

Technical report

ULM A-002/2023

Accident on 27 January 2023 involving a TECNAM P-92 ECHO aircraft, registration EC-KNB, operated by Ignagua Center, S.L., at Casarrubios del Monte Aerodrome (Toledo, Spain)

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Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission regarding the circumstances of the accident that is the object of the investigation, its probable causes, and its consequences.

In accordance with the provisions of Article 5.4.1 of Annex 13 of the International Civil Aviation Convention, Article 5.6 of Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010; Article 15 of Law 21/2003 on Air Safety; and Articles 1 and 21.2 of RD 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent their recurrence. The investigation is not intended to attribute any blame or liability, nor to prejudge any decisions that may be taken by the judicial authorities. Therefore, and according to the laws specified above, the investigation was carried out using procedures not necessarily subject to the guarantees and rights by which evidence should be governed in a judicial process.

As a result, the use of this report for any purpose other than the prevention of future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

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ABBREVIATIONS

° ‘ “	Sexagesimal degrees, minutes and seconds
°C	Degrees Celsius
AEMET	State Meteorological Agency
AESA	Spain's National Aviation Safety Agency
AMM	Aircraft maintenance manual
cm	Centimetres
CV	Metric horsepower
FI	Flight instructor rating
ft	Feet
h	Hours
km	Kilometres
kt	Knots
LAPL	Light aircraft pilot license
LEMT	ICAO code for Casarrubios del Monte Aerodrome- Toledo
m	Metres
MAF	Multi-axis fixed-wing aircraft rating
MHz	Megahertz
MPa	Megapascals
NE	Northeast
NM	Nautical miles
Nm	Newton metre
NW	Northwest
s/n	Serial number
RTC	National radio operator
SL	Limited company
TULM	Ultralight aircraft pilot license
ULM	Motorised ultralight aircraft
UTC	Coordinated universal time
VFR	Visual flight rules

Technical report

ULM A-002/2023

Owner and Operator:	Ignagua Center, S.L.
Aircraft:	TECNAM P-92-ECHO, registration EC-KNB (Spain)
Date and time of accident:	Friday, 27 January 2023, 11:25 local time ¹
Site of the accident:	Casarrubios del Monte Aerodrome (Toledo)
Persons on board:	2 crew
Type of operation:	Commercial aviation – Instruction – Dual command
Phase of flight:	Landing – Taxi on runway
Flight rules:	VFR
Date of approval:	19/December/2023

Synopsis

Summary:

On Friday, 27 January 2023, the TECNAM P92-ECHO aircraft, registration EC-KNB, suffered an accident while landing on runway 26 at Casarrubios del Monte Aerodrome (Toledo).

The aircraft had taken off with an instructor and student on board for an instruction flight involving the practice of take-offs and landings.

During the sixth touch-and-go landing, the aircraft touched down as planned on runway 26, but before it could get airborne again, one of its right main gear attachments broke, causing it to veer to the right and off the side of the runway, resulting in damage to the landing gear and the right wing.

The pilot and passengers were unharmed. The aircraft was significantly damaged.

It has been concluded that the cause of the accident was the collapse of the right main landing gear leaf spring and consequent runway excursion, which occurred due to poor maintenance practices that led to the rupture of the rear bolt in the right leaf spring clamp plate.

The bolt failed as a result of progressive fatigue.

¹ Unless specified otherwise, all times in this report are local. On the day of the accident, local time was equivalent to UTC+1 hours.

The report contains an operational safety recommendation addressed to Ignagua Center, S.L., in the same terms as the one issued previously following the investigation with reference ULM-A-012/2021, recommending it ensure the correct execution of maintenance tasks involving tightening torque to the main landing gear attachment elements, to which the operator has not responded and which has therefore been filed as closed with unacceptable action.

1. THE FACTS OF THE INCIDENT

1.1. Overview of the accident

On 27 January 2023, an instructor and student from the Ignagua Center S.L. flight school took off at 10:49 h in a TECNAM P92-ECHO aircraft with registration EC-KNB to carry out a local instruction flight.

The flight was the first of the day and consisted of touch-and-go landings on runway 26 at Casarrubios del Monte Aerodrome.

According to the instructor, 36 minutes into the flight, the student carried out the sixth landing with total normality and no sharp falls or adverse circumstances.

During the landing rollout, having applied full power to take to the air again, he heard a bang that prompted him to take the controls and assume immediate control of the aircraft.

