

CIAIAC

COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
E INCIDENTES DE
AVIACIÓN CIVIL

Report A-037/2018

Accident involving a Piper PA-28R-200,
registration EC-HSZ, at the Cuatro
Vientos Airport (Madrid)
on 4 September 2018.



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DE ESPAÑA

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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 (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

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.

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

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Abbreviations

° C	Degrees centigrade
AEMET	Spain's National Weather Agency
AESA	Spain's National Aviation Safety Agency
BGE	Backup gear extender
HP	Horsepower
ft	Feet
h	Hours
hPa	Hectopascals
Kg	Kilograms
Km	Kilometers
Kt	Knots
LT	Local time
m	Meters
METAR	Meteorological aerodrome report
Mhz	Megahertz
MPH	Miles per hour
PPL	Private pilot license
rpm	Revolutions per minute
SB	Service Bulletin
SEP	Single engine piston
UTC	Coordinated universal time

Synopsis

Operator:	Private
Aircraft:	Piper PA-28R-200, registration EC-HSZ
Date and time of accident:	4 September 2018 at 19:45 LT ¹
Site of accident:	Cuatro Vientos Airport (Madrid)
Persons on board:	1, uninjured
Type of flight:	General aviation - Private
Flight rules:	VFR
Phase of flight:	Landing – Landing run

Date of approval:

Summary of event:

On Tuesday, 4 September 2018, a PIPER PA-28R-200 aircraft, registration EC-HSZ, suffered an accident while landing. It was making a flight with another aircraft. Both had departed from the Burgos Airport en route to the Cuatro Vientos Airport (Madrid).

After taking off from the Burgos Airport and attempting to raise the landing gear, the pilot noticed that the amber light indicating the gear was in transit remained on. After obtaining visual confirmation from the pilot of the other aircraft of the position of the landing gear (nose leg retracted and main gear legs intermediate), he again actuated the landing gear control in both the down and up direction, to no effect. He then attempted to lower the gear using the manual emergency procedure, which was also unsuccessful.

He decided to continue the flight to Cuatro Vientos, reporting his condition upon arriving and again receiving visual confirmation of the gear position from the control tower at the Cuatro Vientos Airport.

After landing, the gear collapsed and the aircraft skidded on runway 27 before coming to a stop inside the runway.

The occupant was not injured and exited the aircraft under his own power. The aircraft sustained heavy damage.

The investigation has concluded that the accident was caused by the inoperative condition of the manual emergency system for lowering the landing gear due to improper and undocumented tasks performed on it.

¹ All times in this report are local unless specified otherwise. To obtain UTC, subtract 2 hours from local time.

1. FACTUAL INFORMATION

1.1. History of the flight

On Tuesday, 4 September 2018, a PIPER PA-28R-200 aircraft, registration EC-HSZ, had taken off from the Cuatro Vientos en route to the San Sebastian Airport with three persons on board, all of them pilots.

The purpose of the flight was to pick up an aircraft at the San Sebastian Airport, which would be piloted by one of the three individuals, and move it to the Cuatro Vientos Airport.

The return flight was carried out in two segments, the first between the airports of San Sebastian and Burgos, and the second from Burgos to Cuatro Vientos. During this last segment, the sole occupant of the aircraft with registration EC-HSZ was the pilot, and the other two individuals would fly on the other aircraft.

According to the pilot of aircraft EC-HSZ, after taking off from the Burgos Airport and retracting the gear, he realized that the landing gear transit light was on. His colleagues in the other aircraft verified that the nose leg was retracted, but that the main gear legs were in an intermediate position.

After several unsuccessful attempts to alter the position of the landing gear, the pilot opted to use the emergency gear extension system. Despite trying for practically the entire duration of the flight (around 2 hours), he was unable to lower and lock the gear, so he decided that he would report the emergency as soon as he contacted the tower at the Cuatro Vientos Airport.

At the request of the tower, he made a low pass to confirm that the gear was halfway down, after which the aircraft was cleared to land on runway 27.

The aircraft made a gradual descent with a shallow slope and remaining stabilized at all times. After touching down, the landing gear collapsed and the aircraft skidded on the runway some 80 m before coming to a stop inside the runway. The wings did not touch the asphalt.

