated in the accident was a test flight, requested to the pilot by the aircraft's operator. That would be the first flight with the plane after the two-month period in which it was parked at the Araguaína Aerodrome (SWGN), in an open place.

The pilot used to not faithfully follow the parameters established in the manual for takeoff. He mentioned that he had his own standards, based on factual parameters, developed from his perceptions and experience in aviation, and then established as his operational model.

According to the pilot, the aircraft's engine shut down about 1 minute after takeoff, when he began to try to re-start the engine. When questioned about the use of the emergency checklist, the pilot informed that he had memorized the procedures and believed that he had faithfully performed all of them.

Still according to the pilot, he was certain, based on his previous experiences and memorized procedures, which he believed to be the right ones, that he would be able to restore normal flight conditions. Therefore, he focused on the application of procedures that could lead to the engine re-start.

However, at another moment of the interview, contrary to what he initially said about being certain of the engine's re-start, the pilot reported that he even evaluated the possibility of a forced landing in the open field ahead. Even so, because of the difficulty in visualizing the outer area on his right, he could not do it.

The pilot said he had begun to feel very distressed and anxious when he realized that he would not be successful in re-starting the engine. Only then, he decided to make a forced landing, but because of the low altitude and the speed he was supporting, it was no longer possible to prepare and choose a suitable place.

The pilot and the operator were partners in the middle of 2008. They had a Seneca aircraft, which was used only for private purposes. The partnership was broken up in mid-2010 when the pilot sold his share to the operator who had been using the aircraft for commercial purposes.

According to reports, at the time of the last IAM of the aircraft, there were conflicts between mechanics of the maintenance company and the operator, due to their disagreement as to the services that were prescribed as necessary in the engine cylinders. The operator did not entrust the prescribed adjustments to that maintenance team.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

Belts and suspenders worked properly, preventing the pilot from suffering further injuries. The abandonment of the aircraft occurred by own means, through the normal door of the airplane.

1.16 Tests and research.

1.16.1 Primary Exams of the Engine and its Components.

During the initial action, the aircraft was removed from the accident site to more suitable facilities in the city of Araguaína, so that it was possible to analyze the various systems of the aircraft and investigate aspects related to maintenance.

In the course of this research, it was verified the existence of a foreign body inside the fuel selector, according to Figure 5. The material was sent for laboratory analysis in the DCTA.

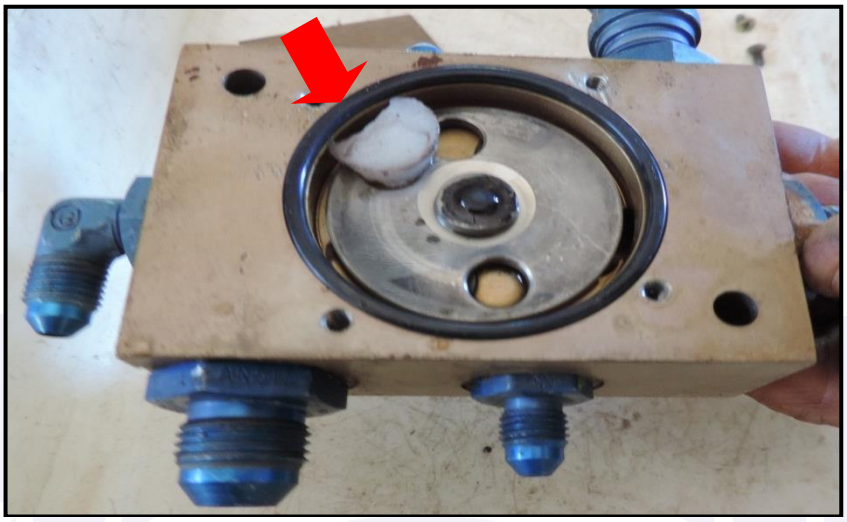

Figure 5 - The red arrow indicates the foreign body found inside the fuel selector valve.

1.16.2 Fuel Analysis.

Fuel samples were collected from the aircraft and forwarded for analysis by the National Agency for Petroleum, Natural Gas and Biofuels (ANP), in Brasília, DF.

The tests indicated that the aviation gasoline, collected at the fuel pump's inlet line, was within the expected specifications.

1.16.3 Engine Analysis and Fuel System Components.

Continental engine model TSIO-520-H, serial number 506468, was disassembled for analysis at the Global Parts Company (Goiânia - GO). The components of the fuel system were inspected and tested at Global Parts Company, WIP Aviação (Goiânia - GO) and PLANAVE (São Paulo - SP). The analyzes were conducted by a DCTA engineer.

