CIAIAC

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

# Report A-021/2020

Accident involving a EUROCOPTER AS350 B2 aircraft, registration EC-MVV, in the municipality of La Vansa i Fórnols (Lleida) on 6 July 2020

GOBIERNO DE ESPAÑA

MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA

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# 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 and its 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 5.6 of Regulation (UE) nº 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 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.

## Contents

# Abbreviations

| | |
|---|---|
| ° | Sexagesimal degrees |
| ° ’ ” | Degrees, minutes, seconds |
| % | Per cent |
| AD | Airworthiness Directive |
| AENOR | The Spanish Association for Standardisation and Certification |
| AESA | Spain’s National Aviation Safety Agency |
| ALS | Airworthiness limitations |
| CAMO | Continuing airworthiness management organisation |
| CIAIAC | Civil Aviation Accident and Incident Investigation Commission |
| cm | Centimetres |
| COE | Special Aerial Operator Certificate |
| CPL(H) | Commercial Helicopter Pilot License |
| DGAC | Civil Aviation General Directorate |
| E | East |
| FCU | Flight control unit |
| FH | Flight hours |
| ft | Feet |
| ft / min | Feet per minute |
| g/kw.h | Grams / kilowatt-hour |
| GS | Operational safety manager |
| h | Hour |
| ICAs | Instructions for continued airworthiness |
| ISO | International Standardisation Organisation |
| kg | Kilogram |
| km | Kilometre |
| LESU | Name of the airport at La Seu d’Urgell (Lleida) |
| m | Metre |
| MAYDAY | International distress signal derived from the French ”m’aider” (help me) |
| M1 | Module 1 of the engine. Gear case for accessories + drive shaft |
| M2 | Module 2 of the engine. Axial compressor |
| M3 | Module 3 of the engine. High-pressure section of the gas generator |
| M4 | Module 4 of the engine. Free turbine |
| M5 | Module 5 of the engine. Gearbox |
| N | North |
| N1 / NG | Speed of the gas generator |
| N2/NFT/NR | Speed of the free turbine |
| PPL(H) | Private Helicopter Pilot License |
| RC | Compliance officer |
| RET | Crew training manager |
| RMA | Continuing airworthiness manager |

| | |
|---|---|
| ROT | Ground operations manager |
| ROV | Flight operations manager |
| Rpm | Revolutions per minute |
| SAR | Search and rescue |
| SASEMAR | Maritime rescue |
| SB | Service bulletin |
| shp | Shaft horsepower |
| SPO | Special Procedures Operations |
| STCH | Standard type certificate helicopter |
| TCH | Type certificate helicopter |
| TRH(I) | Flight instructor rating |
| UE | European Union |
| VFR | Visual flight rules |

## Synopsis

| | |
|---|---|
| Owner and operator: | HELITRANS PYRINEES |
| Aircraft: | EUROCOPTER AS-350-B2 registration EC-MVV |
| Date and time of incident: | 6 July 2020, 12:18 h (local time[1]) |
| Site of incident: | Municipality of La Vansa i Fórnols (Lleida) |
| Persons on board: | Two (fatalities) |
| Flight rules: | VFR |
| Type of flight: | Commercial aviation - Aerial work - En route |
| Date of approval: | 28/07/2021 |


### Summary of incident

On Monday, 06 July 2020, the EUROCOPTER AS 350 B2 helicopter, with registration EC-MVV, operated by HELITRANS PYRINEES, was carrying out concrete piling work in the vicinity of La Vansa i Fórnols (Lleida), with assistance from two ground operators, one from the company itself and the other from an electricity company.

The ground operative employed by the helicopter operator injured his hand, and the pilot landed the aircraft on a road to collect him and take him to La Seu d'Urgell Airport (from where he had departed) so that he could receive medical attention.

During the transfer flight, the aircraft crashed, caught fire, and was destroyed. The impact and subsequent fire killed the two occupants.

The investigation has concluded that the accident occurred due to the impossibility of preparing and executing an autorotation manoeuvre after after suffering a sudden loss of engine power due to the low altitude a witch the helicopter was flying.

The specific cause of the possible loss of engine power could not be established.


[1] Unless otherwise indicated, the report refers to local time. UTC can be calculated by subtracting two units.

# 1. FACTUAL INFORMATION

## 1.1. History of the flight

On Monday, 6 July 2020, the EUROCOPTER AS 350 B2 helicopter, with registration EC-MVV, operated by HELITRANS PYRINEES, departed from La Seu d'Urgell airport together with another similar aircraft, both belonging to the same operator, to carry out construction work on a high voltage power line in the municipality of La Vansa i Fórnols (Lleida).

The pilot flew alone but was assisted on the ground by a company operative, who had travelled to the site where they were going to work in a van.

The works consisted of placing concrete piles on a base for the subsequent installation of pylons for a high voltage power line.

The operative on the ground helped to hook the piles to the helicopter line and informed the pilot when he could start the transfer for its placement. A worker from an electrical company assisted with the placement of the piles.

