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Report A-037/2020

Accident involving a Tecnam
P2008JC aircraft, registration
EC-NJX, at El Berriel Aerodrome
(Las Palmas-Spain) on 25 August
2020



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In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) n° 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

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Abbreviations

AEMET	Spain's State Meteorological Agency
ft	Feet
GCFV	Callsign for Fuerteventura Airport
GCLB	Callsign for El Berriel Aerodrome
h	Hour(s)
kt	Knot(s)
min	Minute(s)
NM	Nautical mile
s/n	Serial number
UTC	Universal time coordinated
VFR	Visual Flight Rules

Synopsis

Owner and operator:	Canavia Líneas Aéreas S.L.U.
Aircraft:	Tecnam P2008JC s/n 1177, registration EC-NJX
Date and time of incident:	Tuesday 25 August 2020, 11:00 local time ¹ (10:00 UTC)
Site of accident:	El Berriel Aerodrome (Las Palmas)
Persons on board:	Crew: one, uninjured Passengers: one, uninjured
Type of flight:	General Aviation – private flight
Flight rules:	VFR
Phase of flight:	Landing - landing roll-out
Date of approval:	16 December 2020

Summary of accident

On Tuesday 25 August 2020 at approximately 11:00 h, the Tecnam P2008JC EC-NJX aircraft suffered a loss of directional control during landing roll-out on runway 07 at the El Berriel Aerodrome (Las Palmas), causing it to exit the runway via its right-hand strip. There were two people on board: a pilot and a passenger (also a pilot from the school). The pilot had obtained his private pilot license through Canavia and rented the aircraft from them to accumulate flight hours.

As a result of its unplanned departure from the runway, the aircraft's nose gear collapsed, and the propeller hit the ground, leaving the aircraft at a standstill on the right-hand runway strip. The two people on board were uninjured and evacuated the aircraft without assistance. The aircraft incurred damage to its nose landing gear, propeller and the lower forward fuselage. Some areas for improvement have been identified in relation to the design, location and actuation of the PARKING BRAKE lever of these aircraft.

The investigation has concluded that the accident experienced by aircraft EC-NJX was probably caused by landing with the right brake-circuit pressurised and the PARKING BRAKE lever in the LOCK position, which produced a braking asymmetry during the landing roll-out.

The report contains five safety recommendations: four addressed to Costruzioni Aeronautiche Tecnam, as the organisation responsible for designing the Tecnam P2008JC aircraft, and one at Canavia Líneas Aéreas, as the owner of aircraft EC-NJX.

¹ All times used in this report are local time.

1. FACTUAL INFORMATION

1.1. History of the flight

On Tuesday 25 August 2020, the Tecnam P2008JC EC-NJX aircraft took off from El Berriel Aerodrome GCLB (Las Palmas) to perform a private flight under visual flight rules. There were two people on board: a pilot, seated on the left, and a passenger (also a pilot), seated on the right.

The purpose of the flight was to accumulate the flight hours required to access the commercial pilot license course. To do this, the pilot had rented the aircraft from Canavia, the school where he had obtained his private pilot license. He was accompanied by one of the pilot's from the school, although he was not acting in any official capacity on board.

The three-hour flight proceeded without incident until landing:

- 08:00 h: the aircraft, making its first flight of the day, took off from El Berriel Aerodrome.
- It headed north-east, climbing to 5500 ft, approaching Fuerteventura.
- 09:00 h: the aircraft was 12 NM west of the island of Fuerteventura and at 1000 ft having lost altitude through two turns: the first to the right and the second to the left.
- The aircraft flew along the south-east coast of the island towards Fuerteventura Airport, maintaining between 500 and 1000 ft of altitude.
- 10:00 h: landing and take-off on runway 19 at Fuerteventura Airport (GCFV).
- The aircraft flies south-west, skirting the coast. It climbed to 2500 ft and increased its speed.
- 10:30 h: the aircraft left the southern coast of Fuerteventura and returned in a south-westerly direction towards El Berriel Aerodrome.
- 11:00 h: the aircraft commenced landing on runway 07 at El Berriel.

