

**COMANDO DA AERONÁUTICA**  
**CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE**  
**ACIDENTES AERONÁUTICOS**



**FINAL REPORT**  
**IG - 047/CENIPA/2021**

<b>OCCURRENCE:</b>	<b>SERIOUS INCIDENT</b>
<b>AIRCRAFT:</b>	<b>PT-JGA</b>
<b>MODEL:</b>	<b>MU-2B-25</b>
<b>DATE:</b>	<b>22MAR2021</b>



## NOTICE

*According to the Law n° 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.*

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

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

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

*This Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).*

*This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree n° 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 22MAR2021 serious incident with the MU-2B-25 aircraft model, registration PT-JGA. The serious incident was classified as “[SCF-NP] System/Component Failure or Malfunction Non-Powerplant – with Landing Gear”.

During the approach procedures for landing at the Ji-Paraná Aerodrome (SBJI) - RO, it was not possible to lower the landing gear by the regular system or by the emergency system. The landing was performed with the landing gear in the retracted position. The aircraft traveled 300 meters on the runway until it came to a complete stop.

The aircraft had minor damage, restricted to the fuselage and to the engines' propeller blades.

The pilot and the two passengers left unharmed.

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



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## GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CIV	Pilot's Flight Logbook
CMA	Aeronautical Medical Certificate
CVA	Airworthiness Verification Certificate
DCTA	Department of Science and Airspace Technology
IAM	Annual Maintenance Inspection
IFR	Instrument Flight Rules
IFRA	Instrument Flight Rating - Airplane
IMC	Instrument Meteorological Conditions
METAR	Aviation Routine Weather Report
MLTE	Airplane Multi Engine Land Rating
PCM	Commercial Pilot License – Airplane
PN	Part Number
PPR	Private Pilot License – Airplane category
SBJI	ICAO Location Designator – Ji-Paraná Aerodrome - RO
SBPV	ICAO Location Designator - Governador Jorge Teixeira de Oliveira Aerodrome, Porto Velho - RO
TPP	Registration Category of Private Service
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

## 1. FACTUAL INFORMATION.

<b>Aircraft</b>	<b>Model:</b> MU-2B-25 <b>Registration:</b> PT-JGA <b>Manufacturer:</b> Mitsubishi	<b>Operator:</b> Private
<b>Occurrence</b>	<b>Date/time:</b> 22MAR2021 - 2131 UTC <b>Location:</b> Ji-Paraná Aerodrome (SBJI) <b>Lat.</b> 10°52'14"S <b>Long.</b> 061°50'48"W <b>Municipality – State:</b> Ji-Paraná - RO	<b>Type(s):</b> [SCF-NP] System/Component Failure or Malfunction Non-Powerplant <b>Subtype(s):</b> with Landing Gear

### 1.1 History of the flight.

The aircraft took off from the Governador Jorge Teixeira de Oliveira Aerodrome (SBPV), Porto Velho - RO, to the Ji-Paraná Aerodrome (SBJI) - RO, at around 1920 (UTC), in order to carry out private personnel transportation, with one pilot and two passengers on board.

During the approach to SBJI, an attempt was made to lower the landing gear by the regular and emergency systems, but without success.

The landing was performed with the landing gear in the retracted position. After the touchdown, the aircraft traveled 300 meters on the runway until it came to a complete stop.

There was no fire.

The aircraft had minor damage. The pilot and the two passengers left unharmed.

### 1.2 Injuries to persons.

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

### 1.3 Damage to the aircraft.

The aircraft had minor damage restricted to the fuselage and the engines' propeller blades.

### 1.4 Other damage.

None.

### 1.5 Personnel information.

#### 1.5.1 Crew's flight experience.

Flight Hours	PIC
Total	8.000:00
Total in the last 30 days	15:00
Total in the last 24 hours	09:00
In this type of aircraft	800:00
In this type in the last 30 days	09:00
In this type in the last 24 hours	09:00

**N.B.:** The data relating to the flown hours were obtained through the pilot himself.

#### 1.5.2 Personnel training.

The PIC took the PPR course at the Lucélia Aeroclub – SP, in 1973.