During the course of his work, the operator incurred a minor injury to his hand with the hook that held the concrete piles and informed the pilot that he had injured himself.

The pilot decided to take him back to the helicopter's departure airport for medical assistance. He descended towards a nearby road and, without landing on the asphalt, picked him up and flew directly towards the aerodrome on a heading of 290º. During the flight, the helicopter crashed into a steep hillside and subsequently caught fire. There were indications that the engine may have been affected by a loss of power.

Figure 1. Final position of the aircraft

### 1.2. Injuries to persons

| Injuries | Crew | Passengers | Total in the aircraft | Others |
|---|---|---|---|---|
| Fatalities | 1 | 1 | | |
| Serious | | | | |
| Minor/None | | | | |
| TOTAL | 1 | 1 | 2 | |

### 1.3. Damage to the aircraft

The aircraft was destroyed.

### 1.4. Other damage

No other damage sustained.

### 1.5. Personnel information

The 47 year old pilot, had held a commercial helicopter pilot license, CPL(H), since 18 August 1995. Prior to that, he had obtained his private helicopter pilot license, PPL (H), in 1993, and he had also held a private aircraft pilot license, PPL (A), since 2018.

He had type ratings for AS350/EC130/SP, AS355/SP and EC135/635/SP, TR (H) AS350/EC130/SP and TR (H) EC135/635/SP helicopters, as well as type instructor ratings for the TRI (H) AS355/SP.

His license and all his ratings were valid and in force, as was his corresponding medical certificate.

He had 11500 h of flight experience, of which 9800 h were in the type of aircraft involved in the incident.

Since 1993, he had flown the following helicopters:

> BELL 47, ROBINSON 22, HUGHES H 500, AGUSTA A 109, EUROCOPTER SA 365 – EUROCOPTER AS350 B/B2/B3 – EUROCOPTER AS 355 N, SIKORSKY S 76 and AÉROESPATIALE SA 315 - SA 316

He had worked for five different operators performing different types of aerial work, such as fishing inspections, search and rescue operations (SAR), emergency medical services (EMS), external load water drops, inspections of power lines (visual y thermal), concreting for the installation of electrical pylons and laying cables and pilot rope.

## 1.6. Aircraft information

### 1.6.1. General information

The EUROCOPTER FRANCE AS 350 B2 helicopter, with registration EC-MVV, was manufactured in 1991 with serial number 2456. It was owned by HELITRANS PYRINEES.

Its basic empty weight was 1200 kg, and its maximum take-off weight was 2250 kg. It had a width of 2.28 m, a length of 10.93 m and a height of 3.34 m.

The diameter of the main rotor was 10.69 m

It had a valid standard category airworthiness certificate.