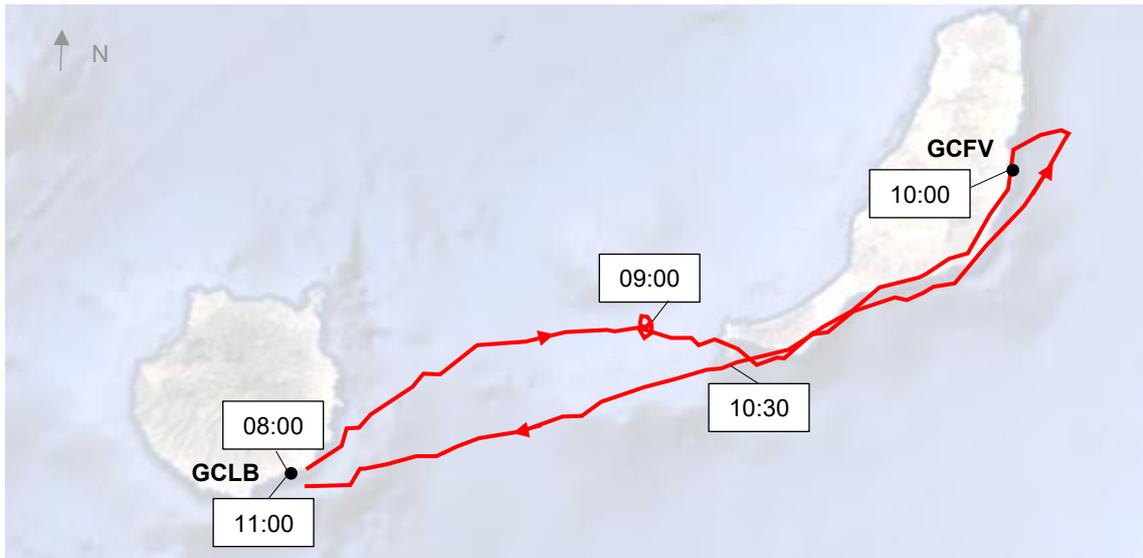


Figure 1. Flightpath of aircraft EC-NJX

After touchdown, which, according to the statements, was “very smooth”, the aircraft began to drift to the right. The crew were unable to regain directional control, and it veered off the runway onto the right-hand strip. The aircraft’s nose gear collapsed, and it came to a standstill, resting on the main gear and lower forward fuselage.

The two occupants were uninjured and left the aircraft unassisted.



Figure 2. Final position of aircraft EC-NJX

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Faralities				
Serious				
Minor				
None	1	1	2	
TOTAL	1	1	2	

1.3. Damage to the aircraft

The main damage was to the nose gear and the propeller. There was also damage to the lower forward fuselage, but to a lesser extent.

1.4. Other damage

None.

1.5. Personnel information

1.5.1 Information on the pilot

The pilot was an 18-year-old Italian national. He had a private pilot license issued in July 2019. His flying experience comprised 114:45 flight hours, of which 26:25 h had been in a Tecnam P2008JC. His activity prior to the flight was as follows:

- During the month preceding the event: a flight 16 days before in a Cessna F150M.
- Two months prior to the event: 21 h of flight time, with 75% of those hours being in the incident aircraft.
- The last flight made by the incident aircraft took place on the 22/07/2020.

1.6. Aircraft information

1.6.1 General information

The EC-NJX, Tecnam P2008JC s/n1177 aircraft was new and had been acquired by Canavia² in early 2020. It was in the process of being registered in Spain and, at the time of the accident, had the third provisional registration certificate valid until 25/09/2020. The Real Aeroclub de Toledo³ had issued its airworthiness review certificate on 21/04/2020, and it was valid until April 2021. At that time, April 2020, the aircraft had a total of four flight hours.

² Canavia Líneas Aéreas S.L.U is an AESA-approved training organisation with reference E-ATO-172.

³ Approval reference ES.MG.189.

It was equipped with a Rotax 912S2 engine, s/n 9139461.

As of 25/08/2020, the aircraft, engine and propeller had accumulated a total of 250 h 45 min of operating time.

The accident flight was the first of the day. The aircraft had been flown two days before the accident, on 23/08/2020, when it completed five flights.

Both the flight manual and the type certificate data sheets indicate that the minimum flight crew is one pilot.

1.6.2 Most recent maintenance inspections

The most recent maintenance services performed on the aircraft were on 24/08/2020 and 14/08/2020:

- 24/08/2020: the day before the accident, with the aircraft having 250 hours of flight time, the 50-hour inspections of the aircraft, engine and propeller had been carried out according to its maintenance programme. With regard to the landing gear and brake system, this inspection only included a torque check of the landing gear fixing screws.
- 14/08/2020: eleven days before the accident, with 207 aircraft flight hours, the aircraft had undergone the 50 h-100 h operation in saline environments inspection, the 50 h-100 h-200 h engine inspection and the 50 h-100 h propeller inspection.

1.7. Meteorological information

The crew's assessment of the meteorological conditions was as follows:

- "Light wind on runway 07 according to the pilot".
- "Not much wind, less than 10 kt aligned with runway 07, according to the passenger".

The photograph taken after the accident (figure 2) shows there were no visibility problems or significant cloud conditions.

1.8. Aids to navigation

N/A.

1.9. Communications

The communications maintained with the different control units are not relevant to the investigation.