### **1.5.3 Category of licenses and validity of certificates.**

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

### **1.5.4 Qualification and flight experience.**

The PIC was qualified and had experience in the kind of flight.

### **1.5.5 Validity of medical certificate.**

The PIC had valid CMA.

### **1.6 Aircraft information.**

The aircraft, serial number 268, was manufactured by Mitsubishi, in 1973 and was registered in the TPP Category.

The aircraft CA was valid.

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

The last inspection of the aircraft, the "100 hours" type, was performed on 19OCT2020 by the maintenance organization Fênix Aviação Ltd., in Arapongas - PR, with 53 hours and 30 minutes flown after the inspection.

The last comprehensive inspection of the aircraft, the "CVA" type, was performed on 19OCT2020 by the maintenance organization Fênix Aviação Ltd., in Arapongas - PR, with 53 hours and 30 minutes flown after the inspection.

Part I of the airframe, engine, and propeller logbooks were outdated. The last posted time record was dated 2019, although there were flight records in the logbook from then until the day of the occurrence. Part II of the airframe, engine, and propeller logbooks did not contain records of the last maintenance performed.

Also, about the control of the airframe, engines, and propellers logbooks, the last maintenance entry was an IAM performed by the company Conal on 15MAY2019. However, after searching the ANAC's website, the Investigation Team was able to note that the company Fênix Aviação Ltd. performed, on 19OCT2020, a "100-hour" inspection along with the inspection to revalidate the CVA.

The aircraft had regular and emergency landing gear lowering systems. The main system was electrically operated with an engine that operated in the lowering and retracting direction. The front doors of the main landing gear and the auxiliary (nose) gear door were mechanically operated, and connected to the landing gear. The rear doors of the main landing gear were powered by an electric actuator.

The alarm and position indication system consisted of three green lights (one for each landing gear) and a red light (Unsafe Warning). The red light remained on during the lowering and retracting motion and was to turn off at the end of each cycle. If the red light did not turn off, there was either a failure or malfunction in the system, or the rear doors of the main landing gear were not fully closed.

Figure 1 shows the sensor that sent the door closed signal.