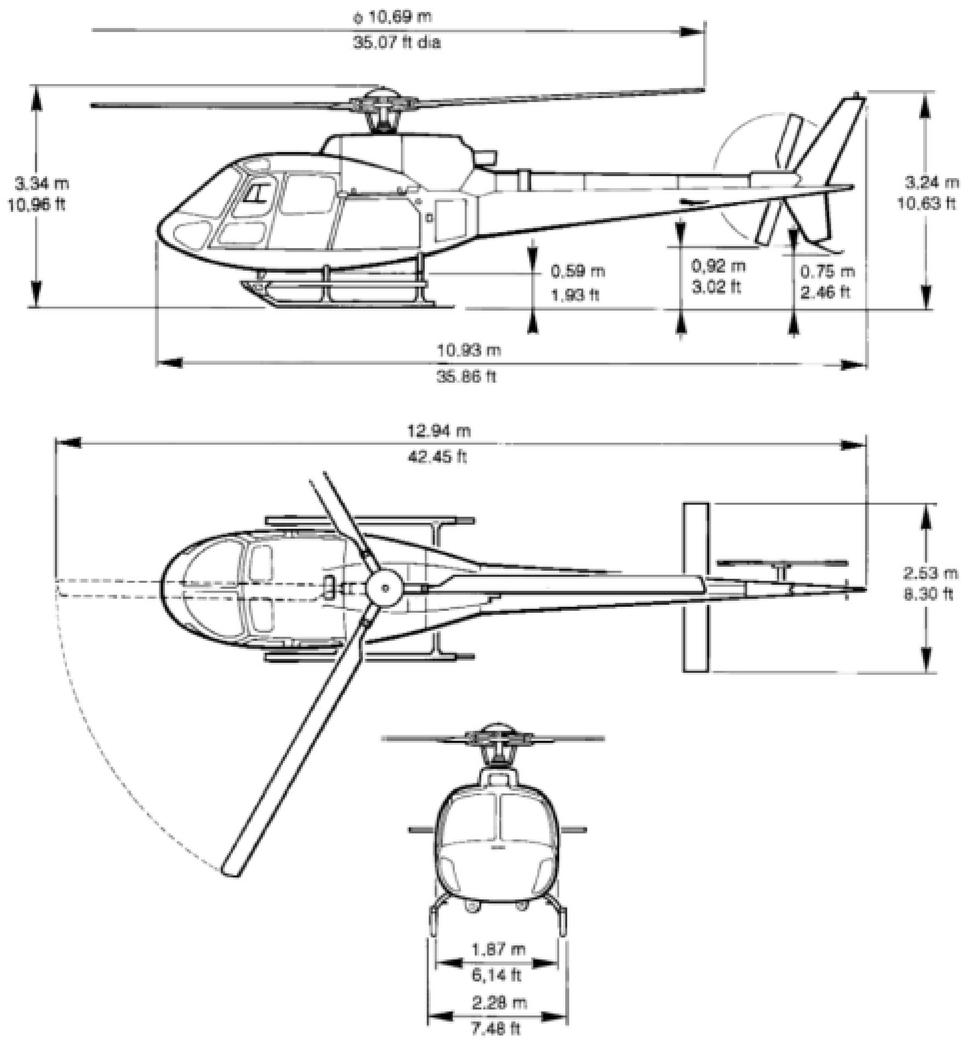



Figure 2. Dimensions of the aircraft

### 1.6.2. Information about the engine

The helicopter was fitted with an ARRIEL 1D1 engine, manufactured by TURBOMECA (currently SAFRAN), with serial number 9147. It provided a take-off power of 732 shp[2] and a cruise power of 625 shp.

It's a turboshaft engine with a free turbine that drives an output shaft through gears that reduce its rotations. The free turbine has a constant speed of 41586 rpm and 6000 rpm at the output of the gears.

The engine transforms the energy from the fuel/air mixture into mechanical power, which is applied to the shaft to drive the main and tail rotors.

[2] shp is the unit of horsepower delivered to the shaft (horsepower), which is equivalent to 75 Kg (f) m/s

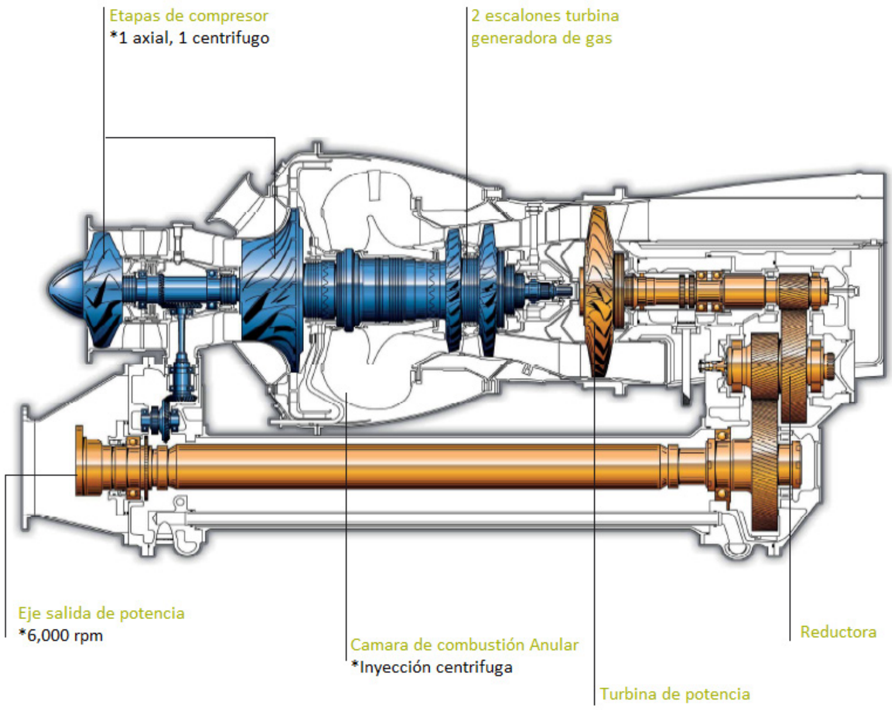



Figure 3. SAFRAN ARRIEL 1D1 engine

The main engine specifications are as follows:

- Maximum weight is 123 kg.
- Specific fuel consumption at cruise speed is 390 g/kw.h.
- Speed of the gas generator (N1/NG): 52000 rpm (100%)
  - Anti-clockwise rotation (looking at the engine from behind)
- Speed of the free turbine (N2/NFT/NR): 41586 rpm (100%)
  - Clockwise rotation
- Speed of the output shaft: 6000 rpm (100%)
  - Clockwise rotation

### 1.6.3. Information about the engine maintenance

The aircraft's maintenance was carried out under the HLB-PM-350-B2 maintenance programme, devised by continuing airworthiness organisation HELITRANS PYRINEES (ES. MG. H26) and approved by the competent authority (AESA), in accordance with section M.A.302 of Annexe I, part M, subpart C of regulation (EU) No.1321/2014 of the European Commission.

The programme contains all the instructions specified by the competent authorities, the instructions for continued airworthiness (ICAs) issued by the holders of type certificates (TCH / STCH), the airworthiness limitations (ALS) and those required by the type of operation.

It also contains a description of the preflight inspection and all the airframe and powerplant tasks, along with their frequency. In addition, it has a list of recurring application airworthiness directives and a list of limited life components for both the airframe and the power plant.