The pilot then secured the aircraft and exited it under his own power.

The pilot was not injured but the aircraft was seriously damaged.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
None	1		1	
TOTAL	1		1	

1.3. Damage to aircraft

The aircraft sustained significant damage to its propeller, landing gear and underside of the fuselage.

1.4. Other damage

Not applicable

1.5. Personnel information

1.5.1. Information on the crew of the aircraft

The pilot, a 58-year-old Spanish national, had a private pilot license (PPL(A)) issued by the National Aviation Safety Agency with a single-engine piston (SEP) rating that was valid until 31 May 2019. He also had a class-2 medical certificate that was valid until 26 April 2019.

He had a total of 253:25 flight hours, of which 100 had been on the type.

1.6. Aircraft information

1.6.1. General information

The Piper PA-28R-200 aircraft has a retractable landing gear and a maximum takeoff weight of 1202 kg. It is equipped with one Lycoming IO-360-C1C engine with 200 HP.

The accident aircraft had serial number 28R-7235020. It was manufactured in 1972 and registered on 5 November 2015.

It had a certificate of airworthiness issued on 7 March 2016 by the National Aviation Safety Agency (AESA), and the corresponding airworthiness review certificate, issued by ITAER INGENIERÍA SL as the approved continuing airworthiness management organization (ES.MG.175) and valid until 9 November 2018.

The aircraft had an insurance policy that was valid until 16 May 2019.

The last maintenance task carried out was on 26 September 2017, with 4716.6 flight hours on the aircraft and 634.1 hours on the engine. It was an overhaul that included the tasks contained in the scheduled 50- and 100-hour inspections, implemented airworthiness directives, and also included tasks to inspect and test different parts of the aircraft: flaps, gascolator, replacement of flexible hoses in the engine and aircraft, lubrication of the propeller, etc.

At the time of the accident, the aircraft had 4756:45 hours.

1.6.2. Landing gear

The aircraft has a retractable landing gear. Its position is selected with a gear-up/down lever that operates hydraulic actuators supplied by an electrically-powered pump.

The different gear positions are indicated by three green lights located below the actuating lever for the “gear down and locked” position.

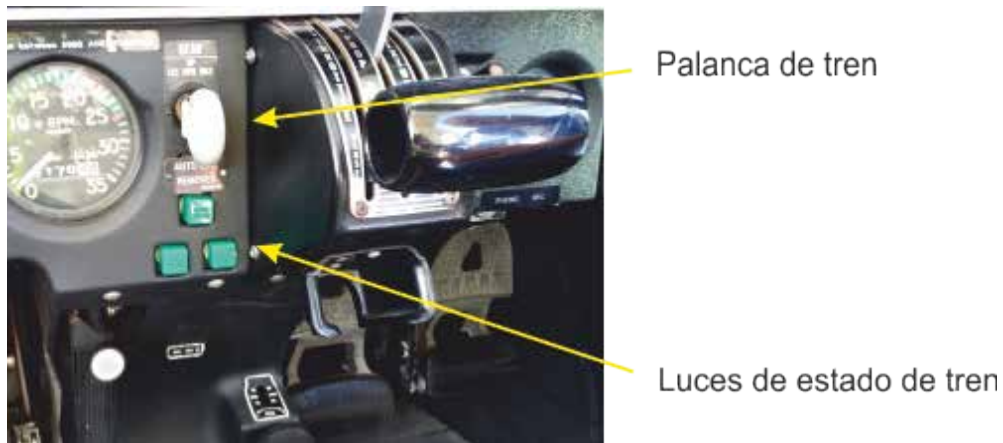


Fig. 1.- Landing gear lever and 3 green lights

There is a yellow light located at the top of the instrument panel to indicate the gear is in transit, whether up or down. There is no light to indicate that the gear is fully retracted, other than all the other lights being off.



Fig. 2.- Amber gear-transit light and red gear warning light

Each gear leg has a switch that, when the leg is down and locked, turns on the light associated with that gear leg. When all three switches are activated, the electrical pump is turned off. If the panel lights are on, the gear lights may be dimmed. When the gear is retracting and the aforementioned switches are off, the yellow gear-transit light turns on and stays on until the gear is up and the switches are activated.