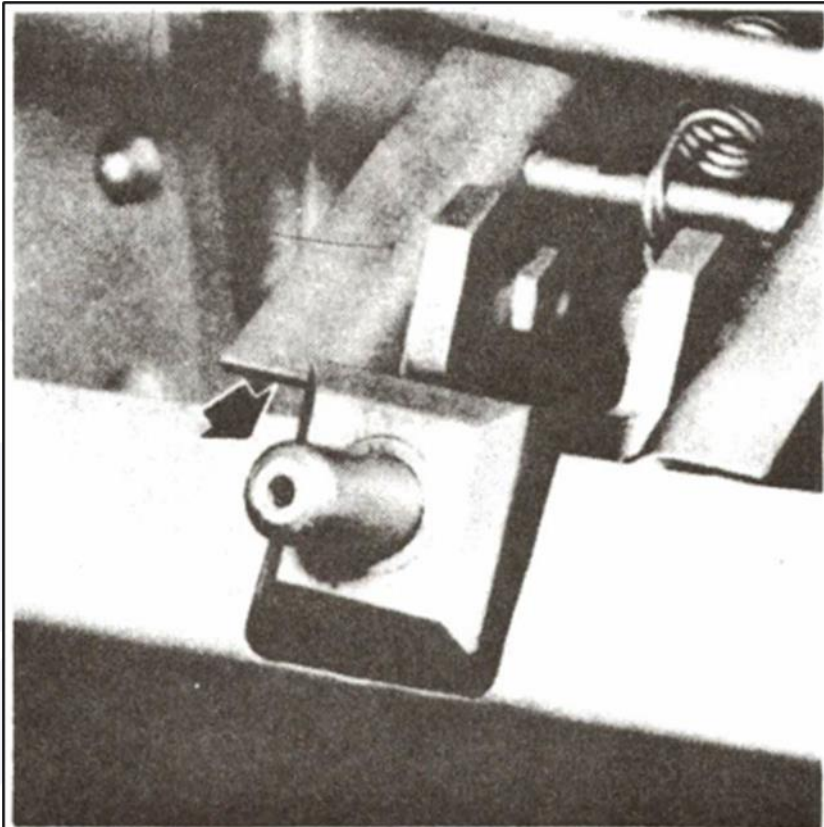


Fig. 4 - 38 Check lock pin  
for stroke

Figure 1 - Extract from the MU-2 maintenance manual, dated 27DEC1999. The black arrow indicates the pin that sent a signal to the landing gear light in transit.

When a failure of the regular system was detected, the emergency system should be used to lower the landing gear. A lever in the cockpit was activated to release the doors and activate the landing gears. It should be pumped until it stopped, which happened after being moved approximately 130 times, moment that the lowering cycle would be completed (Figure 2).

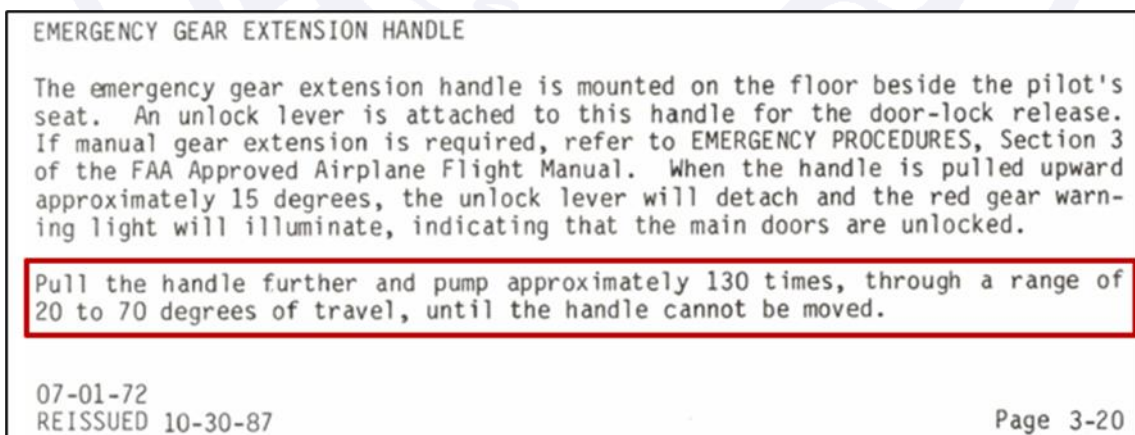


Figure 2 - Extract from the MU-2 maintenance manual, dated 30OCT1987. In the red highlight, it is possible to check the reference number of movements on the lever.

The activation of the emergency landing gear lowering lever acted directly on the safety pin, which was located on the left main landing gear (Figure 3).