1.10. Aerodrome information

El Berriel Aerodrome (GCLB) is a private aerodrome which, according to the AIP, is owned by the Aeroclub de Gran Canaria. It is located in the south of the island of Gran Canaria and has an elevation of 25 ft. It has a 20 m wide and 800 m long asphalt runway, orientation 07/25. The runway side-strip is made from of compacted earth.

The photograph in figure 2 shows the vegetation in the transition zone between the asphalt runway and the strip.

1.11. Flight recorders

The aircraft did not carry flight recorders because they are not a requirement for this type of operation.

1.12. Aircraft wreckage and impact information

The aircraft came to a halt on the second-third of the runway, just before the right-hand strip of runway 07. It displayed damage to the nose gear, which had collapsed, the propeller and the lower forward fuselage. There were tracks in the earth under the aircraft.

A round-shaped mark and disturbed earth immediately below the propeller cone were identified at the aircraft's final resting position. There was no evidence of drag marks on the lower fuselage, indicating that this was where the nose gear had collapsed. The two-bladed propeller had damage to both blades, one of which was completely fractured 1/3 of the way along and bent back on itself. The damage to the other blade was less significant and located on the tip. The damage suggests that the propeller was already slowing down when it hit the ground.

The nose gear was still attached to the aircraft, although the structure was deformed and moved out of position. The structure of the main landing gear and the rest of the aircraft showed no apparent damage or deformations.

The lower forward fuselage displayed more minor deformation marks and cracks.



Figure 3. Damage to the aircraft

The left main gear and nose gear tyres were unmarked. In contrast, the right main gear tyre showed black discolouration marks in two areas, as shown in Figure 4.



Figure 4. Marks on the right main gear tyre

1.13. Medical and pathological information

Neither of the occupants required medical assistance.

1.14. Fire

There was no fire.

1.15. Survival aspects

The aircraft maintained its structural integrity during the accident. The cabin compartment did not suffer any deformation, and the belts and seats remained intact and in position.

1.16. Tests and research

1.16.1 Pilot's testimony

The pilot was interviewed on two occasions. During the two interviews, the pilot referred to the passenger with the term "safety pilot", which is why he is included in this section. The description given was as follows:

- *The flight proceeded normally until landing. On our way back to El Berriel we joined the traffic circuit for runway 25, but as there was a lot of turbulence, we decided to land on runway 07. The wind on runway 07 was very light.*
- *After entering the circuit, I completed the final checklist, which includes verifying that the PARKING BRAKE is released. I rechecked it on the final approach. I was using the checklists provided by the Canavia school, which are laminated and approximately A4-size.*
- *The landing was very smooth and on the runway centreline, but while taxiing down the runway, the aircraft started to slow down, vibrate, and drift rapidly to the right.*
- *We tried to correct it with the rudder, but the aircraft kept drifting to the right. Even the safety pilot asked him if he was hitting the brakes, to which he replied 'no'.*
- *We veered off to the right of the runway. The nose gear collapsed and the propeller hit the ground.*
- *When the aircraft came to a stop, we secured it, and as we were leaving, we noticed the PARKING BRAKE was on.*
- *Some colleagues commented that it was worth checking the position of the PARKING BRAKE lever before landing.*
- *The position of the lever is barely visible from the passenger seat and there is no in-flight warning of its position.*
- *There were no loose objects or items in the vicinity of the PARKING BRAKE lever.*
- *He used Canavia's checklists.*
- *He believed the lever had slipped into the locked position by itself during landing.*

He was specifically asked why he didn't use the red catch⁴ that locks the PARKING BRAKE lever in position. He responded that he didn't know it had been installed and that the last time he had flown the aircraft, the catch wasn't there.

1.16.2 Passenger testimony

The passenger was interviewed. Given that most of the information provided coincides with the pilot's statement, it is only detailed any new relevant information here:

- *The wind on runway 07 was less than 10 kt and aligned with the runway.*
- *The approach was carried out with full flap and at 55 kt.*
- *On landing, as soon as it started to taxi, the aircraft braked, began to vibrate, and veered to the right.*
- *He tried to help the pilot correct the trajectory with the rudder with no success.*
- *They didn't contemplate a go-around because they were already taxiing on the runway when the control problems began.*
- *When they got out of the plane, they saw the PARKING BRAKE lever on.*
- *From his position sitting on the right side of the aircraft, he couldn't see the position of the parking brake lever.*
- *In his opinion, because of its location, it's easy to move the PARKING BRAKE lever with your leg inadvertently.*

1.16.3 Checking the brake system

When maintenance personnel went to retrieve the aircraft, they were initially unable to move it. After moving the lever to the FREE position, the aircraft was moved with no further issues. The movement of the lever was tested on several occasions to see if it was working correctly. The PARKING BRAKE lever was found to be working normally, and no anomalies were detected.

