ULM A–005/2019

REPORT

Accident involving an ULM EVEKTOR EV-97 EUROSTAR SL aircraft, registration EC-LSP, on 24 February 2019 at La Nava–Corral de Ayllón Aerodrome, in the municipality of Corral de Ayllón (Segovia – Spain).

Please note that this report is not presented in its final layout and therefore it could include minor errors or need type corrections, but not related to its content. The final layout with its NIPO included (Identification Number for Official Publications) will substitute the present report when available.

GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
SUBSECRETARÍA
COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

FOREWORD

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, its probable causes and its consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with Articles 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 Regulation 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 from their recurrence. 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 evidence in a judicial process.

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

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

CONTENTS

Abbreviations

00:00 .... Hours and minutes (period of time)
00.00:00..................... Hours, minutes and seconds (chronological time)
AEMET .... Spanish State Meteorological Agency
AESA.......................... Spanish National Aviation Safety Agency
C.G. .... Centre of gravity
MAC .... Mean aerodynamic chord
dd/mm/yyyy .... Day, month and year (date)
DGAC .... Spanish National Aviation Authority
ft .... Feet
GPS........................... Global positioning system
hPa .... Hectopascals
kg............................... Kilograms
km/h........................... Kilometers per hour
LAPL.......................... Light aircraft pilot license
LAPL(S)..................... Light aircraft pilot license (glider)
LECA .... ICAO indicator for La Nava–Corral de Ayllón Aerodrome
LEIR .... ICAO indicator for Air Marugán Aerodrome
LECA .... ICAO indicator for Robledillo de Mohernando Aerodrome
m. .... Meters
MAF........................... Multi-axis fixed-wing
rpm .... Revolutions per minute
SERA......................... Standardised European Rules of the Air
TULM......................... Ultralight aircraft pilot license
ULM........................... Ultralight aircraft
UTC .... Coordinated universal time
VFR .... Visual flight rules

SYNOPSIS

Owner and Operator:	Private
Aircraft:	ULM EVEKTOR EV-97 EUROSTAR SL, registration EC-LSP
Date and time of accident:	24 February 2019, at 10:45 hours [(1)]
Site of accident:	La Nava–Corral de Ayllón Aerodrome, municipality of Corral de Ayllón (Segovia – Spain).
Persons on board:	1 crew and 1 passenger, fatal.
Type of flight:	General aviation – Private
Flight rules:	Visual flight rules
Phase of flight:	Take-off – Initial climb
Date of approval:	24th November 2021

Summary of the accident.

The EVEKTOR EV-97 EUROSTAR SL aircraft, registration EC-LSP, took off at around 07:30 hours from Air Marugán Aerodrome (LEIR – Segovia), with the pilot and a passenger on board.

Shortly afterwards, at 08:30 hours, it reported its passage through Robledillo de Mohernando Aerodrome (LERM – Guadalajara).

According to the information provided by a resident of Corral de Ayllón who witnessed the accident sequence, the aircraft made an approach to runway 36 at La Nava–Corral de Ayllón Aerodrome (LECA – Segovia) after 10:30 hours and, on the final stretch of the runway, began to climb, banked to the left and crashed into the ground.

The aircraft crashed on the right side of the runway and was destroyed. Its two occupants died.

The investigation has identified the probable cause of the accident as an in-flight loss of control at low altitude, resulting in its subsequent frontal impact with the ground.

As a consequence of the investigation of this accident, eight safety recommendations are issued in relation to the ballistic rescue parachute system installed on the aircraft.

(1) All times referenced in this report are local time. UTC can be calculated by subtracting one hour from the local time.

1.- FACTUAL INFORMATION.

1.1.- History of the flight.

The EVEKTOR EV-97 EUROSTAR SL aircraft, registration EC-LSP, took off at around 07:30 hours from Air Marugán Aerodrome (LEIR – Segovia), with the pilot and a passenger on board.

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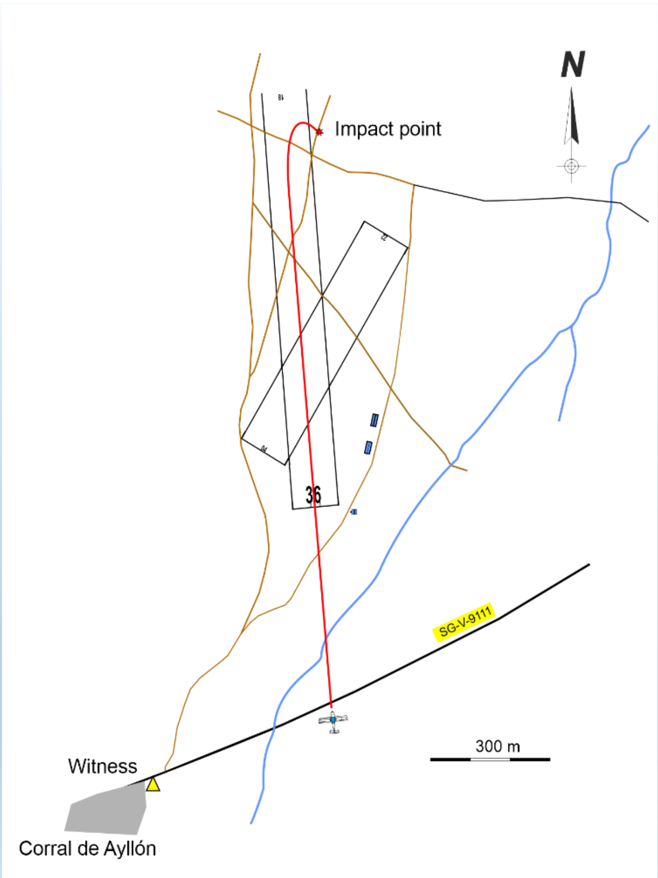

Figure 1.- Aircraft trajectory.

The witness lives in one of the last houses to the north of the town, which has views of the entire airfield from its windows. He stated that he was in his house when he saw the aircraft flying from south to north through his window. When it reached the Corral de Ayllón road (SG-V-9111), it made a left turn followed by a right turn to line up with the runway and began to descend. Next, he saw the aircraft flying at a low speed and very close to the ground but seemingly without touching down, over the entire runway. He noted that, in his experience, if the aircraft had touched down, it would have kicked up a lot of dust because the ground was very dry.

He lost sight of it at one point and had to go to a different window to continue watching. Two or three seconds later, when he had it in view again, he saw that its right wing was raised. Then he heard a sharp sound, and that was it.