The engine, due to damages (Figure 6), could not be installed in the test bench or other aircraft to perform the functional test.

Figure 6 - Situation of the engine after impact.

In the lubrication system, no abnormality was found to justify the engine malfunction. The oil pump, the main filter, the primary filter and the crankcase were inspected. There was no filings in these components.

The components of the fuel system were bench tested. The nozzles showed flow within the tolerance range provided by the manufacturer. The fuel pump ran normally, without any oscillation of parameters.

The analyzes indicated that the engine and its components had normal conditions which should allow the proper operation.

1.16.4 Analysis of the Material Found Inside the Fuel Selector Valve.

The foreign object found inside the fuel selector valve was referred for analysis at the IAE's Chemistry Division Laboratory of the DCTA, in São José dos Campos - SP.

In the infrared analysis, the foreign object was identified as silicone. According to the laboratory tests, the silicone reacted with the gasoline, causing an expansion of its volume.

1.16.5 Foreign Body Source Research.

The SERIPA VI investigation team visited the facilities of the maintenance shop responsible for carrying out the last inspection of the aircraft, in order to identify the origin of the foreign body.

After analyzing the service cards performed, as well as the interviews with the staff that worked on the aircraft, it was not possible to identify the origin of the abnormality. It should be mentioned that the other part of the staff was of employees who no longer worked in the shop.

In the research, it was considered the possibility of contamination of the system with the fall of the foreign body through the filling nozzle and passing through the feed lines that reach the fuel selector valve.

The research did not allow proving the hypothesis raised. Two factors indicated the low probability of this occurrence because the aircraft has a high wing, making it more difficult to ergonomically use the upper wing as a support platform for placing objects. The second factor refers to the volume of the foreign body that indicated a high level of difficulty to transit through the feeding lines that leave the tanks on the wing and get at the selector.

1.17 Organizational and management information.

The aircraft belonged to an air taxi company, based on the city of Belém - PA, with a branch in Santarém - PA, and was the company's only airplane bound to air taxi services.

The pilot had no employment relationship with this company. He only performed flights as a freelancer, when requested by the operator.

Regarding the crash flight, the pilot claimed that the ergonomic features of the aircraft's high wing and the panel position hampered his view of the outer area to his right during the abnormal flight condition. According to the pilot, the position he occupied on the left seat; the fact that the airplane control panel covered the entire front of the aircraft; and the aircraft's wings position, high-wing type, limited the extent of his view of the right front sector on the takeoff line, causing him to turn left, even though it was a residential perimeter.

1.18 Operational information.

The aircraft was within the weight and balance parameters specified by the manufacturer.

The aircraft performed only 3 flights after the last inspection, concluded on 25OCT2013.

On 08DEC2013, a flight from Carolina - MA (SBCI), to Araguaína -TO (SWGN), lasted 25 minutes.

On 19DEC2013, the aircraft performed two flights, each one lasting 1 hour and 12 minutes. It left from SWGN to an Aerodrome near Palmas - TO and returned to SWGN. In the Logbook, these flights were registered in the name of a pilot who held a commercial pilot's license. However, who performed them was the private pilot involved in the 19FEB2014 accident, according to his own information and the passengers themselves.

According to the pilot, on the 19DEC2013 flights, the aircraft performed normally, with no indication of malfunctions. Passengers also did not notice any abnormalities.

From 19DEC2013 to 19FEB2014, the aircraft remained in the uncovered SWGN parking lot.

According to the pilot himself, the flight of 19 FEB2014 would be carried out with an approximate duration of 20 minutes, in order to verify the functionality of the aircraft systems that had been stopped for 2 months.

The pilot said that he had made all preparations for the flight, giving emphasis to the drainage action of the fuel tanks, due to the 2 months that the aircraft was stopped in the parking lot, without rain protection.

He said the aircraft had 160 liters of fuel, corresponding to the weight of 115.2 kg. Adding the basic weight of the aircraft (1,099.84Kg), with the pilot's weight (110Kg) and the weight of the fuel, the takeoff weight of 1,325.04Kg was reached.

The maximum takeoff weight of the aircraft was 1,724 kg.

In the last fuelling record, the aircraft had 268 liters, which were added to the remaining fuel on 19DEC2013. After this supply, the aircraft flew 2 hours and 24 minutes.