He immediately noticed that the aircraft was veering to the right on the ground, so he reduced the throttle to idle, and they came to a stop on the runway strip.



Fig. no. 1 - Final condition and position of the aircraft.

The pilot and passengers were unharmed. The aircraft was significantly damaged.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
Unharmed	2		2	
TOTAL	2		2	

1.3. Damage to the aircraft

The aircraft sustained significant damage to the anchor point of the right main landing gear leaf spring, the underside of the left wing, and the attachment and underside of the right horizontal stabiliser.

1.4. Other damages

There were no further damages of any kind.

1.5. Information about the personnel

The 59-year-old instructor had an ultralight aircraft pilot license (TULM) issued by Spain's National Aviation Safety Agency (AESA) on 22/04/2009, with the multi-axis fixed-wing aircraft (MAF) and instructor FI (MAF) ratings, valid until 30/04/2024.

His class 1, 2 and LAPL medical certificates were valid until 16/06/2024.

He had a total of 3088:84 h of flying time, which included 1180:77 h in the type of aircraft involved in the incident and 999:53 h as an instructor.

The day before the incident, he had rested for 24 h, having flown 10:24 h and 27:33 h in the last 30 and 90 days, respectively.

The 64-year-old student had an LAPL medical certificate with validity until 09/06/2024. He had enrolled on 1/07/22 and had accumulated a total of 32:53 flight hours.

1.6. Information about the aircraft

1.6.1. General information

The Italian-designed TECNAM P92-ECHO aircraft, manufactured in 2007 with s/n: P92-E-033, is a single-engine, two-seater, ultralight monoplane with a braced high wing, fixed tricycle-type landing gear and steerable nose wheel.

The aircraft was equipped with an 81 hp ROTAX 912 UL piston engine with s/n: 9580933.

Main landing gear

As the landing gear system was the main system involved in the accident, its composition is detailed below.

Each main landing gear leg has a special curved steel plate (1) or leaf spring positioned crosswise to the fuselage to cushion the aircraft from the loads produced during landing.

The leaf spring is attached to the underside of the fuselage through the main beam with three bolts and stop nuts, two lateral bolts (5) to secure the clamp plate (4) to the edge of the beam, and a central bolt (6), which secures the inboard end, closest to the axis of the aircraft. Two pieces of leather shim (2, 3) are inserted between the leaf spring and the beam to cushion the connection between the two.

The wheels are cantilevered over the landing gear's sprung leg and have hydraulic disc brakes controlled by a lever positioned between the two seats in the cabin. A shut-off valve for the hydraulic circuit is located in the same place.