Concerned about what might have happened, he decided to go and investigate. On the way to the airfield, he met a neighbour, whom he asked to accompany him. The pair then met another neighbour (and health professional) who was on his bike and also agreed to accompany them.

When they arrived at the accident site, the health professional approached the aircraft wreckage, found that two people were dead and asked them to notify the emergency services. They did so by calling 112 and waited at the scene for them to arrive.

Figure 1 shows the aircraft trajectory, based on the information provided by the witness and its final position.

1.2.- Injuries to persons

Injuries	*Crew*	*Passengers*	*Total in the aircraft*	*Others*
Fatalities	1	1	2	
Serious				
Minor				N/A
None				N/A
TOTAL	1	1	2	

1.3.- Damage to the aircraft

The aircraft was destroyed as a result of the accident.

1.4.- Other damage.

There was no other damage.

1.5.- Personnel information.

The 63-year-old pilot had an ultralight pilot license (TULM), dated 21/03/2007, and a fixed-wing multi-axis rating (MAF), valid until 31/10/2019; he also had a light aircraft pilot license for gliders (LAPL(S)), dated 07/11/2017, and a glider tow rating (SAIL AERO TOW). Both licenses were issued by Spain’s National Aviation Safety Agency (AESA).

In addition, he had a LAPL medical certificate, issued on 14/09/2017 and valid until 14/09/2019.

According to the available information, he had around 800 flight hours, of which approximately 85 were in type.

1.6.- **Aircraft information**.

The EVEKTOR EV-97 EUROSTAR SL ultralight aircraft is a two-seater, side-by-side, low-wing aircraft with a semi-monocoque metal structure and tricycle landing gear. It is equipped with a ROTAX 912 ULS engine capable of supplying a maximum power of 100 HP at 5,800 rpm and a three-blade propeller with adjustable pitch on land, made of composite materials.

It has a wingspan of 8.10 meters, a length of 5.98 meters and measures 2.47 meters tall at its highest point.

Developed and manufactured by EVEKTOR AEROTECHNIK, A.S., in the Czech Republic, it has an Airworthiness Type Certificate, No.280-1/2, initially issued by Spain's National Aviation Safety Agency (AESA) on 18/05/2005 and revised on 13/03/2014.

It was equipped with a Magnum 501 ballistic rescue parachute system manufactured by STRATOS 07, S.R.O., in the Czech Republic.

1.6.1.- Airframe.

Manufacturer:	EVEKTOR AEROTECHNIK, A.S.
Model:	EV-97 EUROSTAR SL
Manufacturing No.:	2012 3943
Year of manufacture:	2012
Registration:	EC- LSP
Operator:	Private

1.6.2.- Certificate of airworthiness.

Class:	Special restricted
Category:	Private
Technical performance:	Normal
	Aircraft for visual flight only
Date of issue:	20/06/2014
Validity:	Valid as long as the aircraft is maintained and used as per the specifications and pertinent usage limitations set forth in the Airworthiness Type Certificate No. 280-I/2 issued by Spain's National Aviation Safety Agency (AESA).

1.6.3.- Maintenance records.

Total flight hours:	1286:38
Last 1000-hour check:	26/11/2017
Hours last 1000-hour check:	1010:25
Last 200-hour check:	09/09/2018
Hours last 200-hour check:	1207:00
Last 50-hour check:	01/12/2018
Hours last 50-hour check:	1260:30

1.6:4.- Engine.

Make:	ROTAX
Model:	912 ULS
Manufacturing No.:	6779640

Flight hours and maintenance interventions as airframe.

1.6.5.- Weight and balance.

Maximum take-off weight:	450 kg
Basic empty weight:	306 kg
Estimated operating weight:	425 kg

Centre of gravity limitations (C.G.):

- Front: 20% MAC
- Rear: 34% MAC

Estimated position of the C.G. during the operation: 31% MAC

1.6.6.- Ballistic rescue parachute system.

The aircraft was equipped with a Magnum 501-type STRATOS 07 ballistic rescue parachute system, with serial number 423 SP.

The system consists of a folded parachute in a textile container with straps that are attached to the aircraft's structure and suspend it from the parachute if fired. It is deployed by a cable attached to a pyrotechnic device and a system activation handle. Figure 2 shows a photograph of the system and a description of its components obtained from its installation and user’s manual.

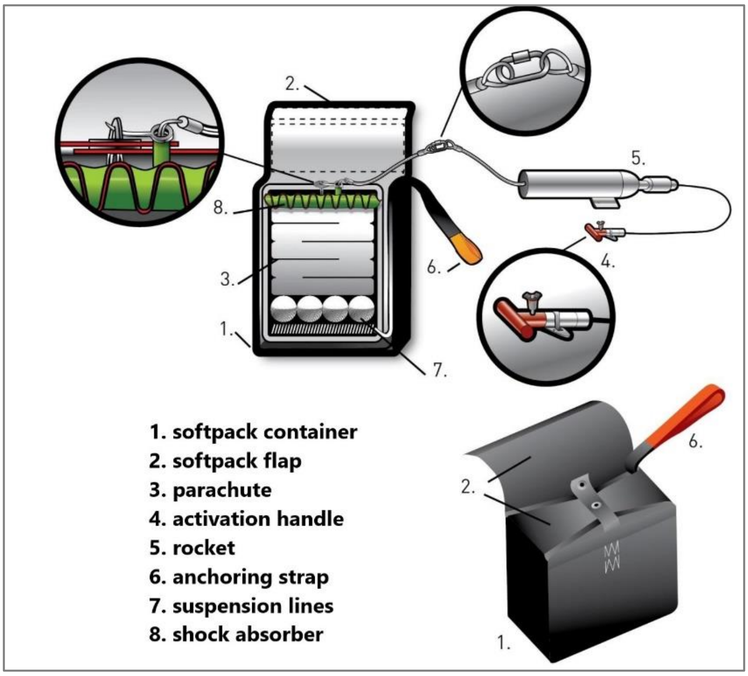

Figure 2.- Ballistic rescue parachute system and description of its components.

The system was installed at the front of the aircraft, between the instrument panel and the firewall bulkhead. The system's activation handle was located in the lower centre of the aircraft's front instrument panel, within reach of its two possible occupants when seated in either of its control positions. The parachute's external deployment zone was marked with a sign and a warning notice on the outside of the aircraft fuselage skin.

1.7.- Meteorological information.

There were no limiting meteorological conditions for visual flight.