1.16.4 The Tecnam P2008JC brake system

The Tecnam P2008JC has a hydraulic brake system that operates on each main landing gear wheel independently. Hydraulic pressure is applied by putting pressure on the tip of each of the pilots' pedals (PEDAL TIP), reaching the brake through hydraulic lines. Both the pilot and co-pilot pedals are connected, although the master brake is on the pilot's side.

The system has a PARKING BRAKE which consists of a valve (PARKING BRAKE valve) located at the height of the pedestal that intercepts the two hydraulic lines. This valve is activated from the cockpit by the PARKING BRAKE lever, which acts as a non-return valve. To activate the parking brake the system must be pressurised by pressing on the pedal brake and sliding the PARKING BRAKE lever into the LOCK position. When this happens, hydraulic pressure is trapped in the line between the valve and the brake.

⁴ The red catch is an accessory installed by Canavia to ensure the PARKING BRAKE lever stays in the FREE position. See section 1.16.5.

The valve has been designed so that the PARKING BRAKE can be activated in two ways:

- press on the pedals to pressurise the system and slide the lever into the LOCK position, or
- slide the PARKING BRAKE lever into the LOCK position and then pressurise the system by pressing on the pedal brakes.

1.16.5 Location of the PARKING BRAKE lever in the cabin

The PARKING BRAKE lever has two positions:

- FREE, moving the lever forward or towards the pedals. In this position the valve is open.
- LOCK, moving the lever backwards or towards the pilot's seat. In this position the valve is closed, trapping the hydraulic pressure between the valve and brake in each of the hydraulic lines.

The FREE and LOCK positions are selected by moving the lever, which has a ball-shaped knob at the end, along an arc measuring 5 cm. Both positions are indicated on the panel itself.

The whole assembly is located in the lower left-hand side of the pedestal, 2 cm from the floor. The lever is 6 cm above the ground at the lowest points of the arc and 7 cm above the ground at the top of the arc. The lever protrudes 3 cm from the pedestal. The entire assembly (pedestal-lever) is black.

Figure 5 shows four photographs taken in an aircraft similar to the one involved in the event to illustrate the location of the lever in the cockpit and its perspective from the pilot's position.



Figure 5. Position of the PARKING BRAKE lever in the cockpit

1.16.6 Previous events and actions carried out by Canavia with regard to the PARKING BRAKE

It was consulted the database of the Event Notification System to look for possible similar events. The result was negative, i.e., no events related to problems with the PARKING BRAKE had been reported for the Tecnam P2008JC.

It was consulted the manufacturer, Tecnam, for events of a comparable nature with an equally negative result.

1.16.7 Previous events and actions carried out by Canavia with regard to the PARKING BRAKE

Canavia provided information about an event that occurred on 09/07/2020. In this event, the student had landed, applied the brakes as was about to leave the runway when he accidentally activated the PARKING BRAKE, causing the aircraft to stop. According to the description of the incident, operations told him to check the PARKING BRAKE, since they had experienced problems with the lever before, after which they confirmed that it was, indeed, in the lock position.

As a consequence, Canavia installed a red catch at the beginning of August (figure 6) to ensure that the PARKING BRAKE lever remains in the FREE position. The new catch ensured that two actions would have to be performed to activate the PARKING BRAKE: flipping the catch and then moving the lever. According to Canavia, notification of this new installation was carried out verbally. The new catch was not installed the last time the pilot flew the aircraft. The modification was made without consulting the manufacturer and without referring to approved maintenance data.



Figure 6. Catch installed by Canavia in aircraft EC-NJX

1.16.8 Tests carried out on the PARKING BRAKE lever

Several tests were carried out on an aircraft similar to the accident aircraft intending to reproduce the conditions necessary to move the PARKING BRAKE lever inadvertently. Figure 7 shows a pilot with an average build and approximately 1.70 m tall, seated in two different positions:

- the photograph on the left shows a normal flying position, with feet on the pedals.
- the photograph on the right shows a non-flying position, with feet flat on the ground, away from the pedals.



Figure 7. Position of the PARKING BRAKE lever in relation to the pilot

A pilot of a similar height and build to the one involved in the incident would have his seat in the position shown in the photograph. It can, therefore, be extrapolated for analysis. An attempt was made to inadvertently slide the PARKING BRAKE lever across the length of the arc from the FREE position (furthest from the pilot's seat) to the LOCK position (closest to the pilot's seat).

After several attempts, it was found that:

- In the flying position, with the pilot's feet on the pedals, the PARKING BRAKE lever was not activated by other movements. In this position, the pilot's feet are a long way from the lever.
- Due to the height of the parking brake, contact with the lever can only be made with the foot, not the leg.
- The lever moved very easily. There was no resistance when moving it.
- The leg position to access the lever was only possible in a non-flying position; feet off the pedals, knees bent, and the leg flexed slightly outward from the knee towards the foot.
- It was possible to partially move the lever from its FREE position with a single foot movement. However, it was not possible to move it all the way to the LOCK position with a single movement.
- To move the lever all the way across the arc between the two positions (FREE to LOCK), required several backward and upward foot movements.