To the left of the yellow light is a red warning light, which has an acoustic alarm. Its dual purpose is to warn when the power is lowered below approximately 14 inches of intake pressure and the landing gear is not down and locked. It also warns that the gear lever is in the up position when the airplane is on the ground, or, if in the air, when the speed is below that required to close the hydraulic valve and the switch for the backup gear extender (BGE) pump. See 1.6.2.1.

Each leg is raised and lowered by a single hydraulic cylinder. As the leg is retracted, the doors close through a mechanical connection. The legs are kept retracted by hydraulic

pressure in the cylinder. There are no hooks to hold the legs in place and if the hydraulic pressure were to be lost, the legs would extend.

During normal operations, the gear is raised and lowered using the gear actuating lever; however, if hydraulic pressure or electric power is lost, it can be lowered using the emergency extension lever located between the two pilot seats, or actuating the BGE (the gear could drop by itself if the speed were to fall below approximately 105 MPH (90 KT), and if no power is applied, at that point the hydraulic valve in the BGE opens to release the hydraulic pressure).

There is a lever between the pilot seats to lower the gear in an emergency that also determines how the automatic gear extension lever behaves. This gear has three positions:

- The center or normal position of the lever arms the automatic gear extension system.



- The down position is used to lower the gear in an emergency. This position opens valves in the hydraulic systems to prevent the fluid from impeding or blocking the downward motion of the gear legs.



- The up position (override) of the emergency gear lever disarms the automatic extension system.



In this position, if electrical power is available, the position of the gear legs will be as selected in the gear lever. The emergency gear lever is kept in the up position by way of a locking pushbutton. To release the lock and return the lever to the armed position or to lower the gear using the emergency procedure, the emergency gear lever has to be pulled up, after which it can be moved into the other positions.

1.6.2.1. Structure of the automatic Backup Gear Extender (BGE)

There is a backup system that, if armed, automatically lowers all three gear legs – regardless of the position of the normal gear selection lever – when the airspeed is slow and the throttle power is low. The system can be disarmed to carry out certain maneuvers, such as slow flying, stall testing, etc., without unexpected gear extensions.

The emergency gear extension system was designed as a backup device to help avoid landing with the gear inadvertently raised, and retracting the gear early during takeoff. If properly operated and maintained, the system automatically lowers the gear when the speed and power reach a set value, and it also helps avoid retracting the gear before a given speed and power are achieved.

As described in the Pilot's Operating Handbook, this system is controlled by differential air pressure across a diaphragm that is mechanically joined to an electric valve and a switch that turns the electric-hydraulic pump on. The system that provides static and ram air pressure to this diaphragm is located on the left part of the fuselage, above the wing. Any blockage of the orifices could cause the gear to lower.