According to the information provided by the State Meteorological Agency (AEMET), the agency does not have a station in La Nava or Corral de Ayllón. The closest ones are in Fresno de Cantiespino (about 6 km to the southwest), La Pinilla (about 23 km to the south) and Aldeanueva de Serrezuela (about 28 km to the west-northwest). The records and remote sensing images from these stations show that around the time of the accident, the temperature in the crash area was approximately 10ºC, the wind was light, there were hardly any clouds and no convective activity. Therefore, it is considered that there were no significant meteorological phenomena at the time of the accident.

Additionally, residents of Corral de Ayllón reported that it was a sunny day with no wind.

1.8.- Aids to navigation.

Not applicable.

1.9.- Communications.

The only known communications of the aicraft are those held with Robledillo de Mohernando Aerodrome (LERM) as it flew through it shortly after 08:30 hours.

1.10.- Aerodrome information.

La Nava–Corral de Ayllón Aerodrome (LECA) is located 2 km north of the town of Corral de Ayllón, in the province of Segovia. Its reference point (41º 24' 39” N – 003º 26' 54” W) has an elevation of 1,012 m / 3,320 ft. It has two compacted natural terrain runways with 04/22 and 18/36 orientations, measuring 953 x 220 m and 1,603 x 220 m, respectively.

1.11.- Flight recorders.

The aircraft was not equipped with flight recorders. They are not a requirement for the type.

It did have an AvMap GPS receiver installed, model EKP IV, serial number 50L6X7C102-BB-0000194. This piece of equipment can save information about the flight in its memory, provided certain conditions are met.

It was recovered from the aircraft and studied in the CIAIAC flight recorder laboratory. Due to the severity of its damage, the manufacturer was consulted about the possibility that it still kept information about the flight in its memory; the manufacturer proposed to carry out a check on its main circuit board and, in view of the results of the same, reported that there was no possibility of recovering any type of data from its memory.

1.12.- Wreckage and impact information.

The aircraft wreckage was found on a road located inside La Nava Aerodrome, approximately 220 metres to the southeast of runway header 18 of runway 18/36, with an orientation of 032º.

Figure 3.- Views of the aircraft in its final position.

Figure 4.- Nose impact zone, with the remains of the propeller and the wing marks.

Off the road, 7.40 metres in front and to the right of the wreckage [(2)] and propeller hub, was a hole made by the nose of the aircraft when it first hit the ground. One of the three propeller blades was still in the hole (see figure 4).

Linear marks measuring approximately 3.80 and 4.40 metres long were visible on either side of the hole. These marks were made by the two wings when they hit the ground. Looking from the main wreckage, the shortest mark, made by the left wing, was located to the left of the hole, and the longest mark, made by the right wing, was located to its right. The wing marks on the ground and their leading-edge on the main

[(2)] As a general rule, the relative positions, movements, turns and deformations of the aircraft structure are described from the point of view of an observer seated in the normal flight position in the cabin.

wreckage formed an angle of approximately 58º. There were no marks to suggest that any of the aircraft's components dragged along the ground.

The aircraft suffered a major frontal impact, as a result of which its entire nose, from immediately in front of the elevator and roll control levers to the propeller hub, including the front instrument panel, the engine and the nose landing gear, was rotated, at an angle close to 90º, around an axis perpendicular to the aircraft's plane of symmetry, and downwards, with respect to its horizontal plane. The instrument panel was found practically on top of the engine, the brake and yaw control pedals were underneath it, and the landing gear nose leg was under the remains of the cabin, correctly attached to the forward structure of the aircraft, with its wheel to the rear.

Figure 5.- Front of the aircraft. Propeller blades in the main wreckage.

In its final position, the propeller cone had suffered a significant impact on one side and was barely damaged on the other. Of the three propeller blades, one had separated from the propeller hub and remained in the hole made by the aircraft's nose during the initial impact. The other two were with the main wreckage, with one snapped close to its root and the other still in position. None of the propeller blades showed signs of damage caused by rotating against the ground.

The rear of the cabin, from immediately in front of the elevator and roll control levers to the back, had maintained its shape and escaped breakage. The levers were in the normal position in the cabin.

The two main landing gear legs were attached to the aircraft structure in their normal position, with damage limited to the front part of the right-hand wheel fairing.

The tail empennage was undamaged, but the rear of the aircraft's fuselage had cracks and deformations that suggest it was displaced forward and to the left.

The left wing's leading edge was completely crushed and broken in several places, the most significant damage being near its tip. The right wing's leading edge was also crushed, with deformations typical of a frontal impact with the furrows on the cultivated land and had practically no cracks.

Figure 6.- Photographs of the leading edges of the two wings.

The wingtip fairings were virtually undamaged, and the navigation lights were in their respective positions and in good condition.

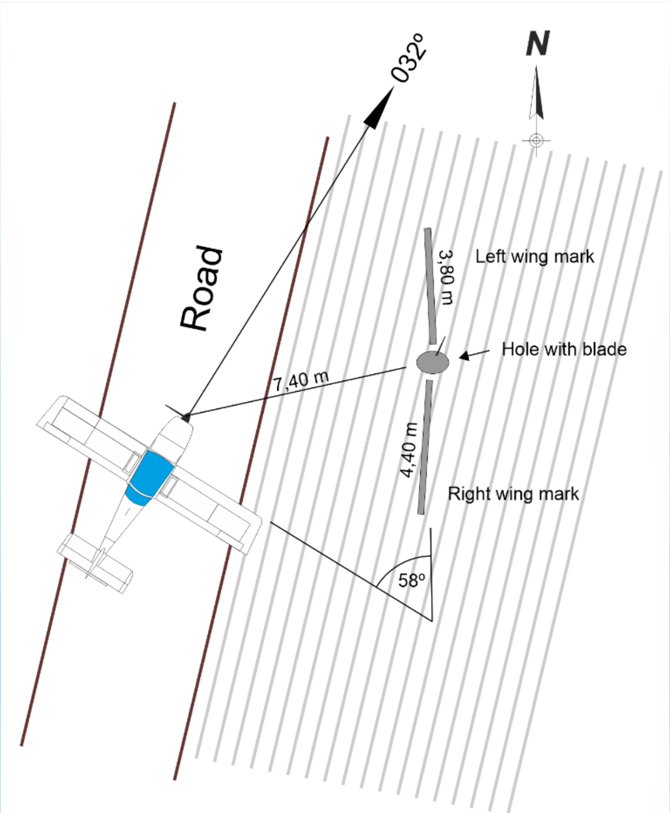

Figure 7 .- Sketch of the marks on the ground and the final position of the aircraft.