Finally, it was confirmed that the position of the PARKING BRAKE lever was not visible from the seat on the right of the aircraft.

1.16.9 Consultations with other operators

In addition to Canavia, we consulted with two additional flight schools owning Tecnam P2008JC MKII aircraft. One of the schools consulted operated two aircraft of this type and had not experienced any problems with the PARKING BRAKE. The other school, which operated three aircraft of this type, had not had any incidents related to the PARKING BRAKE either, but they were aware that it could be activated in-flight due to its position in the cabin. In fact, they draw attention to the position of the lever when training instructors and students, and they have included the verification of its position in the Before Descend checklist.

1.17. Organisational and management information

1.17.1 PARKING BRAKE actions in the checklists

The manufacturer's Flight Manual stipulates six PARKING BRAKE actions at different times of the flight. The following table shows the terminology used and the flight phases where the use of the parking brake lever is specified. It has been included Canavia's checklists as well as the manufacturer's because they were the ones the pilot was using.

Nombre de la lista de chequeo		Acción sobre el PARKING BRAKE	
Manual de Vuelo	Canavia	Lista Manual de Vuelo	Lista Canavia
before engine start	before engine starting	3. Engage	3. ENGAGE
before taxiing	taxiing	5. OFF and taxi	1. RELEASE
prior to takeoff	engine run up	1. Brake pedals press, ON	1. SET ON
takeoff and climb	line up	2. OFF	1. RELEASE
---	Approach	-	5. CHECK RELEASE
engine shutdown	engine shutdown	1. ENGAGE	1. SET
post flight checks	post flight checks	4. RELEASE	4. RELEASE

In addition to the checks established by the manufacturer, Canavia had added an extra check to the approach list (5. BRAKES - CHECK RELEASE), which was mentioned by the pilot during his description of the event.

As a comment to both lists, the FREE-LOCK terminology marked on the PARKING BRAKE lever (section 1.16.4) is not the one used in the manufacturer's or operator's lists.

⁵ With regard to the identification of the lists, there are differences between those of the manufacturer and those of Canavia, because Canavia has developed its own checklists and instead of 6 has 15. Its use was specified at the same times during the flight.

1.18. Additional information

1.18.1 Information on the passenger

The Passenger was 25 years old. He had a commercial pilot license issued in September 2019. He was not a qualified instructor. He had 232:10 h of flying experience, 50 min of which was in the Tecnam P2008JC.

1.19. Useful or effective investigation techniques

Not required.

2. ANALYSIS

On Tuesday 25 August 2020, the Tecnam P2008JC EC-NJX aircraft suffered a loss of directional control during landing roll-out on runway 07 at the El Berriel Aerodrome (Las Palmas), causing it to run off the runway onto the right-hand strip.

The event has been analysed on the basis of confirmed factual data (displacement of the aircraft to the right, tyre conditions, PARKING BRAKE lever in the LOCK position, functional tests of the brake system before and after the event) and the descriptive data obtained from the statements of the pilot and passenger (the aircraft braking during the landing roll-out and their inability to correct its trajectory during the event). The absence of data from flight recorders, which are not mandatory in this type of operation, means it has been impossible to confirm the usage of the flight controls and brake system during the event. Taking these premises as a starting point, the analysis is separated into the following sections:

- Section 2.1: Cause of the loss of control
- Section 2.2: Origin of the asymmetrical braking
- Section 2.3: Management of the loss of control
- Section 2.4: Aspects relating to the interaction between pilot and passenger
- Section 2.5: Meteorology, brake system and runway condition
- Section 2.6: Considerations with regard to the location of the parking brake lever

2.1. Cause of the loss of control

Although the condition of the tyres prior to the event is unknown, the fact that the left main and nose gear tyres did not display any signs of wear or marks and that, according to the crew, the aircraft veered to the right while braking, suggests that the discolouration marks identified on the right main landing gear wheel occurred during the event. These black discolouration marks are indicative of heat produced by the tyre's contact with the asphalt. They occur when a wheel is braked and, rather than turning freely, drags along the runway after making contact with it.

The various initial pieces of information (direction of the deviation, tyre marks and behaviour of the aircraft) are coherent and consistent with one another, and therefore, the EC-NJX aircraft deviated to the right as a result of an asymmetrical braking action on the main landing gear. In this case, the right main gear wheel must have been braked, while the left main gear wheel was either not braked at all or braked to a lesser extent.

Therefore, it is considered that the immediate cause of the loss of control during the landing roll-out was an asymmetry in the braking action of the aircraft.