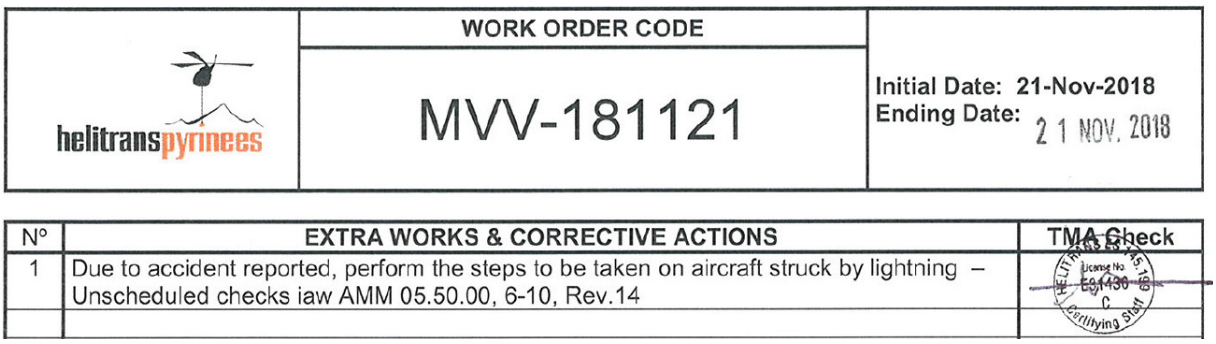
The last maintenance overhaul was carried out on 21 June 2020, when the aircraft had 5951 operating hours, 40165 cycles and 5631 engine hours.

As per the maintenance programme (HLB-PM-350-B2. Ed1 Rev.4) the scheduled 100 FH, 150 FH, 150 H/6M and 150 H/12 M aircraft inspections, along with the scheduled 100 H, 150 H, 200 H and 400 H engine inspections, were carried out.

They also carried out other inspections of accessories, some lubrication, applied two directives (AD2014-0076 R1, AD2015-0195), and SB 05.00.83 R2.

The aircraft had previously been involved in an accident also investigated by the CIAIAC (A-045/2018) on 20 November 2018 when it had 4788 flight hours. The accident occurred when an electrical arc from a voltage tower affected two ground workers receiving the suspended concrete load during transport tasks in the municipality of Ribera d'Urgellet (Lleida).

The day after the accident, a lightning strike inspection was conducted in accordance with task 05-50-00, 6-10, Rev14 of the maintenance manual. No defects were found. At the same time, the mechanics carried out the scheduled 30 h / 1-month aircraft inspections and 200 h / 7-day engine inspections.



| helitranspyrinees | WORK ORDER CODE MVV-181121 | Initial Date: 21-Nov-2018 Ending Date: 21 NOV. 2018 |
|---|---|---|

| Nº | EXTRA WORKS & CORRECTIVE ACTIONS | TMA Check |
|---|---|---|
| 1 | Due to accident reported, perform the steps to be taken on aircraft struck by lightning – Unscheduled checks iaw AMM 05.50.00, 6-10, Rev.14 | |
| | | |

Figure 12. Task 05-50-00, 6-10, Rev14

From the time the aircraft was recommissioned to the day of the accident currently under investigation, the engine underwent multiple scheduled overhauls.

The M3 module underwent two boroscopic inspections of the first stage of the high-pressure turbine and the combustion chamber every 600 operating hours; in April 2019 (4992 aircraft hours / 4671 engine hours) and in February 2020 (5582 aircraft hours / 5261 engine hours).

| M: Mandatory | | | R: Manufacturer required | | | | OP: Optional | |
|---|---|---|---|---|---|---|---|---|
| *Maintenance tasks* | *Task No.* | *Level* | *Periodicity* | *Tolerance* | *Unit* | *Reference Counter* | *Operating condition* | *Date/Signature* |
| Borescope inspection of 1st stage turbine blades of gas generator. | 72-43-00-280-806 | R | Every 600 from 1,200 | +60 | FH | TSN | All | |
| *Component standard for above task* : **ALL** *Application conditions of above task*: **Module 03 installed on engine installed on helicopter or engine removed** | | | | | | | | |
| Inspection and check of the combustion chamber. | 72-43-00-280-806 | R | Every 600 | +60 | FH | TSN | All | |
| *Component standard for above task* : **POST TU 244** *Application conditions of above task*: **Module 03 installed on engine installed on helicopter or engine removed** | | | | | | | | |

Figure 13. MVV 190325 carried out on 8-4-2019

| M: Mandatory | | | R: Manufacturer required | | | | OP: Optional | |
|---|---|---|---|---|---|---|---|---|
| *Maintenance tasks* | *Task No.* | *Level* | *Periodicity* | *Tolerance* | *Unit* | *Reference Counter* | *Operating condition* | *Date/Signature* |
| Borescope inspection of 1st stage turbine blades of gas generator. | 72-43-00-280-806 | R | Every 600 from 1,200 | +60 | FH | TSN | All | |
| *Component standard for above task:* **ALL** *Application conditions of above task:* **Module 03 installed on engine installed on helicopter or engine removed** | | | | | | | | |
| Inspection and check of the combustion chamber. | 72-43-00-280-806 | R | Every 600 | +60 | FH | TSN | All | |
| *Component minimum standard for above task:* **POST TU 244** *Application conditions of above task:* **Module 03 installed on engine installed on helicopter or engine removed** | | | | | | | | |

Figure 14. MVV 200211 R1 carried out 28-2-2020

In addition, during the February 2020 overhaul, all the blades, disc and rotor bearings in the second stage of the high-pressure turbine were replaced, as per service bulletin SB 292 72 0849. The SAFRAN mechanics applied the bulletin at the HELITRANS PYRINEES facilities at Seu d'Urgell-Andorra Airport.