In summary, the wreckage showed breakages and deformations characteristic of having suffered a frontal impact with the ground, following an almost vertical trajectory, with slight yaw and roll attitudes to the left, and a small component of rotation to the left around the aircraft's longitudinal axis.

After the initial impact, the aircraft ricocheted backwards, and the wreckage settled in a horizontal position, 7.40 metres away from the first impact site, with a heading of 032º. As it ricocheted, the aircraft turned approximately 58º to the left of its horizontal plane.

The figure 7 shows the marks left by the aircraft on the ground and the final position of the wreckage.

1.13.- Medical and pathological information.

The aircraft's occupants died as a result of the injuries they sustained in the accident.

1.14.- Fire.

There was no fire.

1.15.- Survival aspects.

Given the characteristics of the impact of the aircraft with the ground, there was no possibility of survival for its occupants.

1.16.- Tests and research.

1.16.1.- Inspection of the aircraft wreckage.

Investigators from the Civil Aviation Accident and Incident Investigation Commission inspected the aircraft wreckage at the crash site.

Firstly, they were able to verify that the main structural components of the aircraft were in their relative positions with practically all the connections between them having been preserved.

The cockpit had practically disappeared; the seats were open to the elements, and the cockpit hood was separated from the main wreckage. The instruments were so severely damaged no useful information could be obtained from them. All the breakers were found outside of their housings. The throttle controls were locked in different positions and could not be moved. The communications devices and the transponder were still in their housings, but the GPS receiver was broken and had detached from its support.

In terms of the flight controls, there was continuity in the bank command, to the extent that when one aileron was moved, so did the other aileron and the control levers, and in the pitch command, to the extent that, when the elevator moved, it did so freely and resulted in the movement of the corresponding control levers. The rudder moved freely but did not have any effect on the yaw control pedals.

The flaps were deployed and locked in the take-off position, coinciding with the position selected with the control lever in the cabin.

The engine was found resting on the ground, with the firewall bulkhead enveloping it from behind, preventing a detailed inspection of its condition; as explained in 1.16.2, the inspection was carried out with help from a qualified mechanic at the accident site and later completed in a specialised workshop.

The pyrotechnic device on the ballistic rescue parachute system had separated from its anchorage to the aircraft structure but had not been activated; the activation handle support was severed and hanging from the activation cable, making it impossible to secure the system. As detailed in 1.16.3, the Civil Guard Explosive Deactivation Service was called on to inspect and diffuse the device.

1.16.2.- Inspection of the aircraft's engine.

The aircraft's engine was inspected with the support of the company AVIASPORT, S.A., official distributor and head of the Technical Service in Spain for ROTAX aviation engines. The inspection began at the accident site, where it was supported by a qualified mechanic, and was completed at its facilities, where the engine was moved.

1.16.2.1.- Inspection at the accident site.

As a starting point, and as indicated in 1.12, it was confirmed that one of the three propeller blades had separated from the hub when the aircraft first impacted the ground, and the other two remained with the main wreckage. Of these two, one had snapped near its root, and the other was still in position. None of the blades displayed any damage that could be attributed to the propeller having rotated against the ground. This suggested that the impact of the aircraft with the ground could have occurred with the engine stopped.

In order to access all the engine components, it was necessary to separate the firewall bulkhead, which was embracing it and preventing its detailed inspection.

A general inspection of the wreckage confirmed that the engine was correctly installed. Regarding the discrepancy in the positions of the throttle controls in the cabin (the left throttle at idle and the right at full throttle), it was found that the left control had broken and detached from the rod that connects both throttle levers. The right throttle, however, was still connected to it.

The carburettors were in good condition. There was fuel in their float bowls and no water or particle contamination.

The upper spark plugs showed no evidence of combustion problems in the cylinders. Due to the position of the engine, the lower spark plugs could not be accessed.

The magnetic particle detector (*chip detector*) had no chips.

The lubrication system's oil tank was opened and disassembled; it contained about a third of the amount of oil it should have had with the engine in service, but no evidence was found, in the oil or the reservoir itself, to suggest the engine had been running at elevated temperatures. The oil cooler was crushed between the exhaust and the engine crankcase; since it was lower than the tank, the oil could have leaked out through there, but there were no oil stains on the ground. The oil filter was in good condition but had come off, so oil could also have leaked through there. The filter was opened and examined, with no particles found inside.

Apart from the damage caused by the aircraft hitting the ground, the on-site inspection did not find any additional evidence to suggest the engine was affected by a pre-existing fault or that it wasn't supplying power at the moment of impact.

For this reason, it was decided the inspection should be continued in the workshop.

1.16.2.2.- Inspection in the workshop.

An external inspection of the engine found that it appeared to be clean and well maintained, with the only damage being that sustained during the accident.

The propeller was disassembled and the speed reduction gearbox was opened; the latter's interior was well lubricated, and there were no particles or foreign elements inside.

The gearbox had suffered a significant frontal impact, the propeller hub had been displaced (backwards) into the engine’s crankcase, the four bolts that secure the hub bearing to the front gearbox case were broken, and the rear part of the case was cracked.

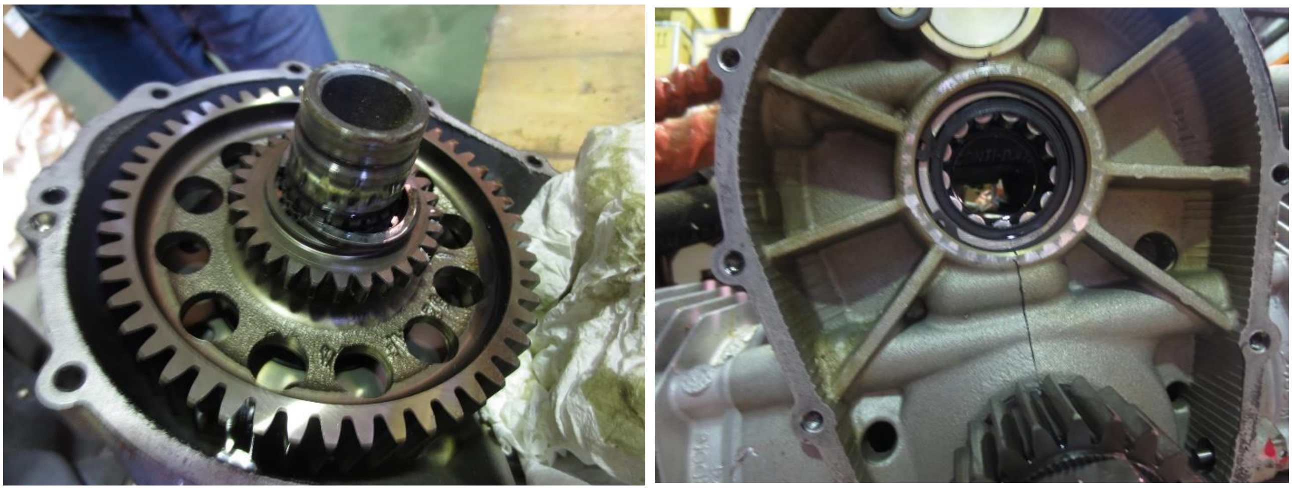

Figure 8(a).- Displaced propeller hub and cracked rear case.