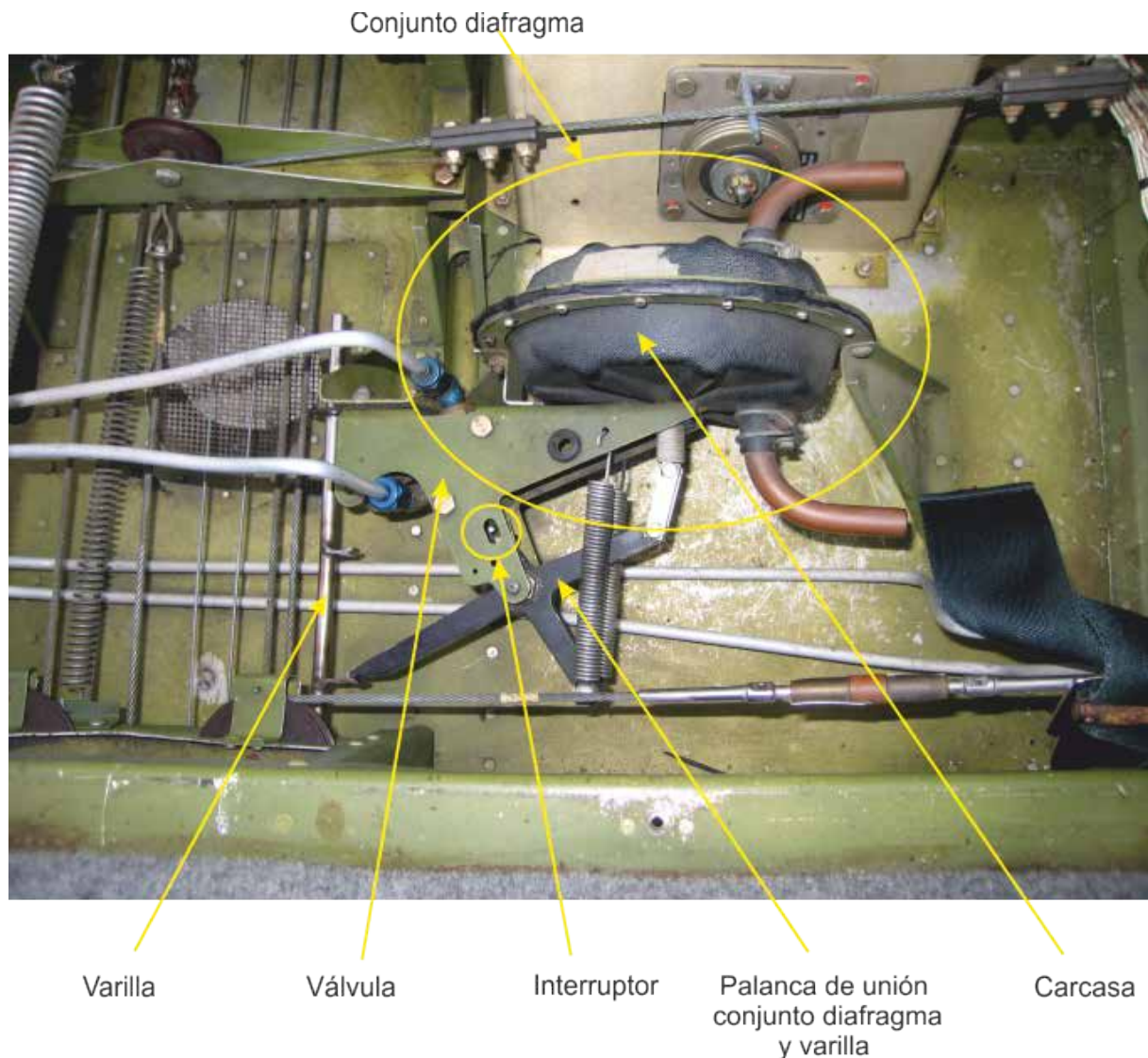


Fig. 3.- Automatic gear extension system

When the emergency landing gear lever is in the top position, the system is overridden and the gear position is controlled only using the normal gear lever, regardless of the power/speed combination. There is a pin that locks the travel of the lever to keep it in the override position, meaning that in order to override the system, the lever has to be pulled upward and the pin inserted. The pin is spring loaded to help unlock the system, meaning that when the lever is pulled and the spring released, it returns to its position. The system has to be locked when practicing stalls with the gear up.

When this system is used to emergency lower the gear, the lever releases hydraulic pressure to allow the gear to drop due to its own weight. According to the Pilot's Operating Handbook, the lever has to be held down to manually lower the gear in an emergency.

The main cause for this system's failure to operate properly is the poor condition of the diaphragm. As a result, there is a Service Letter (No. 810) in which the manufacturer provides guidelines for replacing it when necessary.

For various reasons arising from the in-service experience for this airplane type, the manufacturer issued Service Bulletin No. 866A to either remove the BGE or, alternatively as described in Part II of the SB, to specify operating requirements for those operators that elected to keep this system in service.

The inspection revealed that, in the accident airplane, Part I of SB 886A had been implemented, although this action was not documented. Compliance with that part of the SB involved removing the BGE in accordance with Piper Part Number 765-303 Back up Landing Gear Extender Removal Kit.

1.6.2.2. Emergency gear extension procedure

According to the procedure contained in the aircraft Flight Manual, the following steps are required to emergency lower the gear:

1. Master Switch – Verify On
2. Breakers – Check
3. Panel lights – Off (daytime)
4. Gear indicating lights – Check

If the gear is not down and locked:

5. Reduce speed below 100 mph.
6. Move the gear lever to the "down" position".
7. If the gear does not lock in an aircraft equipped with the BGE (backup gear extender), raise the emergency lever to the "Override Engaged" position.
8. If the gear still fails to lock, move and hold the emergency gear lever in the "Emergency Down" position.
9. If the gear still fails to lock, yaw the aircraft sharply from side to side with the rudder.