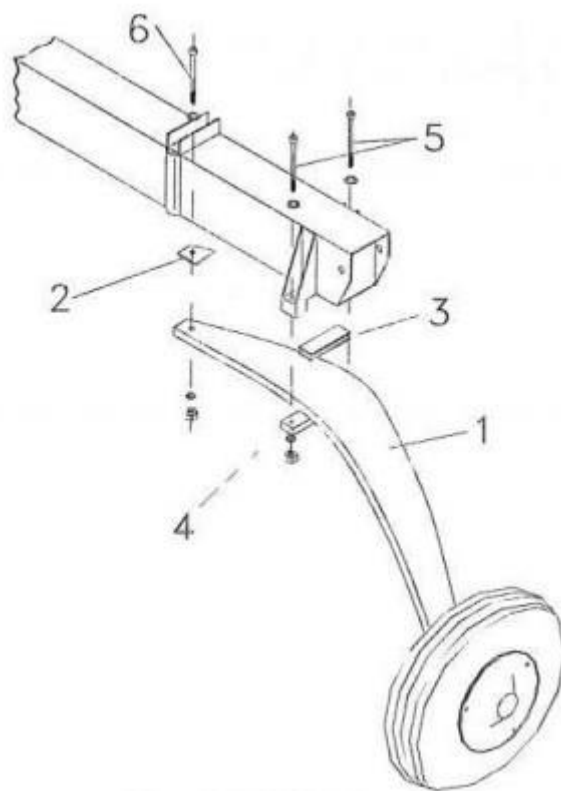


Fig. no. 2.- Leaf spring attachment

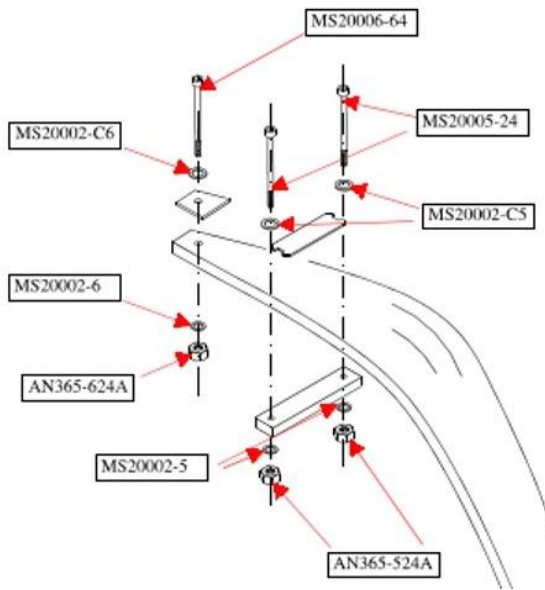


Fig. no. 3.- Part numbers of the main landing gear attachment system

The brakes work simultaneously on both wheels via a t-shaped joint.

The control lever activates the master cylinder and its corresponding brake fluid reservoir. The system is equipped with a non-return valve, which ensures the braking action is always effective, even if the parking brake circuit has been accidentally closed.

The system for securing the leaf springs to the fuselage has been improved over time by the aircraft manufacturer by modifying the type of self-locking nuts and bolts used.

The current valid part numbers, quantities and required tightening torques are shown in Figure 3 and the table in Figure 4.

<i>Description</i>	<i>Part number</i>	<i>QTY</i>	<i>Torque value</i>
Central bolts	MS20006-64	2	//
Lateral bolts	MS20005-24	4	//
Stop nut for lateral bolts	AN365-524A	4	15 +/- 1 Nm
Stop nut for central bolts	AN365-624A	2	25 +/- 2 Nm
Washer under Lateral bolts	MS20002C-5	4	//
Washer under Central bolts	MS20002C-6	2	//
Washer under Lateral Stop Nuts	MS20002-5	4	//
Washer under Central Stop Nut	MS20002-6	2	//

Fig.no. 4. Description of the part numbers that make up the main landing gear attachment system

It should be noted that in addition to applying the recommended tightening torques to ensure the correct attachment of the leg to the fuselage, the manufacturer also recommends the nuts be replaced one by one, without applying the final torque until they have all been replaced. Thus, the correct torque should be applied after fitting all the nuts. This practice has been proven to reduce the risk of the main landing gear leg detaching.

According to the aircraft manufacturer, the use of any bolts other than those recommended may result in vibrations at the landing gear attachment point and cause the nuts to become loose, compromising the connection.

Operational procedures

The following operating procedures from the aircraft's flight manual are relevant to the investigation.

- **Pre-flight inspection**

The external aircraft inspection tasks corresponding to the landing gear are as follows:

- Left and right main gear: check tyre pressure (1.4 bar), tyre condition and corresponding alignment, condition of the fuselage skin.
- Nose wheel leg: check tyre pressure (1.0 bar), condition of tyre and shock absorber.

- **Before landing**

Landing light..... ON position
 On downwind leg: speed and flaps according to traffic.
 Traffic..... check
 Flaps..... as required
 Optimal touchdown speed with full flaps.... 39 kt

1.6.2. Maintenance information

The aircraft was built in 2007 with serial number: P92-E-033. It is owned and operated by the ultralight pilot school Ignagua Center S.L.

The aircraft had an approved maintenance programme specifying the following maintenance overhauls:

- Pre-flight inspection.
- Basic inspection every 100 h of flight or 12 months.
- Periodic inspection every 200 h of flight.
- Special inspection every 600 h of flight.

According to the AMM, the tasks to be carried out on the main landing gear during the 100-hour flight inspections include a review of the general condition of all its components and attachments, to include a structural inspection of the leaf springs, as well as the brake and hydraulic systems and wheels and tyres.

In addition to the inspections specified in the approved programme, the AMM establishes another special inspection of several of the main landing gear components every 1,200 hours, during which the leaf springs must be removed to check their integrity, curvature and general condition.