At approximately 04:00 pm, on 19FEB2014, the pilot performed a start-up procedure to check the systems with the aircraft in the parking area, and then he cut off the engine.

Around 04:28 pm, the pilot performed a new starting procedure. He reported that the engine performance did not indicate abnormalities. He then proceeded to take off from SWGN threshold 9, using the flaps in the position 10º.

According to the pilot, the rotation was made with speed between 60 and 65kt. When the aircraft was just over 400ft., high, already close to the vertical of the opposite threshold, the engine failed.

The pilot reported that, with no runway to land, he began the engine's re-start procedures and simultaneously made a left turn toward the wind leg in order to return and land. He said the curve was made based on his judgment that there would be success in the engine's re-start.

With the rapid loss of altitude and no success in the flight departure procedure, the pilot proceeded to a forced landing in the residential neighborhood next to the Aerodrome.

The Cessna T210L's emergency checklist, as the first response to engine failure after takeoff, guided:

- Lower the nose of the aircraft to keep speed and establish an attitude of glide. In many cases, the landing must be done by keeping the flight plane straight and forward, with small changes of direction, just to avoid obstacles. Altitude and velocity will rarely be sufficient to perform a 180° turn in glide to return to the runway. The checklist procedures assume that there is adequate time for safe positioning of the fuel and ignition systems before touching the ground.

The checklist procedures for engine failure immediately after takeoff were as follows:

“Engine Failure Immediately After Takeoff”

1 – Airspeed – 85KIAS

2 – Mixture – IDLE CUT-OFF

3 – Fuel Selector Valve – OFF

4 – Ignition Switch – OFF

5 – Wing Flaps – AS REQUIRED (30° recommended)

6 – Master Switch – OFF”

The checklist procedures for forced landing were as follows:

“FORCED LANDING - Emergency Landing without Engine Power”

1 – Airspeed – 90 KIAS (flaps up) / 80 KIAS (flaps DOWN)

2 – Mixture – IDLE CUT-OFF

3 – Fuel Selector Valve - OFF

4 - Ignition Switch – OFF

5 – Landing Gear – DOWN (UP if terrain is rough or soft)

6 – Wing Flaps – AS REQUIRED (30° recommended)

7 - Master Switch – OFF

8 – Doors – UNLATCH PRIOR TO TOUCHDOWN

9 – Touchdown – SLIGHTLY TAIL LOW

10 – Brakes – APPLY HEAVILY

The Cessna T-210L emergency checklist featured a specific procedure for in-flight engine failure that differed from engine failure immediately after takeoff. At failure of the engine during flight, the procedures contemplate attempting to start the engine in flight.

Figure 7 below shows the top view of the SWGN Aerodrome, highlighting the landing location of the PR-VPI and the condition of the land, free of residences or constructions on the takeoff line (yellow arrows).

Figure 7 - Top view of the SWGN Aerodrome.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

During the investigation, they studied the factors involved in this accident, highlighting aspects related to the origin of the engine failure immediately after take-off and to the procedures adopted by the pilot.

On the last inspection of the aircraft, on 25OCT2013, according to the maintenance records, the services provided in the engine were performed. In the three flights between that inspection and the accident, there were no reports of engine abnormalities, noting that the pilot himself who was involved in the accident made the last two flights.

According to the pilot, the amount of fuel in the aircraft was 160 liters. The data from the last fuel supply and the signs of fuel leakage, with a significant amount, after the drilling of the wings during the impact, indicated that the amount reported by the pilot appeared to be compatible.

The analysis of the fuel collected in the lines of entry of the mechanical pump of the engine, after the accident, indicated normal characteristics of aviation gasoline.

In this way, the engine failure was not due to the inadequate quality or lack of aviation gasoline in the aircraft tanks.

Because the aircraft has been in the parking lot for two months, since the last flight, without rain protection, it would be possible to consider the possibility of water accumulation in the fuel. However, the pilot reported draining the tanks and, in addition, he performed a start and cut cycle of the engine, before the takeoff in which the failure occurred, reporting normal functionality of the systems.

The damage to the engine due to the impact impaired its test in the test bench (operation without disassembly). However, its components were disassembled in an appropriate shop and analyzed on a bench by the engine research engineer, who is part of the research team. These tests did not indicate abnormalities that could affect the correct functioning of the engine.