2.2. Origin of the asymmetrical braking

One of the conclusions arrived at as a result of the tests carried out on the PARKING BRAKE was that the lever can only be unintentionally moved when the pilot's feet are off the pedals, and his legs are bent. This position can be adopted in the en-route phases of flight but not when in-circuit because directional adjustments require the use of the pedals. Based on this finding, it is highly probable that the PARKING BRAKE lever was in the LOCK position when the aircraft touched down.

It was also found that it was highly unlikely a pilot could unintentionally move the lever along the full extent of the arc from FREE to LOCK (more than one foot movement was required to move the lever all the way across the semicircular groove). Consequently, it is believed the pilot must have put the lever in the LOCK position by mistake, either during the pre-landing check or the final approach check. In this regard, the fact that, due to its location, dimensions and colour, the PARKING BRAKE lever is not easily distinguishable from either of the two cabin flight positions (pilot and copilot), must be considered a contributing factor (section 2.6).

Furthermore, the Tecnam P2008JC's braking system requires that, in addition to the PARKING BRAKE lever being in the LOCK position, the system must be pressurised. The right and the left brakes are pressurised independently, allowing for potential braking asymmetry as happened in the accident. In this case, the fact that the aircraft drifted to the right shows that the right brake circuit was more pressurised than the left one. The system is pressurised through the pedal brakes, so at some point, the pressure exerted on the right pedal brake was greater than on the left one. With regard to when the circuit was pressurised, there are several possibilities: before landing, during landing, or a combination of both.

Due to the absence of flight data to confirm when the pedal brakes were used, it can only base the analysis on the descriptions provided by the pilot and passenger. Both parties refer to the aircraft immediately breaking and drifting right as soon as they touched down. This could indicate that when the aircraft made contact with the ground, the right brake circuit was already pressurised. Applying the brakes during landing so as not to exhaust the entire length of the runway could be another option, but the pressure would have been applied simultaneously to both pedals, not just one side. In any case, it has been unable to confirm either of these possibilities.

In conclusion, it is believed the asymmetric braking occurred because the pilot mistakenly moved the PARKING BRAKE to the LOCK position, causing asymmetric pressurisation of the brake circuit, possibly before the landing. This means that the right brake was applied when the aircraft started its landing roll-out and remained so until the aircraft came to a halt. The description of the aircraft's behaviour during the landing roll-out (vibration and displacement) is consistent with this brake configuration.

The pilot did not have much overall flight experience (114 h) and had not spent much time in the incident aircraft (26 h), which would explain why he had not sufficiently internalised the correct position of the PARKING BRAKE and the mistake he made while going through the checklists. He was unaware of the existence of the red catch and, when he last flew the aircraft in July, Canavia had not yet fitted it. The fact that the lever and catch are hard to see from the pilot's position, together with the fact that he didn't know a catch had been installed, explain why he didn't use it.

2.3. Management of the loss of directional control

With regard to the management of the emergency, given that the aircraft had already started taxiing on the runway and they had no directional control, the crew made the correct decision to remain on the ground and not initiate a missed landing manoeuvre. Consequently, the pilot did not apply power, and the aircraft's brakes slowed it down. This theory is supported by the damage to the aircraft, which indicates that it was not travelling at high speed when the nose gear collapsed and the propeller struck the ground. The markings on the ground suggest that the nose gear collapsed when it came into contact with the runway side-strip. The transition zone between the runway and the strip is covered with low-level dense vegetation which probably caused the collapse of the nose gear and, consequently, the propeller to impact the ground.

Even though the whole event happened very quickly, the identification of what was happening was rapid and, as a consequence, the actions to correct the aircraft's deviation focused on two areas:

- eliminating the braking action that the passenger thought the pilot was applying and, therefore, instructed him to stop, and
- counteracting the drift to the right using the vertical rudder.

The first action failed because the system was stuck, and even though the pilot was not applying pressure to the pedals, the pressure on the brake was maintained. The second corrective action was also unsuccessful due to the limited aerodynamic efficiency at low speeds. In this case, the only way to counteract the asymmetry would have been to engage the left brake, pressurising the left brake circuit as well as the right. The design of the PARKING BRAKE valve, which functions as a non-return valve, allows this action and it would have balanced the asymmetry despite maintaining the braking action because the PARKING BRAKE valve was in the non-return position.

2.4. Aspects relating to the interaction between pilot and passenger

There were two people on board the aircraft EC-NJX: a pilot, seated on the left, and a second person (also a pilot), seated on the right. For the purposes of this private flight, this second person was on board as a passenger, although he was referred to by the term "safety pilot". Although both Canavia and the "safety pilot" himself recognised

he had no official function on board, the reality is that his presence in the cabin was not that of a mere passenger, but that his role during the flight was to manage any emergency on board. In other words, unofficially, he was given authority to act on the aircraft, exercising the functions of pilot-in-command.