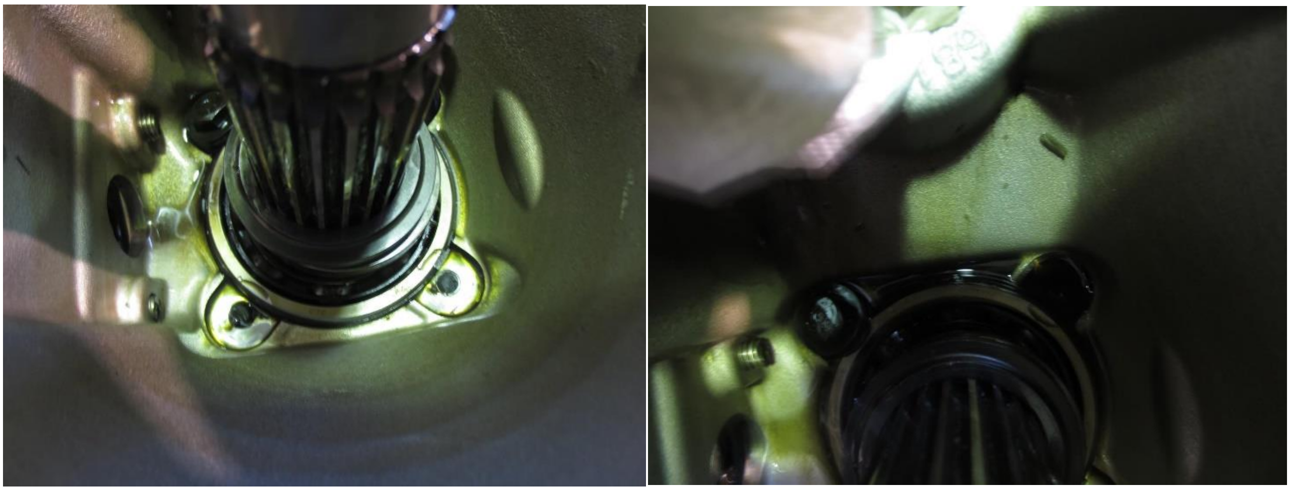

Figure 8(b).- Propeller hub. Broken bearing to case bolts.

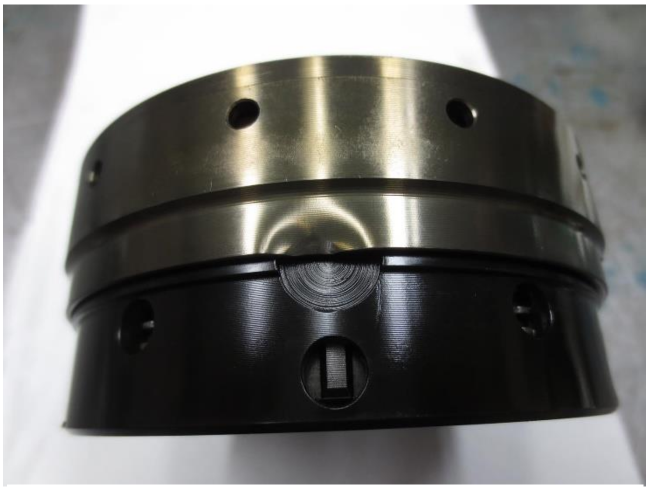

Figure 8(c).- Displaced overload clutch housing.

The overload clutch housing was displaced (rotated) away from its original position, as seen in figure 8(c). This would suggest the propeller stopped rotating almost instantly, with the engine turning and supplying power at the moment of impact.

Thus, the inspection results suggest that at the moment of impact, the engine was working and supplying power, that the impact was frontal and involved enormous force, and that the propeller stopped rotating almost instantaneously.

1.16.3.- <u>Ballistic rescue parachute system.</u>

The investigators detected the possible presence of elements of a ballistic rescue parachute system and consulted one of the co-owners of the aircraft, who confirmed that one had been installed

Consequently, the initial inspection was purely visual, and the Civil Guard's Explosives Deactivation Service was called to inspect and deactivate the system's pyrotechnic device (*rocket*) before continuing with the investigation.

Figure 9 - Ballistic rescue parachute system components in the aircraft wreckage.

In regard to the components of the ballistic rescue parachute system, it was installed in the forward part of the aircraft and, as indicated in 1.16.1 and seen in figure 9, the parachute container was found on top of the engine wreckage, the pyrotechnic device had separated from its anchorage to the aircraft structure but had not been activated, and the system activation handle support was severed and hanging from the activation cable, making it impossible to secure the system with the locking pin.

As indicated in 1.6.6, the parachute's deployment zone was marked with a sign and a warning notice on the exterior of the aircraft's fuselage, indicating the presence of the system. These marks were not visible in the wreckage due to the breakage and deformations affecting that part of the aircraft.

The team of specialists from the Civil Guard Explosives Deactivation Service proceeded to inspect the remains of the aircraft with members of the Judicial Police Unit based at the Civil Guard Headquarters in Segovia and the CIAIAC investigator in charge of investigating the accident.

They confirmed the aircraft had suffered a frontal impact of considerable force and that it was leaking fuel (automotive petrol). The ballistic parachute was located at the front of the aircraft, between the engine and the cabin.

As a result of the impact, the system's pyrotechnic device (*rocket*) had separated from its anchorage but remained attached to the aircraft by the parachute suspension cables and the firing cable.

As the force of the aircraft's impact on the ground caused the parachute to detach from its support, the internal condition of the pyrotechnic device was unknown. Therefore, in the interest of safety, the decision was taken to destroy it.

Given the risk that the methods necessary to destroy it could set fire to the aircraft's fuel, making further investigations difficult, the specialists decided to remove the pyrotechnic device by safely cutting the steel cables connecting it to the aircraft. It was then transferred to a nearby location that met the necessary safety conditions and destroyed.