NOTE

If electric power is lost, the landing gear must be lowered using the emergency procedures described above. The gear indicating lights will not work.

1.6.2.3 Landing gear maintenance

According to the aircraft manufacturer, the tasks done on the landing gear in the various inspections are as follows:

Circle Type of Inspection (See Notes 1, 2 and 3)					
	50	100	500	1000	Annual
DESCRIPTION	50	100	500	1000	
H. LANDING GEAR GROUP					
1. Inspect oleo struts for proper extension (Check fluid level as required)	0	0	0	0	
2. Inspect nose gear steering control and travel		0	0	0	
3. Check wheels for alignment		0	0	0	
4. Put airplane on jacks		0	0	0	
5. Inspect tires for cuts, uneven or excessive wear and slippage.....		0	0	0	
6. Remove wheels, clean, check and repack bearings.....		0	0	0	
7. Inspect wheels for cracks, corrosion and broken bolts		0	0	0	
8. Check tire pressure	0	0	0	0	
9. Inspect brake lining and disc		0	0	0	
10. Inspect brake backing plates		0	0	0	
11. Inspect brake and hydraulic lines.....		0	0	0	
12. Inspect shimmy dampener		0	0	0	
13. Inspect gear forks for damage		0	0	0	
14. Inspect oleo struts for fluid leaks and scoring		0	0	0	
15. Inspect gear struts, attachments, torque links, retraction links and bolts for condition and security		0	0	0	
16. Inspect downlock for operation and adjustment (See Note 19)	0	0	0	0	
17. Inspect torque link bolts and bushings (Re-bush as required)			0	0	
18. Inspect drag and side brace link bolts (Replace as required).....				0	
19. Inspect gear doors and attachments		0	0	0	
20. Inspect warning horn and light for operation		0	0	0	
21. Retract gear - check operation		0	0	0	
22. Retract gear - check doors for clearance and operation		0	0	0	
23. Inspect anti-retraction system		0	0	0	
24. Inspect actuating cylinders for leaks and security		0	0	0	
25. Inspect all hydraulic lines, electrical leads, and attaching parts for security, routing, chafing, deterioration, wear and correct installation (See Piper Service Letters 808 and 810)		0	0	0	
26. Inspect position indicator switch and electrical leads for security		0	0	0	
27. Lubricate per lubrication chart	0	0	0	0	
28. Insure landing gear is down and locked; then remove airplane from jacks		0	0	0	

No references were found in the manufacturer’s maintenance program involving a check of the proper operation of the emergency gear extension system.

1.7. Meteorological information

According to information provided by Spain's National Weather Agency (AEMET), and as reflected in the METAR reports on file at the Cuatro Vientos Airport, there were few clouds and no storm activity. There was a weak wind from variable direction, predominantly from the southwest, with good visibility. The temperature was 29° C and the pressure 1012 hPa.

The METARs for the Madrid-Cuatro Vientos Airport around the time of the accident were as follows:

METAR LEVS 041700Z 22006KT 170V250 9999 FEW 040 29/10 Q1012=

METAR LEVS 041730Z 23006KT 190V280 CAVOK 29/09 Q1012=

METAR LEVS 041800Z 24007KT 9999 FEW050 28/10 Q1012=

1.8. Aids to navigation

Not applicable.

1.9. Communications

The aircraft was in radio contact with the Cuatro Vientos tower on 118.7 MHz.

1.10. Aerodrome information

The Cuatro Vientos Airport is a civil and military facility located 8 km south of downtown Madrid at an elevation of 2269 ft. It has one asphalt runway open to civil traffic in a 09/27 orientation that is 1500 m long and 30 m wide.

1.11. Flight recorders

Not applicable

1.12. Wreckage and impact information

The aircraft made an emergency landing on runway 27 at the Cuatro Vientos Airport with the main landing gear legs partly extended and with the nose leg fully retracted.