According to the aircraft's logbook issued on 12/11/2019, it had a cumulative record of 3432:08 flight hours at the time of the accident. The flight prior to the accident took place the day before at 17:00 h. It lasted 54 minutes and included one landing. On the same day, the aircraft had made two earlier flights, one at 9:10 h with a duration of 1:18 hours and one landing, and the other at 11:00 h with a duration of 1 hour and two landings.

The aircraft's last maintenance overhaul, recorded as a standard overhaul that included inspections of the bolts on the main landing gear and the nose wheel, was carried out in the pilot school's workshop on 25/01/2023 when the aircraft had 3428:20 flight hours.

According to the valid engine logbook issued on 02/03/2021, the last overhaul was a 100 h overhaul on 25/01/2023 when the engine had 560 h of flight time.

1.6.3. Airworthiness status

The aircraft involved in the incident was initially registered on 24/01/2008. According to the registration certificate subsequently issued by AESA on 27 September 2021, entry number 8165, the owner of the aircraft is AERORENT DEPORTIVA ELDUAYEN, S.L. and the lessee is IGNAGUA CENTER, S.L.

The aircraft had a restricted certificate of airworthiness, no. 6577, issued on 28/01/2008 by AESA, on which the manufacturer is listed as "Aero Emporda, S.L.", and the aircraft designation is "P-92-ECHO" in the "School-3-Standard" category.

1.7. Meteorological information

The State Meteorological Agency (AEMET) does not have a station at the accident site; the closest and most representative stations are in Robledo de Chavela, Aranjuez and Toledo, located 36 km to the northwest, 42 km to the southeast, and 42 km to the south, respectively.

According to the data recorded at those stations, the most likely meteorological conditions in the area at the time of the accident were light winds from the NE and NW and no significant weather phenomena. The recorded gusts were moderate, also from the NE and NW. The temperature was approximately between 4°C and 8°C.

1.8. Aids to navigation

N/A.

1.9. Communications

There were no communications.

1.10. Information about the aerodrome

Casarrubios del Monte Aerodrome in the province of Toledo (with ICAO callsign LEMT and GPS coordinates 40° 14' 06" N; 04° 01' 35" W) is a privately owned restricted aerodrome. It has an asphalt runway with a 08/26 orientation measuring 950 x 26 m at an elevation of 625 m, characterised by a threshold at 400 m on runway 08. Air-to-air communications are made on the 123,500 MHz frequency.

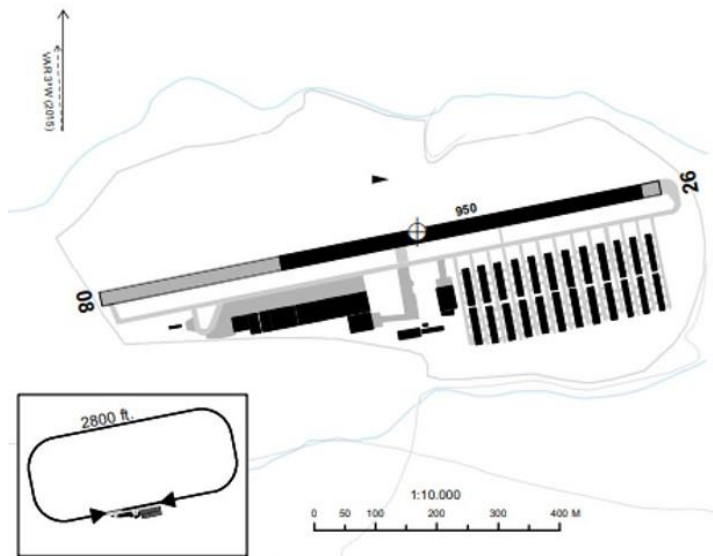


Fig. no.5.- Plan of Casarrubios del Monte Aerodrome

The traffic pattern for general aviation and ultralights is to the north of the airfield at 2800 ft with the entrance point 4 NM to the southwest of Navalcarnero. There is another pattern for gyroplanes to the south of the airfield.

The aerodrome is surrounded by a track road approximately 10 m below the runway level, which gives rise to a significant drop-off at the end extension of runway 26.



Fig. no. 6 - Casarrubios del Monte

1.11. Flight recorders

The aircraft was not equipped with a flight data recorder or cockpit voice recorder as they are not required by the applicable regulations.

1.12. Information about the aircraft's path and wreckage

The accident occurred during the rollout after touchdown on runway 26 just after applying full power to take off again. It was then that the aircraft started to veer to the right of the runway and eventually came to a stop at the edge of the runway strip.