Following this SB appliance, the operator reinstalled the engine in the helicopter airframe and performed all the adequate controls and checks. The helicopter returned to service but SHE didn't get or didn't capture the information and the state of the engine was not updated and was not switched from non-airworthy to airworthy.

On 1 May 2020, with 5797 aircraft hours, it experienced another incident when an engine cowling opened mid-flight and hit one of the rotor blades.

The maintenance conducted as a result of this event consisted of an impact inspection on the main rotor, in accordance with maintenance manual task 05-50-00, 6-6, and changing and balancing the three blades and two engine cowlings.

## 1.7. Meteorological information

The elevation of the point of the accident site (42° 14 ′59″ N - 1° 30 ′39″ E) is approximately 1200 m.

According to the data published by the Catalan Meteorological Service, the temperature recorded at the La Seu d'Urgell - Bellestar station, located at the coordinates point

42° 24 '14.988 "N - 1° 25' 57.972" E, with a elevation of 849 m (2,785 ft) on the day of the accident at 12:00 h (local time) was 30.1°C and 30.3°C at 12:30 pm.

### 1.8. Aids to navigation

Not applicable.

### 1.9. Communications

Not applicable.

### 1.10. Aerodrome information

The airport, known as Andorra - La Seu (LESU), is located 3.8 km southwest of La Seu d'Urgell. Its GPS coordinates are 42° 20 '46 "N - 1° 24' 53" E. The aerodrome's traffic pattern is to the east of the runway.

Its elevation is 802 m (2630 ft), and it has an asphalt runway designated 03 - 21, which is 28 m wide and 1267 m long (1387 m x 80 m including the strip). It has a helicopter landing zone in the airport's westernmost area, to the south of the buildings and ground facilities.


Figure 15. La Seu d'Urgell Airport

### 1.11. Flight recorders

The aircraft was not carrying flight recorders because it was not a regulatory requirement.

### 1.12. Aircraft wreckage and impact information

The helicopter crashed into a sharply inclined slope, at the coordinates point 42° 14 '59" N-1° 30 '39" E, with its longitudinal axis oriented at 290° with respect to magnetic north, and slightly tilted to the right side.

This orientation coincides with the heading it would have been following to fly in a straight line from where it took off after collecting the operator to the La Seu d'Urgell Airport.

The helicopter impacted with a slightly forward angle, with a downward nose pitch.

After the impact, a fire broke out. It reached exceedingly high temperatures and consumed everything from the main rotor forwards. However, the part of the helicopter situated behind the rotor was not affected by the fire, and there were no signs of smoke damage.

The entire tail cone assembly broke off on impact and ended up at the edge of a cliff. The horizontal stabiliser was found on a slope 3 m below the main wreckage, with the vertical stabiliser 1 m further below.

Both parts had dents on the right side.

The tail rotor was found on another ledge in the valley, approximately 20 m below the rest of the tail cone.

Figure 16. Tail cone and horizontal stabiliser

Two of the three blades remained in their normal position on the main rotor. They were both damaged during the impact, one near its attachment point and the other roughly halfway along. The damage wasn't severe; although they were deformed by the impact, they remained practically intact. Part of the third blade was still attached to the rotor head and completely charred. The rest of it had detached and fallen downhill. The pilot of the helicopter recovering the wreckage spotted it from the air and retrieved it.

In the cabin, the control levers had come loose due to the effects of the fire. Therefore, we were unable to determine their position during the last moments of the flight.

From the charred remains, we were, however, able to verify that the fuel control lever was in its normal flight detent position, the rotor brake was in the lowered position, and the emergency fuel cut-off lever was in the forward position (detent), indicating that it had not been actuated. All three were in-flight positions.

Three blade marks were observed on the ground, with significantly vertical cuts. Two of them were to the left of the tail cone, looking from the direction of flight. The first was 1.2 m away from the cone and was the most evident. It would have been made by the blade that came off on impact. The second mark was located 20 cm behind the first and would have been made by the blade to the left, looking from the direction of flight. The third mark was 50 cm to the other side of the tail cone.

Parts of the fuselage and tail cone had separated and laid near the main wreckage.

Figure 17. Tail rotor

The landing skids were crushed under the helicopter and burned but remained whole.

### 1.13. Medical and pathological information

After the impact, the pilot remained inside the cockpit, but the passenger was thrown out to the left in the direction of travel and was found next to the helicopter.