The aircraft touched down at the start of the runway, approximately 87 m past the threshold markings and slightly left of the centerline. After this point, for a length of about 10 m, there were tire marks on the runway, along with contact marks left by the tips of the propeller blades. Next, over an 80-m length, there was a mark, initially in a straight line that later veered to the right, compatible with the skidding of the underside of the fuselage that led to where the aircraft came to a stop on the right side of the runway with the nose pointing north.

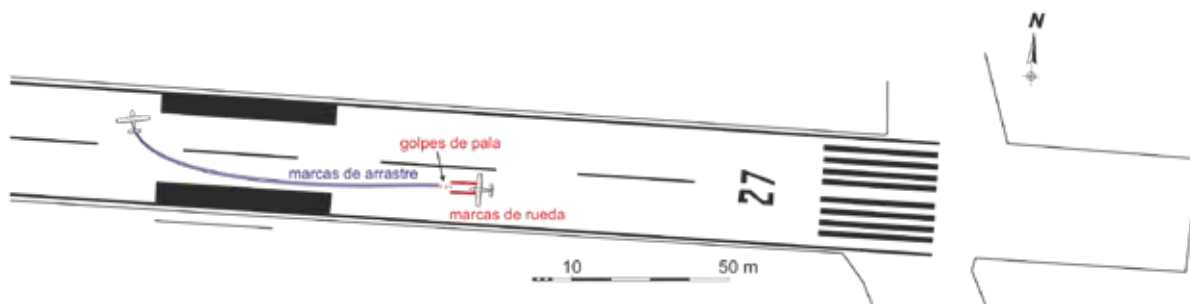


Fig. 4.- Diagram of the marks and location of aircraft

As a result of the landing, the aircraft sustained significant damage to the propeller as well as fractures and scraping in the landing gear and underside of the fuselage.



Fig. 5.- Condition of the aircraft

1.13. Medical and pathological information

Not applicable.

1.14. Fire

There was no fire.

1.15. Survival aspects

The airport's various emergency services reported immediately to the accident site.

1.16. Tests and research

1.16.1. Interviews and reports

1.16.1.1. Pilot's statement

The pilot provided a statement to investigators.

In it, he explained that in order to pick up an aircraft at the San Sebastian Airport and transfer it to the Cuatro Vientos Airport, he had flown on aircraft EC-HSZ that morning from Cuatro Vientos with two other pilots, one of whom would be tasked with piloting the aircraft they picked up.

After the two aircraft took off from San Sebastian, they headed to the Burgos Airport. He flew EC-HSZ with another pilot accompanying him, and the other aircraft was flown by the third pilot.

The flights to both San Sebastian and Burgos were normal and he did not notice anything unusual with the aircraft.

In Burgos, they decided he would fly alone in EC-HSZ and that the other two pilots would fly in the aircraft they had just picked up.

After taking off and retracting the gear, he noticed that the landing gear transit light was on.

He reduced power (25 inches of intake pressure and 2500 rpm) and lowered the speed below 100 kt. He again lowered the landing gear lever and reduced the cruise speed (24 inches of intake pressure and 2300 rpm). At that point, he called on the frequency that they use when several aircraft travel together to communicate with one another and told his colleagues in the other aircraft to wait for him, that he had a gear in transit indicating light and that he was going to fly alongside them so they could tell him the position of the gear.

His colleagues told him on the radio that the nose leg was up and that the main gear was intermediate.

He started yawing the airplane sharply and pitching it up and down in an effort to lock the gear down. Upon seeing that the gear's position was unchanged, he decided to use the emergency gear extension system.

He started by placing the lever in the EXT EMERG position, but since he did not receive the gear down indication (three green), he tried different combinations with the normal and emergency gear levers. He did the procedure from memory, even though the aircraft flight manual was in the aircraft (the abbreviated lists of procedures do not contain the emergency lists).

He continued trying to lower the gear for the entire flight (approximately 2 hours). At no time did he remember pulling the breaker for the electric motor for the gear. He was confident he would be able to lower it but by the time he crossed the Guadarrama mountains, he started thinking he would have to land without it.