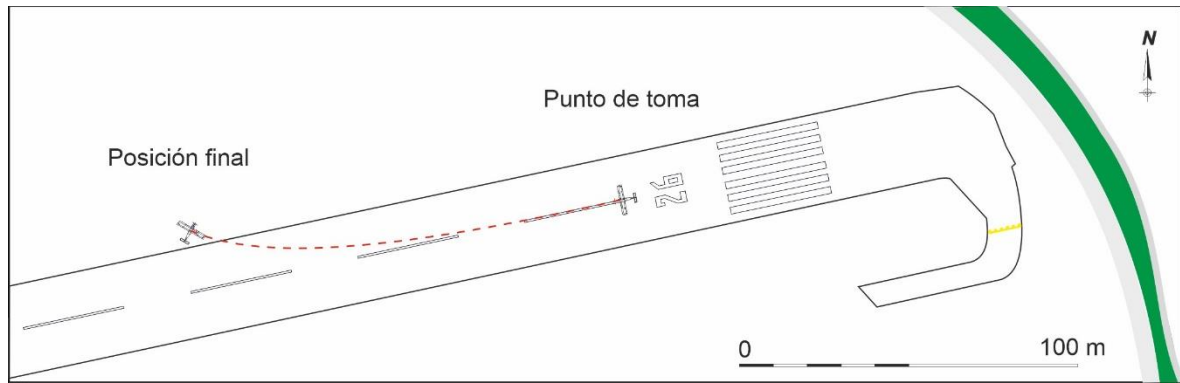


Fig. no. 7.- - Diagram showing the path of the aircraft

The aircraft touched down immediately after the runway designator marking and travelled approximately 125 m before stopping 240 m from the start of the asphalt.

On exiting the aircraft, the pilot could see that the right leaf spring was partially detached and had bent backwards in the direction of travel.



Fig. no. 8.- Final position of the main landing gear legs



Fig. no. 9 - Close-up of the detachment of the right leaf spring

The inspection of the aircraft identified damage to the right main landing gear leg, the right wing, the right stabiliser on the tail empennage and the underside of the fuselage. The tyres and brake system were in good condition with no abnormal wear.



Fig. no. 10.- Damage to the wing and right stabiliser

At the time of access to the wreckage, the aircraft was already being repaired, so we could only view the part of the rear clamp retaining bolt that remained lodged in the aircraft. The other leaf spring retaining bolts were not available for inspection.

1.13. Medical and pathological information

N/A.

1.14. Fire

N/A.

1.15. Survival aspects

The harnesses and restraint systems worked adequately, and the cabin interior maintained its structural integrity.

1.16. Tests and research

1.16.1. Inspection of the main landing gear attachment system

Our inspectors were only able to view the part of the rear clamp retaining bolt that had remained lodged in the aircraft; the other bolts securing the right leaf spring were unavailable.



Fig. no. 11 - Close-up of the ruptured bolt

This bolt revealed a fracture at the thread level. A detailed study of the fracture surface revealed features typical of a fatigue fracture.

There were two distinct areas on the fracture surface, one being the part of the fracture where the fatigue mechanism had taken effect and the other being the area subjected to the static load from the remaining section of the part.

The left landing gear's leaf spring attachment bolts were in good condition, with no corrosion, cracks or deterioration that could have contributed to the event.

The front right leaf spring fastening bolt, which secures the clamp plate to the edge of the fuselage beam, was deformed and bent in the direction of travel.

According to the aircraft's online maintenance manual, which follows the UNE standard, the lateral bolts must be 6 in diameter and 8.8 in strength. They should have a tightening torque of 10.4 Nm.

In 2011, a TECNAM service bulletin issued a requirement to change these bolts to MS20005-24, which measures 5.97 cm in length and 0.79 cm in width. According to the specification, they must have a minimum strength of 883 MPa and a tightening torque of 15 Nm +/- 1 Nm.

A torque wrench must be used to ensure the correct fit of the threaded elements to which the torque is applied. The maintenance workshop was unable to confirm whether the bolts were tightened using this tool and, consequently, the tightening torque could not be guaranteed.

According to information provided by the maintenance centre, the inserts between the leaf spring and the beam to cushion the connection between the two were worn and made of a plastic composite instead of the leather indicated by the manufacturer.