The autopsy determined that both died on impact.

The toxicological results from the autopsies did not reveal any anomalies.

### 1.14. Fire

After the impact, a fire erupted, engulfing the engine and completely burning the cabin plus the area below and behind it.

The tail cone, stabilisers and rear rotor were the only parts not affected by the fire.

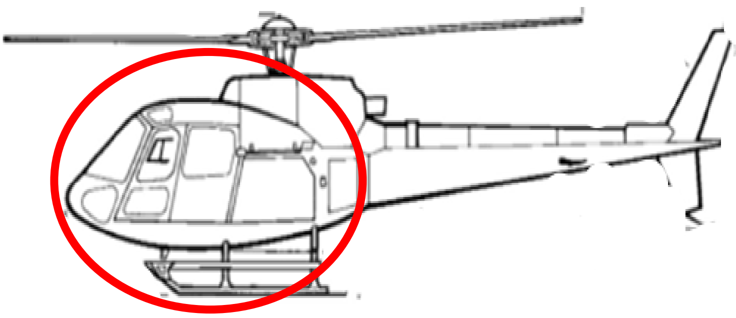


Figure 18. Fire-affected area

### 1.15. Survival aspects

The impact and subsequent fire killed the two occupants.

### 1.16. Tests and research

The engine was disassembled and analysed in a workshop, with the participation of various specialist technicians, including one from the engine manufacturer. The study produced the following results:

Figure 19. Exhaust deflecting nozzle

- The outlet deflecting nozzle was crushed by the impact.
- The engine had burn damage to its exterior but had not been subjected to an intense fire. The area around the deflecting nozzle had a bluish colour.
- The accessory area was partially burned.
- The inlet compressor screw was slightly proud. The underside was deformed.


Figure 20. Position of the anticipator

- In the fuel control unit (FCU), the throttle lever was at the 60° position within the green arc (between full power and safety speed). The anticipator was at the zero position. It's used to control and adjust the position of the collective pitch lever in advance. If this fails, it's automatically compensated with the N2 revolutions, so we can disregard this as a factor in the accident.

- The piece that sends the power to engage the tail rotor shaft was bent. This would indicate that the motor was sending power from the main shaft to the tail rotor shaft although it was not possible to determine the level of power. The bending may have been cause with low power. The dismantling of the five engine modules was carried out from back to front (i.e., beginning with the M5 module 4 and ending with the set formed by the M2 and M3 modules).
- The magnetic seal to access the M5 module was in position.
- The outlet nozzle was bent around the M5 module and had to be cut to remove it, but this did not affect the results of the analysis.
- The inspection of the M5 module found that the bushing that engages the M4 and M5 modules was aligned, suggesting there hadn't been any over-torque.
- The nozzle had to be cut and disassembled to access the outlet of the free turbine in the M4 module. A lack of friction marks on the free turbine blades suggests the engine was idle.
- The Fuel Control Unit (FCU) was dismantled and the shaft was found to be in good condition. It appears that fuel was reaching the engine. It was sent to the manufacturer for analysis, which concluded the damage observed was a consequence of the impact with the ground and the subsequent fire.
- A possible accessory case blockage was also ruled out.
- The free and, the power turbine were accessed and it was verified that both was rotating normally.
- The inlet turbine of the M4 module had several scratch marks, but they occurred after the engine had stopped (known as cold friction) because they were highly polished and grey rather than the blueish colour they would have been if the engine had stopped when it was hot.
- The shaft of the M4 module was bent. This may have been caused by the impact or, more likely, because the M3 module was blocked.
- The M3 module was inspected with a boroscope from the rear section. The colour of the M3 module's outlet blades looked good. Some stripes were observed, appearing to indicate that the first turbine stage's rotor blades were broken (cracked).
- The boroscope was also inserted through the injector hole, revealing other lines that seemed to indicate the diffuser was broken, potentially because it had been struck by the first turbine stage blades of module 3 when moving.

As a result, the module 2 and 3 assembly was separated and disassembled to analyse whether the shadows observed were related to an internal failure.

- The engine oil filter was removed and found to be burned.
- The bleed valve was removed and appeared to be in good condition.
- The rear fixing screw of module 2 had snapped.
- The nozzle area was separated from the assembly.
- On removing module 2, the tightening torque applied to the screws was confirmed to be correct. The module was blocked (it didn't rotate) and burned. Probably as a result of the fire that broke out on impact.
- Shavings were also found inside. It looked as if the M3 module had blocked first and, as a result, module 2 suddenly blocked as well. This module rotates at 53,000 rpm so a sudden stop generates a lot of energy.
- All the compressor blades were worn away on their outer edge, producing shavings and chips had been generated in the centrifugal compressor as a result of residual turns of the compressor assembly.
- After disassembling the M2 and M3 modules, both were found to be in good condition. There were no breakages in any of the blades, and the shadows observed during the boroscopic inspection had been produced by the position of the viewer.
- The areas affected by the Service Bulletin's 292 72 0347 maintenance tasks were in perfect condition.
- The inspectors subsequently opened the M1 module (accessory case) and verified that all its elements were also in good condition and rotated without impediment.