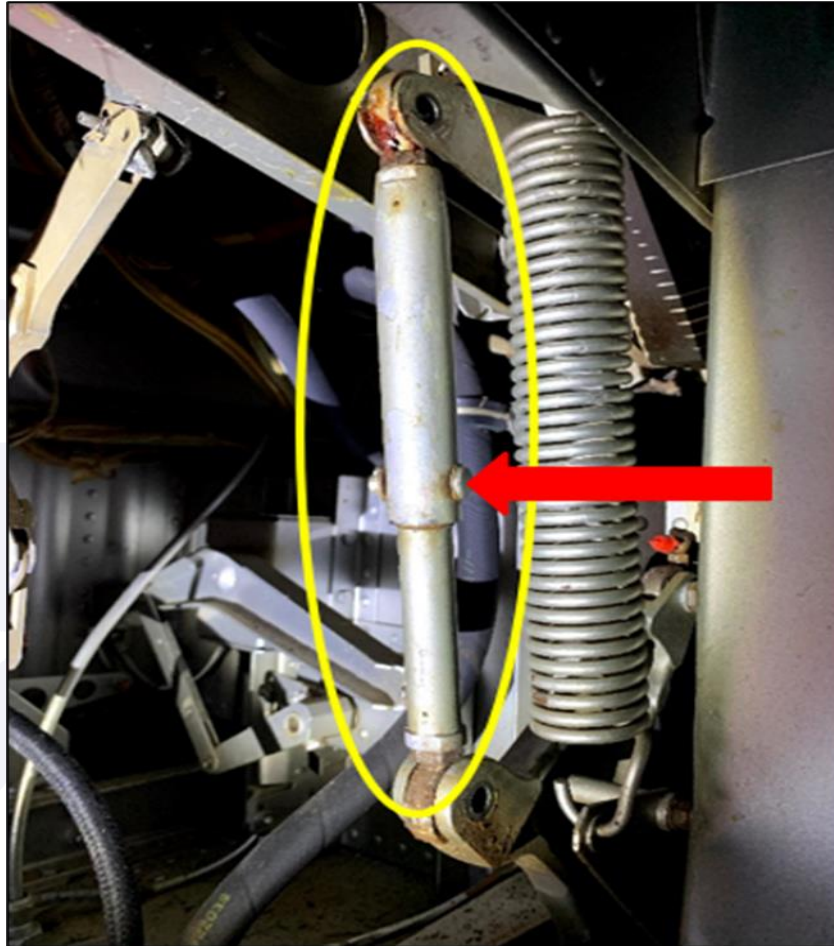


Figure 3 - Close-up photo of the landing gear housing on the left side. In the detail indicated by the red arrow, the safety pin in its original position.

The Safety Pin, when shearing, released the entire mechanism of the doors causing them to open by gravity, allowing the landing gear to be lowered through lever movements. There were two maintenance interventions on the landing gear set, one on 15MAY2019 by the Conal company, according to service order number 5604/19, and another by the Fênix company, on 17OCT2020, in accordance with service order 259/020. There were not found records of tasks performed on the safety pin.

### 1.7 Meteorological information.

The Ji-Paraná Aerodrome METAR had the following information:

METAR SBJI 222100Z 04006KT 9999 FEW020 27/24 Q1009

The conditions were favorable for the visual flight with visibility above 10 km and few clouds at 2,000 ft. The wind had an intensity of 6 kt.

### 1.8 Aids to navigation.

All navigation and landing aids operated normally at the time of the aircraft approach.

### 1.9 Communications.

Nil.

### 1.10 Aerodrome information.

The Aerodrome was public, managed by the Rondônia State Government and operated under VFR and IFR.

The runway was made of asphalt, with thresholds 03/21, dimensions of 1,800 x 45 m, with an elevation of 597 ft.

### 1.11 Flight recorders.

Neither required nor installed.

### 1.12 Wreckage and impact information.

The touchdown of the aircraft with the landing gear retracted occurred approximately 200 meters from threshold 21 of SBJI, with no evidence of a previous impact.

The occurrence was observed by the ground emergency response team.

After the touchdown, the aircraft traveled approximately 300 meters on the runway until it came to a complete stop, with the fuselage touching the side strip. In the last 50 meters, the aircraft turned 180° to the left in relation to its axis of displacement, coming to a complete stop near the left side of the runway.

The landing gear, of the retractable type was in the retracted position. The flaps were lowered at 20°. The elevator trim tabs were in the up position, at 25°. The aileron trim was left 5th, and the rudder trim was in neutral.

### 1.13 Medical and pathological information.

#### 1.13.1 Medical aspects.

Nil.