1.17. Organisational and management information

The school that owns and operates the aircraft involved in the incident, Ignagua Center, S.L., has been authorised by AESA since 11/10/2016 as a ULM flight school for the multi-axis fixed-wing ultralight aircraft rating (MAF). Its base of operations is at Casarrubios del Monte Aerodrome - LEMT (Toledo), and it is subject to the limitations derived from the applicable regulations.

The organisation is permitted to run courses for those looking to obtain the pilot license for multi-axis, fixed-wing ultralight aircraft (MAF), instructor courses and seminars (FI) and radio operator courses (RTC).

1.18. Additional information

We have reviewed similar accidents, investigated by various authorities, involving the main landing gear attachment system of Tecnam P-92 Echo aircraft.

In all the cases identified, the main landing gear leaf spring attachment bolts (sometimes lateral and sometimes central) were severed due to material fatigue, with cracks or corrosion sometimes found around the breakage zone.

In addition, the investigations into accidents ULM-A-005/2020 and ULM-A-012/2021 identified their causes as the breakage of one of the lateral bolts securing the landing gear leaf spring in one and the detachment of the self-locking nuts in the other.

1.19. Useful or effective investigation techniques

N/A.

2. ANALYSIS

2.1. General aspects

The pilot held the required licence and relevant medical certificates for the flight.

The aircraft had the correct documentation for the flight.

2.2. Analysis of the meteorological conditions

The meteorological conditions in the area and around the time of the event were suitable for the flight and, therefore, adverse conditions are not deemed to have been a factor.

2.3. Operational analysis

According to the pilot's statement, the appropriate pre-flight inspections had been carried out with satisfactory results.

After the aircraft touched down with all three landing gear wheels on the ground, a bang was heard as thrust was applied to take off again and the aircraft veered to the right (remaining on the ground), eventually coming to a stop on the runway strip.

Consequently, we can deduce that the application of thrust put pressure on the right leaf spring attachment, and it must have been at that moment that the bolt broke, allowing the right leaf spring to bend under the fuselage. Up until that point, the aircraft had been moving forward and deviating toward the edge of the runway.

Subsequently, due to the effect of pivoting on its right leg, the aircraft turned more than 90° to the right, now off the runway and on the lateral strip of land that runs alongside it, before coming to a standstill.

In view of the above, it can be concluded that the pilot followed the operating procedures adequately and that his actions did not contribute to the accident.

2.4. Analysis of the aircraft wreckage

The damage to the aircraft is consistent with the pilot's statement.

As the aircraft lost speed, the right wing descended until it hit the ground and then dragged along the runway surface. This dragging caused damage to the intrados and the right horizontal stabiliser.

The damage to the lower fuselage was sustained when the right leg rotated around the central bolt.

The recovered broken bolt revealed characteristics typical of a progressive fatigue fracture.

According to the manufacturer's instructions, applying the correct tightening torque and inserting suitable damping pieces between the leaf spring and the beam is essential to eliminate vibrations and movements that could accelerate the onset of material fatigue.

Given that, on the one hand, the leather parts were clearly missing and, on the other, we were unable to confirm that suitable tools had been used to ensure the correct tightening of the components, we can conclude that good maintenance practice was not followed.

3. CONCLUSION

3.1. Findings

- The rear lateral bolt securing the right leaf spring to the clamp plate ruptured when thrust was applied.
- The rear lateral bolt securing the right leaf spring to the clamp plate ruptured due to progressive fatigue.
- Poor maintenance practices resulted in an inadequate tightening torque and the absence of suitable damping components between the beam and the leaf spring, which led to material fatigue.

3.2. Causes / Contributing factors

It has been concluded that the cause of the accident was the collapse of the right main landing gear leaf spring and consequent runway excursion, which occurred due to poor maintenance practices that led to the rupture of the rear bolt in the right leaf spring clamp plate.

The bolt failed as a result of progressive fatigue.

4. RECOMMENDATIONS

The following operational safety recommendation is issued to Ignagua Center S.L., being identical to the one previously issued following the investigation with reference ULM A-012/2021, to which the operator has not responded and which has therefore been filed as closed with unacceptable action:

REC 45/23

It is recommended that Ignagua Center, S.L. guarantees the use of the appropriate tools to carry out maintenance tasks that require a tightening torque specified by the aircraft manufacturer and also ensures that the technical specifications of the components involved meet the aircraft manufacturer's requirements.