In the case of this type of aircraft, which is certified for a single pilot, and for this type of flight which was a private flight, it was a single-pilot operation and, therefore, the term "safety pilot" is, at the very least, confusing. The fact that a passenger has a pilot license does grant them the right to assume pilot-in-command responsibilities. Therefore, and although it did not have any bearing on the accident, at no time during the flight did the "safety pilot" have any authority to take control of the aircraft.

2.5. Meteorology, brake system and runway condition

The meteorological conditions did not have any bearing on the event. The wind was light, aligned with runway 07 and, therefore, not limiting for the flight. No rain or precipitation could have affected the condition of the runway or braking capacity, and visibility was maximum.

The condition of the brake system it is not considered of influence on the event: it was not identified any element in poor operating condition that could have contributed to braking asymmetry. The maintenance carried out the day before the flight could not have affected the correct operation of the brakes because it did not involve any work on that particular system. Therefore, it has also been discounted. Furthermore, on commencing the flight, the brakes are used while taxiing, and the parking brake is checked four times before take-off. It can be, therefore, assumed that if there had been a problem, they would have detected it. During the removal of the aircraft after the accident, functional tests of the brake system were carried out with satisfactory results.

Finally, with regard to the condition of the runway, the transition between the asphalt of the runway and the strip presented vegetation that probably affected aircraft as it ran off the runway.

2.6. Considerations with regard to the design of the parking brake lever

Three aspects were considered in relation to the PARKING BRAKE lever:

- Difficulty in checking the position of the lever from the pilot's position.
- The possibility of the pilot's foot unintentionally moving the lever, albeit without being able to move it fully from one side to the other.
- Flight procedures involving the lever.

2.6.1 Difficulty in checking the position of the lever

It is considered the installation and design of the PARKING BRAKE lever contributed to this accident. As indicated in sections 1.16.5 and 1.16.8, the dimensions, location and colour of the assembly make it hard to see its position:

- The whole assembly is black: lever, pedestal and background.
- It is small and located close to the floor.
- The movement of the lever is perpendicular to the pilot's line of sight (front-back).
- The position labelling words FREE-LOCK are not visible from the pilot's position.
- It is positioned outside the normal sphere of vision; it is needed to look down to see it.
- It is not visible from the right-hand seat.

In the case of the accident experienced by the EC-NJX aircraft, it is considered probable that the pilot incorrectly put the PARKING BRAKE in the LOCK position. But, the design of the lever does not allow to check its position. Its location made it impossible to double-check, both in-flight, which would have prevented the situation, and during the unintentional runway exit, which would have corrected the problem.

2.6.2 Low probability of unintentionally moving the lever along its full length of travel

With regard to the possibility of unintentionally moving the PARKING BRAKE lever, the tests led to two conclusions.

The first is that in a non-flying position with knees bent (a resting position adopted in en-route flight phases) it is possible for the foot to make contact with the lever. The contact between lever and foot could partly move the lever rearwards from the FREE position, mainly because the lever does not offer any resistance to movement.

The second conclusion is that, although contact is possible, the complete displacement through the arc required to move the lever from FREE to LOCK was not possible with a single movement and would require several very precise backwards movements of the foot.

With this in mind, it is considered necessary to issue a safety recommendation to Tecnam, as the organisation responsible for the design of the P2008JC aircraft, to improve the ergonomic aspects of the PARKING BRAKE lever.

2.6.3 *Flight procedures involving the lever*

The inquiries made to three Tecnam P2008JC aircraft operators showed that two of them were aware of the potential to activate the PARKING BRAKE inadvertently. As a consequence, the training they provide their instructors emphasises this possibility, and they have included checking the position of the lever at similar moments (before descent) in their flight procedures.

These pre-landing checks are not included in the checklists specified by the Flight Manual. Taking into account the particularities of the PARKING BRAKE lever's location and operation, and the consequences for the directional control of the aircraft on the ground, a recommendation is issued to Tecnam, as the organisation responsible for its design, to incorporate these checks into the checklists specified by the *Flight Manual*.

Furthermore, and although there was no contribution to the accident, the review of the *Flight Manual* checklists and Canavia's lists (section 1.17.1), showed that in both documents (the manufacturer's and Canavia's) the terminology used for the PARKING BRAKE (ENGAGE, OFF, ON, RELEASE, SET) does not match the terminology used on the lever itself: FREE and LOCK.

Thus, a recommendation is issued to the manufacturer requesting they standardise the terminology used on the aircraft and in the procedures and manuals.