#### 1.13.2 Ergonomic information.

Nil.

#### 1.13.3 Psychological aspects.

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

### 1.14 Fire.

There was no fire.

### 1.15 Survival aspects.

Nil.

### 1.16 Tests and research.

The complete set of the safety pin, which was installed in the housing of the main landing gear on the left side, was sent to the DCTA.

The rod assy, Part Number (PN) 010A-38754, is shown in Figure 4.



Figure 4 - Photo of the rod removed from the aircraft. In the red detail, the safety pin that did not break and did not allow the emergency procedure to be carried out.

Two tests were performed on the pin that makes up the stem: a mechanical test and a chemical analysis.

The mechanical test is a compression test that aims to verify the shear strength of the pin, which should break when subjected to a load between 900 kgf (8,826 N) and 1,000 kgf (9,807 N).

The chemical analysis verified the material composition of the pin (Figures 5 and 6) that was installed in the stem, which should be AA6061 (Aluminum Alloy 6061-T651 QQ-A-225/8).



Figure 5 - Photo of the disassembled rod. In the red detail, the pin that was analyzed.



Figure 6 - Photo of the pin without any sign of deformation.

The image above (Figure 6) shows the safety pin intact and without damage, even after consecutive attempts of the emergency procedure and the test performed on the bench.

In the mechanical test, the shear test reached a load of 1,553.3 kgf (15,232.2 N). At that moment, the test was interrupted, as the pin had not sheared, even exceeding the reference values. As for the chemical analysis of the material, it was found that the aluminum alloy was the AA7075, that is, more resistant and different from what was foreseen by the manufacturer.

### **1.17 Organizational and management information.**

The aircraft was owned and operated by the same person and was registered in the TPP category. Generally, the PIC was responsible for managing maintenance activities and requests for air support, as required by the aircraft owner.

Also, regarding the planning for the flights the PIC was called according to the owner's need, always with enough time to get ready for the flight to be performed.

The aircraft usually stayed overnight at the Ji-Paraná Aerodrome, where the owner had a hangar for his aircraft.

### **1.18 Operational information.**

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

The pilot was the only one who flew this aircraft and performed approximately 100 flight hours annually.

The PIC had taken off to perform a flight at 2230 (local) the day before, 21MAR2021 to Cuiabá, returning to Ji-Paraná at 0340 (local) on the day of the flight of the occurrence, 22MAR2021. Aware that he would make this flight at night, the pilot reported having rested for a period of 3 hours in the afternoon of the previous day. On the day of the occurrence, the first take-off took place at 0700 (local). For this, he woke up at 0630 (local). This information was confirmed by checking the Logbook, and it indicated that the pilot had been working night shifts.

After taking off from SBPV, and retracting the landing gear, the "landing gear in transit" (unsafe) indicator light remained on. The PIC tried to lower the landing gear to perform an actuation cycle, but the landing gear did not lower.

After that, the flight continued to the destination, and the planned emergency procedure would be performed there. Upon arriving in traffic for landing at SBJI, the emergency lowering procedure was performed as provided for by the manual.

However, the emergency lever could only be moved 3 times until it locked. According to the aircraft manual it would take 130 movements of this lever to lower the landing gear.

So, the pilot flew for a few more minutes to reduce the amount of fuel inside the tanks and prepared for landing with the landing gear retracted.

The touchdown occurred 200 meters from threshold 21 of SBJI, with no evidence of previous impact, and it was observed by the ground emergency response team.

After the touchdown, the aircraft traveled approximately 300 meters on the runway until it came to a complete stop, with the fuselage touching the side strip. In the last 50 meters, the aircraft turned 180° to the left in relation to its axis of displacement, with its total stop occurring close to the left side of the runway (Figure 7).





Figure 7 - Sketch of the occurrence.

### 1.19 Additional information.

Manufacturer has previously issued Service Bulletin no. 238, dated December 5, 2002, and Service News no. 174, dated March 1, 2013, recommending inspection of Safety Pin to ensure that the genuine manufacturer's Safety Pin is installed.