In the research done on the components of the fuel system, even during the first action, a foreign body was found inside the fuel selector valve. The dimensions of this body were sufficient to obstruct the output of the fuel selector valve to the engine power line.

In the take-off phase, the power regime requires high flow of fuel for engine power. With the fuel selector valve's outlet partially or totally obstructed, the amount of fuel has become zero or insufficient to meet the engine's demand, causing it to fail.

After verifying the origin of the engine failure, the investigation team sought to identify the origin of the foreign body. Laboratory analyzes indicated that the composition of the material was silicone.

There was a suspicion that this material would fall into the fuel tank of the wing through the fuel nozzle. However, two factors significantly reduced this possibility: the fact that the aircraft has a high wing, which would partially restrict the placement of objects in the upper part of the wing; and especially the dimensions of this body, which would make it difficult to move through the tank feed lines to the fuel selector valve.

In this way, it was not possible to conclude how the foreign body reached the interior of the fuel selector.

During the failure of the engine after takeoff, regarding the operational procedures adopted by the pilot, it was verified that he identified the problem approximately 400ft of altitude and proceeded to start the engine in flight, executing almost 180° of left turn.

The Cessna T210L's emergency checklist, at engine failure immediately after takeoff, warned of the following: "In many cases, landing must be done by keeping the flight plan straight and forward, with small changes of direction, only to avoid obstacles. The altitude and speed will rarely be sufficient to run 180° of curve, in glide, to return to the runway".

Among the items to be executed for the engine failure immediately after take-off and forced landing, there was no procedure that indicated the attempt to start or re-start the engine in flight. The start-up of the in-flight engine was predicted for engine failure during the flight, but not in the event of engine failure immediately after take-off.

It could be said that the engine's re-start attempt procedure was in disagreement with what determined the aircraft's emergency checklist.

The pilot's experience of having already experienced other engines shut down situations, in which he was able to re-start and continue the flight, has enabled him to recall the procedures he successfully applied. As a result, his confidence to reproduce them was sharpened, causing the false impression that the engine failure could be corrected in the same way.

In this case, the emergency procedures standardized by the aircraft manufacturer should be as follows:

1 – Airspeed – 85KIAS;

2 – Mixture – IDLE CUT-OFF;

3 – Fuel Selector Valve – OFF;

4 – Ignition Switch – OFF;

5 – Wing Flaps – AS REQUIRED (30° recommended); e

6 – Master Switch – OFF”.

In the sequence of emergency procedures, it would be possible to carry out the forced landing procedures, which, again, did not mention the attempt to start the engine in flight.

According to the checklist, normally, at engine failure immediately after takeoff, there is not enough altitude to perform 180° turn in an attempt to return to the runway. In this accident, in addition to executing almost 180° of curve, the pilot stopped maintaining the profile of flight in the line of takeoff, where there was an uninhabited area and a more favorable land to the forced landing, coming to fly over a residential neighborhood with several obstacles.

By the time the pilot realized that there would be no success in starting the engine in flight, the altitude was already insufficient to maneuver the aircraft towards a more suitable area to the forced landing.

Regarding the landing ahead, in the area that, in fact, presented better conditions, the pilot mentioned in an interview that it was difficult to see the right front sector in the takeoff line. According to his perception, his positioning on the left seat, the dimensions of the control panel and the position of the wings of the aircraft (high wing) obstructed his visualization of that region.

This perception was contradictory, since the pilot also stated that his intention, from the beginning, was to continue with the engine's in-flight re-start and return to land on the same runway. In addition, the high wing condition did not obstruct the view of the takeoff line.

As the emergency checklist itself, alerts, in such a situation, the nose of the aircraft should be lowered. This action would also allow a more adequate view of the terrain ahead.

Thus, it was understood that, contrary to what the pilot previously suggested in relation to the influence of the ergonomic characteristics of the airplane about the position of the panel and its high wing configuration, the difficulty of visualizing more favorable areas to the forced landing, in the takeoff line, could have occurred due to the execution of the premature curve on the left.

From the analysis of the data, it was clear that the pilot did not know what was recommended in the emergency checklist for that type of problem, as well as he inadequately evaluated the external factors and the operational conditions that he had in order to manage that abnormal condition.

The high level of self-confidence in re-starting the engine in low altitude, besides being an incorrect procedure, impaired the pilot's ability to maintain a minimum adequate situational awareness to realize that landing in an open area would be his best option to manage that emergency.