3. CONCLUSIONS

3.1. Findings

General:

- Both pilot and aircraft were eligible to carry out the flight.
- The aircraft had been rented from Canavia.
- The pilot had an accumulated flight experience of 114 hours, of which 26 hours were in P2008JC.
- The meteorological conditions were not limiting for visual flight and did not influence the event.
- The right-hand strip of GCLB runway 07 had a covering of vegetation that acted as an obstacle and made taxiing through it difficult.
- The 3-hour flight was uneventful until landing.

Regarding to the event:

- The aircraft landed with the PARKING BRAKE in the LOCK position.
- The right main landing gear tyre showed signs of having made contact with the runway while braked. The left main landing gear did not have similar markings.
- The aircraft veered off the runway to the right side.
- When the aircraft ran off the runway, its nose gear collapsed, and the propeller subsequently impacted the ground.
- The aircraft was at low power when the nose gear collapsed.

About the parking brake system or PARKING BRAKE:

- The pilot was not aware of the position of the PARKING BRAKE lever until after the event occurred.
- Functional tests on the brake system carried out after the event did not identify any issues.
- There were no issues with the condition of the brake system prior to the event.
- The location of the PARKING BRAKE lever within the cabin, as well as its dimensions and colour, makes it difficult to distinguish which position it's in from either of the two pilot seats.
- The unintentional movement of the PARKING BRAKE lever with the foot is possible under certain conditions: feet off the pedals and bent knees (rest position en-route).
- The unintentional movement of the PARKING BRAKE lever through its full path of travel (from FREE to LOCK position) is improbable, although it is possible to move it partially.
- The PARKING BRAKE lever does not have a factory-installed lock for the FREE position.

- Canavia had installed a red catch to secure the PARKING BRAKE lever in the FREE position.
- The locking catch installed on the EC-NJX aircraft was not used by the pilot because he was unaware of its existence.
- The checklists in the manufacturer's Flight Manual did not include checking the position of the PARKING BRAKE lever before landing.
- The terminology used in reference to the PARKING BRAKE lever in the Tecnam and Canavia checklists did not coincide with the terminology used on the lever or with the direction of actuation.
- Two of the three Tecnam P2008JC operators consulted have included checking the PARKING BRAKE lever in their procedures before the approach.

3.2. Causes/contributing factors

The investigation has concluded that the accident experienced by aircraft EC-NJX was probably caused by landing with the right brake-circuit pressurised and the PARKING BRAKE lever in the LOCK position, which produced a braking asymmetry during the landing roll-out and caused the aircraft to run on to the right-hand strip.

4. OPERATIONAL SAFETY RECOMMENDATIONS

The investigation into the accident suffered by the EC-NJX aircraft has revealed some areas for improvement in relation to the design, location and operation of the PARKING BRAKE lever in the P2008JC aircraft. Specifically, it has been found that it is possible to inadvertently change the position of the PARKING BRAKE lever, at least partially, with the right foot. Furthermore, it is currently not possible to confirm the position of the lever (FREE-LOCK) because the labelling on the lever itself is not visible from any cabin position. Finally, discrepancies have been detected between the nomenclature used in the Tecnam manuals and lists, and that used on the lever itself. In order to correct these aspects, the following safety recommendations are issued to Tecnam, as the organisation responsible for the design of the P2008JC aircraft.

REC 36/20. It is recommended that Costruzioni Aeronautiche Tecnam, as the organisation responsible for the design of the Tecnam P2008JC aircraft, should implement measures to improve the PARKING BRAKE lever so that its position can be identified from the pilot's seat.

REC 37/20. It is recommended that Costruzioni Aeronautiche Tecnam, as the organisation responsible for the design of the Tecnam P2008JC aircraft, should implement measures to improve the PARKING BRAKE lever to prevent it from being inadvertently moved from the FREE position necessary to ensure directional control on the ground.

REC 38/20. It is recommended that Costruzioni Aeronautiche Tecnam, as the organisation responsible for the design of the Tecnam P2008JC aircraft, should review and modify all the documentation associated with these aircraft to unify the nomenclature used for the PARKING BRAKE and ensure that it corresponds to the wording used on the lever itself.

To avoid similar events like the one occurred to EC-NJX, with the current design, it is issued the following recommendation focused on the current procedures:

REC 39/20. It is recommended that Costruzioni Aeronautiche Tecnam, as the organisation responsible for the design of the Tecnam P2008JC aircraft, should include the pre-landing verification of the position of the PARKING BRAKE lever in the Flight Manual's checklists.

Canavia Líneas Aéreas modified the PARKING BRAKE lever, adding a catch to hold it in the FREE position. Given that this modification was made without consulting the manufacturer or being supported by approved maintenance data, the following recommendation is issued:

REC 40/20. It is recommended that Canavia Líneas Aéreas should regularise the installation of the red catch added to the PARKING BRAKE of its Tecnam P2008JC aircraft, either by submitting it for official approval or by uninstalling it.