### 1.20 Useful or effective investigation techniques.

Nil.

## 2. ANALYSIS.

It was a private passenger transport flight from SBPV to SBJI.

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

The airframe, engine and propeller logbook records were outdated. The monthly and total hours control found in part 1 of the airframe, engines and propellers logbooks were outdated as the last launch had been carried out in March 2019, that is, the aircraft spent a year without having the hours launched in the Part I of the logbooks.

Despite the pilot having rested approximately three hours between one journey and another, this fact did not contribute to the occurrence.

A mechanical test was performed on the rod to test the shear strength of the pin. The expected load for the pin shear was between 900 kgf (8,826 N) and 1,000 kgf (9,807 N). The test was carried out up to a load of 1,553.3 kgf (15,232.2 N), when the test was interrupted without the pin having sheared.

According to the results obtained, it was possible to conclude that the tested pin presented a greater mechanical resistance than expected, which avoided its breakage and, consequently, that the pilot was unable to succeed in the emergency procedure of lowering the landing gear.

It was not possible to specify when the pin was changed, as there were no maintenance records about it. This fact demonstrated nonconformity in the maintenance of the aircraft, as the control of maintenance actions and the correct record in the logbook was not being done in its entirety.

The result of the chemical composition analysis obtained indicated that the alloy used in the pin was the AA7075. This alloy had a much higher shear strength than the AA6061 alloy, which according to the manufacturer's information, was the expected material.

In view of this, the hypothesis formulated was that there was a problem in the system that prevented the landing gear from locking up or that the rear door closing sensor did not work.

However, it was not possible to determine the cause why the unsafe light remained on. It is possible that this may have made it impossible for the lowering system to be activated by the regular system. However, this hypothesis could not be confirmed, as it was not possible to perform the tests on the equipment.

This aforementioned problem may have interfered with the emergency lowering. In addition, when trying to lower through the emergency system, it did not work because the pin that should have sheared to act in the release of the doors for the lowering of the landing gears was more resistant than foreseen by the manufacturer, that is, a part with different characteristics from those foreseen.

### **3. CONCLUSIONS.**

#### **3.1 Facts.**

- a) the pilot had a valid CMA;
- b) the pilot had valid MLTE and IFRA Ratings;
- c) the PIC was qualified and had experience in the type of flight;
- d) the aircraft had a valid CA;
- e) the aircraft was within the weight and balance limits;
- f) the airframe, engine and propeller logbook records were not updated;
- g) the weather conditions were favorable for the flight;
- h) the pilot rested approximately 3 hours between journeys;
- i) the "landing gear in transit" (unsafe) indicator light remained on after the take-off from SBPV;
- j) the landing gear did not lower by the regular system and there was an attempt to lower it by the emergency system;
- k) the emergency landing gear lowering lever locked after three actuations, when about 130 actuations were required according to the manual;
- l) the safety pin had a greater resistance than that foreseen by the manufacturer;



- m) the safety pin was composed of a material different from that foreseen by the manufacturer;
- n) there were no maintenance records of tasks performed in the safety pin;
- o) the landing on SBJI was carried out with the landing gear in the retracted position;
- p) the aircraft had minor damage; and
- q) the pilot and passengers left unharmed.

### 3.2 Contributing factors.

#### - Aircraft maintenance – a contributor.

The use of a part with characteristics different from those foreseen by the manufacturer made it impossible for the landing gear to be lowered by the emergency system. In addition, there was no documentary record of any maintenance action on the landing gear in which it was possible to identify the safety pin change.

## 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):**

**IG-047/CENIPA/2021 - 01**

**Issued on 11/03/2022**

Disclose the lessons learned in this investigation to maintenance organizations certified to perform services on the MU-2B-25 model aircraft.

## 5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On November 3<sup>th</sup>, 2022.