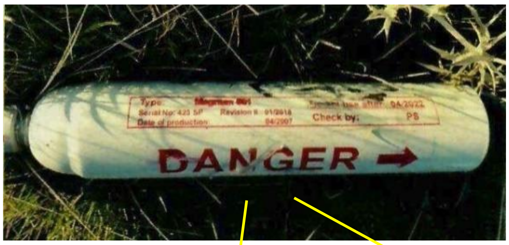

Figure 10.- Ballistic parachute rescue system pyrotechnic device, before and after disposal

1.17.- <u>Organisational and management information.</u>

Not applicable.

1.18.- <u>Additional information.</u>

1.18.1.- <u>Safety recommendations issued by the CIAIAC.</u>

Technical Report ULM A-16/2016 [(3)], on the *accident involving a RANS S6 Coyote II aircraft, registration EC-YDQ, in the vicinity of the "Los Garranchos" Airfield (San Javier-Murcia), on 15 July 2016*, approved by the CIAIAC Plenary on 27 September 2017, addressed the risks associated with ballistic rescue parachute systems in aircraft wreckages in depth. As a result of the investigation into that accident, the CIAIAC issued nine safety recommendations.

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(3) They can be consulted at: https://www.mitma.gob.es/recursos_mfom/2016_016_a_ulm.pdf

The information provided under heading 4 of the report, which justifies and lists the nine issued recommendations, is reproduced below.

4.- SAFETY RECOMMENDATIONS.

As concerns the use of the ballistic parachute, there is no reference documentation available to determine which aircraft (EASA and non-EASA) have this kind of device installed. Emergency and firefighting personnel and general aviation users have to be able to know if an accident aircraft that they will be working on poses a safety hazard and if so, what actions and precautions to take. Adding information on the installation of a ballistic parachute to the aircraft registration registry database could make it easier to inform the relevant personnel in the event of an accident. However, this would require users to report the installation and for the aircraft's documentation to include a mention that this device has been installed. The presence of such a system could also be included in the information supplied on a flight plan, if one is filed. As a result of the above, the following safety recommendations are issued:

***REC 34/17:** It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) establish the necessary measures so that aircraft operating in Spanish territory and that have installed or will install a ballistic parachute report it to the authority.*

***REC 35/17:** It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) seize the regulatory initiative for the installation of ballistic parachutes to be legislated in the following cases:*

- *in nationally regulated aircraft (ULM and amateur-built aircraft) with a Type Certificate (TC), through this certificate (if the ballistic parachute was included in the original configuration) or through the Supplemental Type Certificate (STC) (if the ballistic parachute was installed later).*
- *In nationally regulated aircraft (ULM and amateur-built aircraft) that do not have a type certificate and that include it in the design of the aircraft.*

***REC 36/17:** It is recommended that the Spanish Civil Aviation General Directorate (DGAC) take the relevant regulatory procedures to legislate the installation of ballistic parachutes in the following cases:*

- *in nationally regulated aircraft (ULM and amateur-built aircraft) with a Type Certificate (TC), through this certificate (if the ballistic parachute was included in the original configuration) or through the Supplemental Type Certificate (STC) (if the ballistic parachute was installed later)*
- *In nationally regulated aircraft (ULM and amateur-built aircraft) that do not have a type certificate and that include it in the design of the aircraft.*

***REC 37/17:** It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) establish the measures necessary to indicate the presence of a ballistic parachute as a parameter on the list of aircraft registered in Spain.*

***REC 38/17:** It is recommended that the European Aviation Safety Agency (EASA) lay out the measures required so that aircraft equipped with a ballistic parachute reflect this in the* *flight plan as part of point SERA.4005, Contents of a flight plan, "Emergency and survival equipment".*

REC 39/17: *It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) establish the measures necessary to start an awareness, information and training campaign in Spain targeted at general aviation users and emergency personnel involving the presence of ballistic parachutes and identifying, locating and deactivating them in the event of an accident or incident.*

REC 40/17: *It is recommended that the European Aviation Safety Agency (EASA) lay out the measures required to initiate, at the European level, an awareness, information and training campaign directed at general aviation users and emergency services personnel on the existence, identification, location and deactivation of ballistic parachutes in the event of an accident or incident.*

In concert with having general aviation and other users become aware of the presence and hazards of aircraft equipped with ballistic parachutes, there should be warning labels in aircraft informing of their presence and location, and of the temperatures that can be reached in case of fire. Even though some states have undertaken national initiatives and some manufacturers have their own markings, there is no international standard for this type of warning except for the ASTM F2316-12 that allow to identify the presence and the location of this safety equipment. However, the marking of the routing of the components of the system (along the airframe) and some thermal exposure indicator (that could change its color in case the rocket reached a dangerous temperature to cause its detonation) are not considered in such regulation. Therefore, it would be convenient to have a homogenization of this type of markings. As a result, the following safety recommendations are issued.

REC 41/17: *It is recommended that the International Civil Aviation Organization (ICAO) should liaise with the European Aviation Safety Agency (EASA) to include standards for the design (conspicuity, coloration, visibility, and content) in the installation of ballistic parachute systems. This should include, as compulsory for pyrotechnical systems, specifications of the routing of the components of the system and a thermal exposure indicator to enable emergency responders to quickly and safely disable the system, and fully alert persons to the hazards and the danger areas on the aircraft.*

REC 42/17: *It is recommended that the European Aviation Safety Agency (EASA) should liaise with International Civil Aviation Organization (ICAO) to include standards for the design (conspicuity, coloration, visibility, and content) in the installation of ballistic parachute systems. This should include, as compulsory for pyrotechnical systems, specifications of the routing of the components of the system and a thermal exposure indicator to enable emergency responders to quickly and safely disable the system, and fully alert persons to the hazards and the danger areas on the aircraft.*

Once the addressees had received and responded to the safety recommendations with proposals or implemented measures, each recommendation was assigned a status on the dates indicated below [(4)]:

- REC 34/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 35/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 36/17: C.4. Closed - Unsatisfactory response, on 28/10/2020.
- REC 37/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 38/17: A.3. Open - Satisfactory response. In process, on 26/01/2022.
- REC 39/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 40/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 41/17: C.4. Closed - Unsatisfactory response, on 26/04/2019.
- REC 42/17: C.4. Closed - Unsatisfactory response, on 24/07/2019.

With the exception of REC 38/17, all the addressees submitted responses explaining that, for various reasons, they were unable to undertake the measures required to implement the actions proposed in the safety recommendations issued.