Figure 21. Dissembled parts during the inspection

### 1.17. Organisational and management information

The HELITRANS PYRINEES company was formed on 22 April 2002 and has been offering its services since 2006. It's based at La Seu d'Urgell Airport. It has a Special Operator Certificate, COE, (ES. COE.0096) and also declaration for Special Procedures Operations, SPO (ES.SPO.0029), issued by AESA. It also has a Quality Management System Certificate, ER-1112/2010, in compliance with ISO 9001 and 14001 standards, and an Environmental Management System Certificate, GA-2010/0589, both issued by AENOR.

The company is approved by AESA, as an E-ATO271 training organisation authorised to teach the following courses:

- BRIDGE PPL(A) / PPL(H)
- NIGHT FLIGHT (H)
- EUROCOPTER AS 350 / EC 130. TR (H) and Differences AS350B3 A/TO AS350 SERIES, AS350B3 Arriel B1 AND AS350B3e A/TO AS SERIES, EC130 B4 and EC130 T2 A/TO AS350 SERIES, AS350 SERIES A/TO AS350B3, AS350B3 Arriel 2B1 and AS350 B3E A/TO AS350B3, EC130 B4 AND EC130 T2 A/TO AS350B3, AS350 SERIES A/TO AS350B3 Arriel 2B1 and AS350 B3E, AS350B3 A/TO Arriel 2B1 and AS350B3E, EC130 B4 and EC130 T2 A/TO Arriel 2B1 and AS350 B3E
- EUROCOPTER AS355. TR (H) and Differences AS355 SERIES to AS355N / AS355NP to AS355N
- EUROCOPTER EC 120B. TR (H)
- EUROCOPTER EC 135 / 635. TR (H) and Differences EC135 T1 CDS/CPDS to EC 135 P2+; EC135 T2 to EC 135 P2+; EC135 T2+ to EC 135 P2+; EC 135 P1, P2, T1 and T2 to EC 135 P2+
- ROBINSON R44

The company is also an AESA-approved Airworthiness Maintenance Management organisation, CAMO.

S.L. ES.MG.H026 according to Subpart G (Part M) of EU Regulation 1321/2014 for AIRBUS HELICOPTER AS 350 B3, EUROCOPTER AS350 B2 / EUROCOPTER AS350 B3 / EUROCOPTER AS355 N / EUROCOPTER EC 120B / EC 135 P2 + models and it also has Maintenance Centre S.L. ES.145.199, according to Annex II (Part 145) of the aforementioned Regulation, which carries out maintenance work on older models and the HUGHES 369 D.

It carries out aerial work with external loads, specialising in the installation of power line pylons, the transport and assembly of anchors for avalanches and protection against landslides, the assembly of antennas, repeaters and lighting, the transport and assembly of pylons for mechanical lifts, assembly and disassembly of lift parts for maintenance, provisioning for shelters, selective tree extraction, and aerial pruning. They also offer services for reports and filming.

The company has an accountable manager who oversees the following roles:

- Operational Safety Manager (GS) and Compliance Manager (RCC)
- Ground Operations Manager (ROT)
- Crew Training Manager (RET)
- Flight Operations Manager (ROV)
- Continuing Airworthiness Maintenance Manager (RMA)

The deceased pilot was one of the owners of the company and also the Flight Operations Manager

At the time of the accident, the firm had nine pilots on its payroll.

### 1.18. Additional information

Interviews were conducted with the helicopter operator's managers and some of its pilots.

Based on these interviews, we concluded that the fact that the pilots carry out much of their work at low flight levels had conditioned, to a certain extent, their perceptions of safety margins, making them feel that working so close to the ground is less dangerous than it actually is, given the limited room for manoeuvre in the event of an adverse circumstance such as an engine malfunction.

Our second conclusion was that since the helicopters they operate have reliable engines that hardly ever fail, perhaps the pilots perceive engine failure as an implausible possibility with almost marginal probability.

We also discovered that the pilots usually traversed the mountain range where the accident occurred at 300 ft, which, according to the operations manual, is lower than the 500 ft needed to safely complete an autorotation manoeuvre.

The helicopter operator reported that among the measures he had taken were the following:

- Application of the Airbus Helicopters Service Bulletin SB-AS350-76.00.21, which consists of making a modification to the acceleration and fuel control levers to avoid their interference with moving parts in the cabin.
- Regarding the transfer of injured people, the decision has been made not to transfer in the helicopter any person who has suffered injuries that may be aggravated during the transfer. Emergency Services will be contacted. In the event that the injuries are minor, they may be transferred in the helicopter to a place where they can be evacuated in a vehicle to a hospital, taking into account that the injured person will never be mounted in the front seat, they will always be accompanied by another person and the pilot will previously carry out a self-assessment of his emotional state and stress level before making any transfer.