Finally, it could be seen that the two operational procedures adopted by the pilot, namely, the attempt to re-start the engine and the almost 180° left turn, besides not being recommended in the operational publication of the Cessna T-210L, have withdrawn the focus of the priority task, which was to prepare the aircraft for forced landing. It reduced the probability of success in the emergency.

3. CONCLUSIONS.

3.1 Facts.

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

b) the pilot had valid MNTE and MLTE Technical Qualifications;

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 weight and balance parameters specified by the manufacturer.

f) the airframe, engine and propeller logbooks records were updated;

g) the weather conditions were favorable for the visual flight, with calm wind;

h) the aircraft presented engine failure after takeoff;

i) after the engine failure, the pilot performed the engine start-up procedure in flight;

j) the Cessna T210L's emergency checklist did not recommend re-starting the engine in flight, in the event of engine failure immediately after takeoff;

k) after the engine failure, the pilot performed a left turn;

l) there was no success in the in-flight engine starting procedure;

m) the pilot proceeded to a forced landing in a residential neighborhood, near the takeoff Aerodrome;

n) the aircraft had substantial damage;

o) the pilot suffered serious injuries;

p) four people on the ground were hit by the aircraft;

q) a child suffered fatal injuries;

r) the second child suffered serious injuries;

s) a youngster and the third child suffered minor injuries; and

t) there was damage to a residence.

3.2 Contributing factors.

- **Attention – a contributor.**

There was a fixation of attention on attempts to re-start the engine during the problem, after takeoff. This prevented the pilot from evaluating alternatives that were more adequate to manage the emergency.

- **Attitude – a contributor.**

The high self-confidence placed on the ability of re-starting the engine in-flight, associated with the pilot's unawareness of the items on the aircraft's checklist for this emergency, impaired the analysis of the need for a forced landing as prescribed in the aircraft manual in cases of engine failure immediately after take-off.

- **Piloting judgement – a contributor.**

Given the emergency condition, the pilot inadequately prioritized the task to be performed. He failed to follow the procedures provided in the checklist about engine failure after takeoff, to run the engine in-flight without sufficient time to do so, or the evaluation of parameters that could guarantee the engine re-start.

- **Aircraft maintenance – undetermined.**

Although the investigation was not conclusive with respect to the origin of the foreign body, it is possible that the failure of the engine at takeoff has elapsed from the obstruction of the exit of the fuel selector valve to the engine power line by that material. There is a possibility that some non-conformity in the maintenance services performed on the aircraft has contributed to the foreign body being deposited in the fuel selector.

- **Memory – a contributor**.

The procedures memorized by the pilot, which he said were the ones predicted for the type of crash experienced, did not comply with those established in the aircraft manual, leading him to decide and inappropriately manage the abnormal condition.

In addition, the procedures applied by the pilot were linked to the memory of his successful performance, when he had to manage similar emergencies in previous.

- **Perception – a contributor.**

The decision to try to re-start the engine in flight, contrary to what is stated in the aircraft manual, demonstrated that the pilot had an improper situational awareness of the risks involved and the external environmental conditions he had in case he could not re-start the engine, even if there was time for a forced landing.

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

The decision to re-start the engine proved to be inadequate, both, to contradict the manual for engine failure cases immediately after take-off and for the risk that was not considered in the case of poor performance of the intended procedure.

- **Managerial oversight – undetermined**.

The maintenance supervision services performed on the aircraft may not have been enough to identify and correct any nonconformity that would make it possible to establish an inadequate condition that would allow the entry of a foreign object into the fuel system.

4. SAFETY RECOMMENDATION.

A measure of preventative/corrective nature issued by a SIPAER Investigation Authority or by a SIPAER-Link within respective area of jurisdiction, aimed at eliminating or mitigating the risk brought about by either a latent condition or an active failure. It results from the investigation of an aeronautical occurrence or from a preventative action, and shall never be used for purposes of blame presumption or apportion of civil, criminal, or administrative liability.

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-040/CENIPA/2014 - 01 **Issued on 25/06/2018**

Carry out operations with the Pipes Aircraft Maintenance shop, in order to ensure the proper execution and supervision of the services performed, especially with regard to the prevention of foreign objects being introduced into the aircraft fuel system.

A-040/CENIPA/2014 - 02 **Issued on 25/06/2018**

Carry out managements with the operator to ensure that he / she only uses pilots who have received adequate instruction, especially in the case of in-flight engine failure.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

Nil.

On June 25th, 2018.