In the case of REC 38/17, on 25/05/2022 EASA published the Notice of Proposed Amendment (NPA) 2022-04, which includes the following proposed amendment to SERA (*Standardised European Rules of the Air*):

> ***SERA.4005 Contents of a flight plan***
>
> *(a) A flight plan shall comprise information regarding such of the following items as are considered relevant by the competent authority:*
>
> *[…]*
>
> *(14) Emergency and survival equipment, including ballistic parachute recovery system*

1.19.- Useful or effective investigation techniques.

Not employed.

(4) The responses submitted by the addressees of CIAIAC safety recommendations following investigations into ULM accidents, as well as their assessment and assigned statuses, are published in the annual reports available at: https://www.mitma.gob.es/organos-colegiados/ciaiac/publicaciones/informes-anuales-ulm/accidentalidad-de-las-aeronaves-ultraligeras-motorizadas-ulm
The information corresponding to this case is published in the 2018, 2019 and 2020 annual reports.

2.- ANALYSIS.

2.1.- History of the flight.

On Sunday, 24 February 2019, at around 07:30 hours, the aircraft took off from Air Marugán Aerodrome, with the pilot and a passenger on board. Shortly afterwards, at 08:30 hours, it reported its passage through the Robledillo de Mohernando Aerodrome and, just after 10:30 hours, it made an approach to runway 36 at La Nava–Corral de Ayllón Aerodrome.

According to a witness who watched the accident sequence from his home in Corral de Ayllón, the aircraft was flying from south to north when, about 500 metres before the head of runway 36, it made a turn to the left followed by another to the right, lined up with the runway and began to descend.

It looked to him that the aircraft travelled the length of the runway at low speed and very close to the ground but without touching down (carrying out a low approach manoeuvre); in his experience, given that the ground was so dry, if it had touched down it would have kicked up a lot of dust.

However, it's possible the witness' impression of what happened was mistaken, and that the aircraft did make contact with the ground, performing a touch-and-go landing manoeuvre with an extended amount of time spent on the ground.

On the final stretch of the runway, the aircraft began to climb, banked to the left and crashed into the ground on the right side of the runway. The fact that the aircraft wreckage was found to the right of the runway suggests it drifted to the right during the climb. The two occupants died and the aircraft was destroyed.

The weather conditions were suitable for the flight, with light winds and no significant phenomena at the time of the accident.

2.2.- Aircraft performance.

As indicated in 1.16.1, the inspection of the aircraft wreckage found no evidence of any failure in its structure or flight controls prior to the impact with the ground. Furthermore, as indicated in 1.16.2, the engine inspection found evidence that it was working and supplying power at the time of impact. This rules out the possibility that the accident was caused by a fault in the aircraft.

The aircraft was configured for take-off and the initial climb, with the flaps deployed and locked in the take-off position.

Consequently, regardless of whether the aircraft was performing a low approach manoeuvre or a touch-and-go manoeuvre, the accident occurred in the initial climb phase of flight with the aircraft in the corresponding configuration.

Moreover, as indicated in 1.12, the aircraft wreckage revealed breakages and deformations typical of a frontal impact after a practically vertical trajectory, with yaw and roll attitudes slightly to the left, and a modest left rotation around the longitudinal axis of the aircraft. Additionally, as indicated in 1.16.2, the inspection of the aircraft's engine found evidence that the impact with the ground had been frontal and with considerable force, and that the propeller stopped rotating almost instantaneously.

Given the above, it appears the aircraft suffered an in-flight loss of control during the initial climb phase, without having attained sufficient height to recover from it, and crashed into the ground as a result.

2.3.- Emergency ballistic parachute system.

The presence of an emergency ballistic parachute system in an aircraft, it involves a risk in itself by having a pyrotechnic device among its components. Consequently, to prevent accidental activation on the ground, these types of systems have a locking device that must be used whenever the aircraft is not in flight or about to take off.

If an aircraft with an undetonated ballistic parachute system is involved in an accident, the people working on or close to the aircraft wreckage are placed at risk, primarily for two reasons: Firstly, the system has to be unlocked with the aircraft in flight and it may not be possible to lock it on the ground, or, if it is possible, the lock may not be effective; secondly, the pyrotechnic device may have been damaged by the impact and/or a fire or other heat sources that cannot be assessed at the accident site.

In this case, none of the people who worked in one form or another on the aircraft wreckage and its occupants were unaware that it had an emergency ballistic parachute and, consequently, they were unaware of the associated risks. In fact, the investigators deployed to the accident site only confirmed its installation after consulting one of the co-owners of the aircraft. In addition, although the parachute's external deployment zone was marked with a sign and a warning notice to indicate its presence, these signs were not visible in the wreckage due to the breakages and deformations to that area of the aircraft.

As indicated in 1.18.1, Technical Report ULM A-16/2016 addressed the issue of the risks associated with ballistic parachutes in aircraft wreckages in depth and, as a result of the investigation into that accident, the CIAIAC issued nine operational safety recommendations.

The addressees of eight of the recommendations submitted responses explaining that, for various reasons, they were unable to undertake the measures required to implement the actions proposed in the operational safety recommendations issued. These responses were studied and subsequently assigned the status “C.4.Closed - Unsatisfactory Response”.

Only one recommendation addressee responded that they agreed with the proposal and has started the procedure to implement it. Consequently, this response was studied and assigned the status “A.3.Open - Satisfactory response. In process". However, as of the date of approval of this technical report on the accident at hand, the amendment to the corresponding rule has not yet been published, reason why the recommendation remains open in process.

This investigation detected similar issues, in regard to the risks associated with emergency ballistic parachute systems in aircraft wreckages, to those highlighted by the investigation with reference ULM A-016/2016, which studied the problem in depth and issued nine safety recommendations of which only one is in the process of being applied. However, the safety recommendations did not achieve the desired results and, consequently, the issues have not been resolved and that the problems encountered are still present, it is considered necessary to issue eight new safety recommendations with the same content as those that did not receive satisfactory responses, and that their addressees study them again and provide solutions to the proposals made in them.

3.- CONCLUSIONS.