He ruled out reporting the emergency to Madrid Control and to inform Cuatro Vientos directly when he arrived. He also decided to let his colleagues land first, since he knew the runway would be out of service after his own landing without gear.

He asked Cuatro Vientos to land from a long final to runway 09, although using that runway would mean having a tailwind.

The Cuatro Vientos tower notified all stations monitoring the frequency that because of the emergency, all traffic would have to divert to the alternate aerodrome (Casarrubios). He put the aircraft in direct contact with the fire chief, who wanted to know how much fuel there was on board.

At the tower's request, he made a low pass so they could confirm the condition of the gear. The tower confirmed that the gear was halfway down. After the low pass, the controller asked the pilot to join the downwind leg and cleared him to land on runway 27 so that he could land into the wind.

He touched down at idle thrust with one notch of flaps. As he prepared for the flare maneuver, he applied some power to help the airplane glide a little longer. On short final he thought about cutting the mixture, but did not in case he had to go around.

Upon touching down, he closed off the fuel and when the aircraft stopped, he turned off the master. He immediately exited the aircraft and the firefighters arrived.

Finally, he added that he had been the owner of the airplane for approximately 6 years, during which time the airplane had been flown very little. As for the maintenance, the last inspection had been done by Sinma Aviación, and before that it had been maintained by the company Southwest.

1.16.2. Analysis of the aircraft systems

The aircraft was moved to the apron, where a functional test of the landing gear extension system was carried out, as was a visual inspection of the gear's hydraulic system, including the lines, actuators, pump and electric motor.

No losses of hydraulic fluid were observed and, with the aircraft on jacks, the landing gear was verified not to initiate the retraction sequence.

Later, when technicians attempted to lower the landing gear using the emergency procedure, they discovered that the lever could not be moved to the necessary position since it was being held in place by the rod that connects it mechanically to the automatic gear extension system.

The decision was made to inspect the electric motor, hydraulic pump and the pressure sensor for the automatic gear extension mechanism.

The electric motor was noticed to be missing one of the two screws that attaches the brush holder cover to the body of the motor. Once the brush holder cover was removed, both holders were verified to be excessively worn and outside their housings. One brush was detached from its connecting cable and was resting on the top part of the motor winding. The rotor on the electric motor turned freely, and there were traces of worn brushes and hydraulic fluid. It was determined that the electric motor had not been maintained properly.



Fig. 6.- Condition of the electric pump

As for the pressure sensor mechanism, once opened it was found to be blocked because the diaphragm assembly, consisting of a membrane and circular metal supports, was stuck to one of the sides of the casing that housed it, which prevented it from moving.



Fig. 7.- External appearance of the pressure sensing mechanism



Fig. 8.- Diaphragm assembly stuck to the casing



Fig. 9.- Pressure sensing assembly



Fig. 10.- Diaphragm assembly detached from the casing



Fig. 11.- Half of casing to which diaphragm assembly had adhered



Fig. 12.- Internal view of diaphragm assembly

1.16.3. Video footage

A video recording was provided to investigators by Spain's national police.

The video shows the entire descent of the aircraft, the landing on the runway and the aircraft's travel on the runway.

The descent was shallow with a smooth slope and with the aircraft kept in a flight attitude until it was just a few centimeters off the ground.

The landing was smooth and the aircraft was stabilized at all times. At no point did the wings touch the runway, not even after the aircraft came to a stop.

The video also showed how quickly airport rescue and firefighting personnel responded to the scene.

1.17. Organizational and management information

Not applicable.

1.18. Additional information

Not applicable.

1.19. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

2.1. General

According to the documents consulted, the aircraft's pilot had the license and medical certificate necessary for the flight. The aircraft also had the required documentation.

2.2. Of the meteorological conditions

Based on the weather information available, the flight was not limited by the weather.

2.3. Of the operation

According to the load table, the aircraft's weight was within the limit for its maximum takeoff weight.

The pilot stated that after taking off from Burgos, he selected the gear up but he noticed that the yellow in-transit light remained on. He attempted to change the status of the gear several times by selecting the gear lever up and down after reducing speed and power, but it did not have any effect. He also verified that the fuses were all in the correct position.