3.1.- Findings.

a) The aircraft was equipped with a ballistic rescue parachute system.

b) There were no limiting meteorological conditions for visual flight.

c) The aircraft was making a local round-trip flight from Air Marugán Aerodrome, with the pilot and a passenger on board.

d) After making an approach to runway 36 at La Nava–Corral de Ayllón Aerodrome and travelling almost the entire length it, the aircraft suffered an in-flight loss of control during the initial climb phase, without having attained sufficient height to recover from it, and crashed into the ground.

e) According to information provided by a resident of Corral de Ayllón who witnessed the accident sequence, it travelled the length of the runway at a low speed and without touching the ground.

f) However, the possibility that the aircraft did touch down as part of a touch-and-go landing manoeuvre with an extended length of time on the ground, has not been ruled out.

g) The post-accident inspection confirmed that the aircraft was configured for take-off and did not identify any pre-existing failures or anomalies in the airframe or the engine.

h) None of the people who worked in one form or another on the aircraft wreckage and its occupants were aware that it had an emergency ballistic parachute and, consequently, they were unaware of the associated risks.

i) Technical Report ULM A-16/2016 addressed the risks associated with ballistic rescue parachute systems in aircraft wreckages in depth and, as a result of the investigation into that accident, the CIAIAC issued nine safety recommendations.

j) This investigation detected similar issues, in regard to the risks associated with ballistic rescue parachute systems in aircraft wreckages, to those highlighted by the investigation with reference ULM A-016/2016.

3.2.- Causes/contributing factors.

The probable cause of the accident was an in-flight loss of control from which, having not attained sufficient height, the aircraft could not recover, resulting in its subsequent frontal impact with the ground.

4.- SAFETY RECOMMENDATIONS.

This investigation detected similar issues relating to the risks posed by ballistic rescue parachute systems in aircraft wreckages as those highlighted by the investigation into the accident with reference ULM A-016/2016.

Technical Report ULM A-016/2016 studied the issue and associated risks in depth and, as a consequence, the CIAIAC issued nine safety recommendations, in order to prevent similar situations arising.

Once the addressees had received and responded to the safety recommendations with proposals or implemented measures, each recommendation was assigned a status, on the dates indicated below [5]:

- REC 34/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 35/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 36/17: C.4. Closed - Unsatisfactory response, on 28/10/2020.
- REC 37/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 38/17: A.3. Open - Satisfactory response. In process, on 26/01/2022.
- REC 39/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 40/17: C.4. Closed - Unsatisfactory response, on 06/06/2019.
- REC 41/17: C.4. Closed - Unsatisfactory response, on 26/04/2019.
- REC 42/17: C.4. Closed - Unsatisfactory response, on 24/07/2019.

With the exception of REC 38/17, the addresees submitted responses explaining that, for various reasons, they were unable to undertake the measures required to implement the actions proposed in the operational safety recommendations issued.

In the case of REC 38/17, EASA responded that it agreed with the proposal and that, in the first quarter of 2018, has started the procedure to modify the SERA (Standardised European Rules of the Air) in line with the proposed amendment. As of the date of approval of this technical report on the accident at hand, the amendment to the corresponding rule has not yet been published, reason why the recommendation remains open in process.

Given that the other safety recommendations did not achieve the desired effect and that the problems encountered are still present, it is considered necessary to issue new safety recommendations with the same content of these, and that their addressees study them again and provide solutions for the proposals made.

[5] The responses submitted by the addressees of CIAIAC safety recommendations following investigations into ULM accidents, as well as their assessment and assigned statuses, are published in the annual reports available at: https://www.mitma.gob.es/organos-colegiados/ciaiac/publicaciones/informes-anuales-ulm/accidentalidad-de-las-aeronaves-ultraligeras-motorizadas-ulm
The information corresponding to this case is published in the 2018, 2019 and 2020 annual reports.

REC 50/21

It is recommended that the Spanish National Aviation Safety Agency (AESA) establish the necessary measures so that aircraft operating in Spanish territory and that have installed or will install a ballistic rescue parachute system, report it to the authority.

REC 51/21

It is recommended that the Spanish National Aviation Safety Agency (AESA) seize the regulatory initiative for the installation of ballistic rescue parachute systems to be legislated in the following cases:

- in nationally regulated aircraft (ULM and amateur-built aircraft) with a Type Certificate (TC), through this certificate (if the ballistic rescue parachute system was included in the original configuration) or through the Supplemental Type Certificate (STC) (if the ballistic rescue parachute system was installed later).
- In nationally regulated aircraft (ULM and amateur-built aircraft) that do not have a type certificate and that include it in the design of the aircraft.

REC 52/21

It is recommended that the Spanish National Aviation Authority (DGAC) take the relevant regulatory procedures to legislate the installation of ballistic rescue parachute systems in the following cases:

- in nationally regulated aircraft (ULM and amateur-built aircraft) with a Type Certificate (TC), through this certificate (if the ballistic rescue parachute system was included in the original configuration) or through the Supplemental Type Certificate (STC) (if the ballistic rescue parachute system was installed later)
- In nationally regulated aircraft (ULM and amateur-built aircraft) that do not have a type certificate and that include it in the design of the aircraft.

REC 53/21

It is recommended that the Spanish National Aviation Safety Agency (AESA) establish the measures necessary to indicate the presence of a ballistic rescue parachute system as a parameter on the list of aircraft registered in Spain.

REC 54/21

It is recommended that the Spanish National Aviation Safety Agency (AESA) establish the measures necessary to start an awareness, information and training campaign in Spain targeted at general aviation users and emergency personnel involving the presence of ballistic rescue parachute systems and identifying, locating and deactivating them in the event of an accident or incident.

REC 55/21

It is recommended that the European Aviation Safety Agency (EASA) lay out the measures required to initiate, at the European level, an awareness, information and training campaign directed at general aviation users and emergency services personnel on the existence, identification, location and deactivation of ballistic rescue parachute systems in the event of an accident or incident.

REC 56/21

It is recommended that the International Civil Aviation Organization (ICAO) should liaise with the European Aviation Safety Agency (EASA) to include standards for the design (conspicuity, coloration, visibility, and content) in the installation of ballistic rescue parachute systems. This should include, as compulsory for pyrotechnical systems, specifications of the routing of the components of the system and a thermal exposure indicator to enable emergency responders to quickly and safely disable the system, and fully alert persons to the hazards and the danger areas on the aircraft.

REC 57/21

It is recommended that the European Aviation Safety Agency (EASA) should liaise with International Civil Aviation Organization (ICAO) to include standards for the design (conspicuity, coloration, visibility, and content) in the installation of ballistic rescue parachute systems. This should include, as compulsory for pyrotechnical systems, specifications of the routing of the components of the system and a thermal exposure indicator to enable emergency responders to quickly and safely disable the system, and fully alert persons to the hazards and the danger areas on the aircraft.