After the crew of the other aircraft visually verified the condition of the gear, the pilot pitched and yawed the aircraft in an effort to lower and lock the gear. Since this too had no effect, he decided to carry out the manual procedure to lower the gear, but he stated that the lever could only be moved through part of its total travel and could not be lowered to the bottom position, associated with the manual emergency extension of the gear. The pilot then tried various up and down combinations of the emergency and normal gear lever positions, again to no avail.

He then decided to proceed to the destination airport and report the emergency once on the airport frequency.

Therefore, based on the pilot's statement and on the contents of the aircraft flight manual, the pilot was aware of the manual procedure for lowering the landing gear and performed it correctly, though it did not yield the expected result.

Judging by the video footage, the landing was executed correctly and in a way that minimized the effects of touching down with no landing gear.

2.4. Of the condition of the landing gear system

The aircraft initially had an automatic emergency gear extension system.

Even though no supporting documentation was found, investigators noticed that Service Bulletin SB 866A, which removed this system, had been implemented on the aircraft.

The inspection of the electric pump revealed that it had been improperly maintained; specifically, the brushes showed excessive wear and had been dislodged. According to the pilot, he did not pull the fuse during the flight, so it is possible that the motor was running the entire time, which contributed to the poor condition of the brushes.

Even so, the overall condition of the pump is indicative of a lack of proper maintenance and is sufficient reason for the inability to change the position of the landing gear.

As concerns the landing gear mechanism, investigators verified that the emergency gear lever could not be moved through its range of travel, and specifically that it did not reach the lowest position, associated with the manual emergency lowering of the gear.

This position could not be reached since past a certain point, the rod that relays the motion of the lever to the hydraulic valve – which releases the pressure and allows the gear legs to lower – was blocked along its travel by the pin that connects it to the diaphragm on the backup gear extender (BGE) system. Even though this system had been removed, this did not necessarily entail the removal of the diaphragm.

Opening the casing that contained the diaphragm revealed that the membrane had deteriorated and stuck to one side of the casing (see Fig. 8), precisely in the position where it would be when the lever is in the topmost, or override, position, which disarms the automatic gear extension system. As a result, the rod was only able to move as far as the distance between its two tabs – which push the diaphragm – a distance that, as the diagram/photo show, is insufficient to change the condition of the landing gear mechanism (see Fig. 3).

The casing and diaphragm system is arranged vertically. It is located underneath the rear left seat and is not directly exposed to sunlight or to hot engine components. It therefore seems unlikely that the material could have degraded – practically melted – to the point where it could accidentally adhere to the casing. Even if it could, this condition would only have affected the lower half of the diaphragm; instead, the diaphragm was affected around its entire perimeter (see Figs. 10 and 11). It is more likely, therefore, the result of a conscious action to seal the piston to the casing in the position associated with the removal of the automatic system without realizing that this would disable the manual emergency gear extension system.

The document for Piper Part Number 765-303, the removal kit for the BGE, instructs to verify that the landing gear works correctly once the system is removed. It is possible that the gear worked correctly once the Service Bulletin was implemented, since the membrane may not have been sufficiently stuck due to the short amount of time that had elapsed, but that later, with the lever in the override position, it achieved a strong seal.

3. CONCLUSIONS

3.1. Findings

The aircraft's pilot had the flight license and medical certificate required for the flight.

The aircraft had the documentation required for the flight.

The aircraft's weight was within the maximum takeoff limits.

The flight was not limited by the weather conditions.

The pilot knew the procedure for lowering the landing gear manually and he performed it correctly.

The images available indicate that the landing was executed correctly and in a way that minimized the effects of landing without the gear extended.

The aircraft initially had an automatic system for lowering the gear in an emergency, but this system was later removed when Service Bulletin SB 886A was implemented.

The electric pump stopped working because of its defective maintenance condition.

The emergency gear lever could not be moved into the position to manually lower the gear.

The rod that relays the motion of the lever to the valve that allows the landing gear to fall was blocked.

The diaphragm was worn and stuck to one of the halves of the housing, which prevented the rod from moving.

3.2. Causes/Contributing factors

The accident was caused by the inoperative condition of the manual emergency system for lowering the landing gear due to improper and undocumented tasks performed on it.

4. SAFETY RECOMMENDATIONS

None.

5. APPENDICES