## 1.19. Useful or effective investigation techniques

In the event of an engine failure in a single-engine helicopter, the pilot must perform the autorotation maneuver. For this, the aircraft should be within the flight envelope reflected in the *Basic Operations Manual.*

In these cases, the reaction time of the pilot in lowering the pace and cyclical retarding to load increasing the revolutions of the main rotor are critical factors to successfully complete the maneuver. The rotor of the EUROCOPTER AS350 helicopter is considered to be of medium inertia and if there is a reduction in the engine revolutions it is very possible that the main rotor stalls and this is not recoverable.The phases of autorotation are three. The entrance itself, the planning and the final collection, known as "flare" by its meaning in English, all of which are critical to achieve a safe execution of the maneuver.

According to the helicopter operations manual, the way to act must be as follows:

- Lower the collective control lever.
- Monitor and control rotor revolutions.
- Establish a speed of 65 kt.
- Move the fuel flow control lever to the off position.
- Taking into account the cause of the engine stop or loss of power, the following must be carried out:
  - o Restart the engine
  - o Close the fuel cock
  - o Turn off the generator pumps or the general electrical power switch, especially if you smell burning.
- Maneuver so that the helicopter is oriented against the wind on the final approach.
- When you are at a height of approximately 20 feet or 25 feet, begin to collect and act gradually by raising the collective step lever to reduce the rate of descent.
- Level the helicopter and avoid any lateral displacement.
- Gently reduce the collective step lever after having grounded.

Taking time to react in lowering the collective step lever, not slightly delaying the cyclic lever to increase the revolutions of the main rotor during the entry phase, as well as not maintaining an adequate speed during the planing phase or executing a very abrupt collection (high) or very late during the final phase, are the actions that lead to a poor execution of the maneuver.

The speed / height curve defines the area (the shaded area in Figure 22) where the helicopter's flight envelope should not be found because in that case there will not be enough energy to safely auto-rotate.

During the execution of the maneuver, the pilot must control the value of the revolutions of the main rotor, the speed and the descent rate to balance these parameters continuously, observing the value of each parameter of each one of them and their tendency, to perform the appropriate corrections to enable you to complete the safe descent and landing. All of this actually means a balanced management of energy.

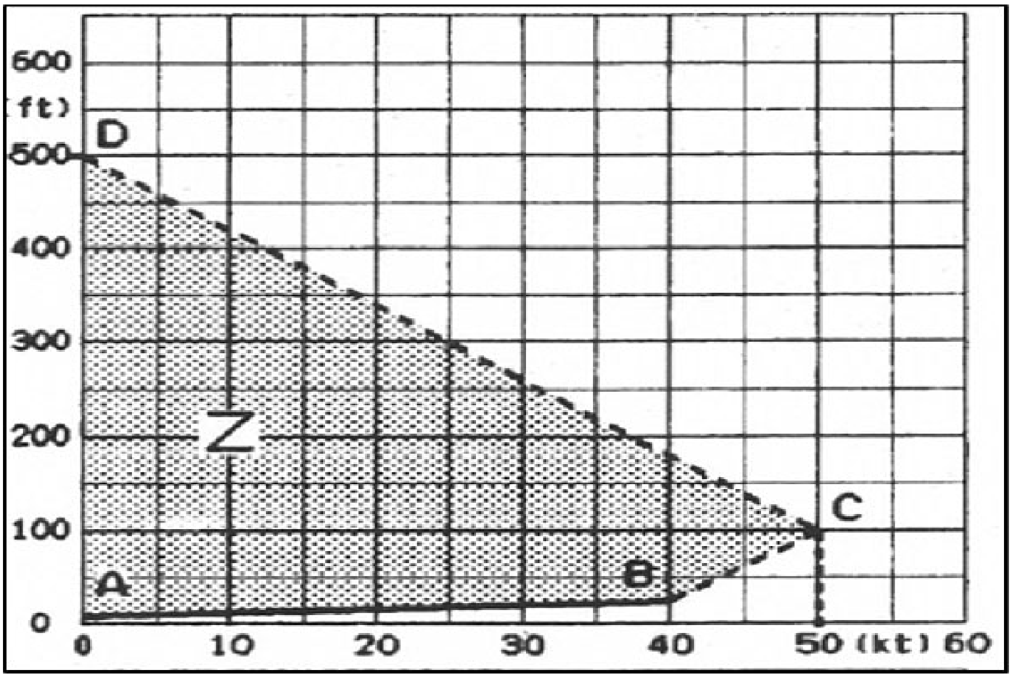



Figura 22. AS-350-B2 height velocity curve

When doing the autorotation maneuver, the helicopters reach descent speeds close to 2500 ft / min and therefore the process requires very fast decision making. Therefore when flying below 500 ft, safe autorotation is not always possible.

The fact that the main rotor of the EUROCOPTER AS350 helicopter is of medium inertia, implies that the pilot has approximately 1 s to lower the collective in case of engine failure, the operating range of the main rotor with power in stabilized flight. It is 390 rpm (+4 - 5) in case of engine failure it is 430 to 320 rpm.

When the rotational speed of the rotor falls below 360 rpm a continuous acoustic warning sounds and when the rotational speed is above 410 rpm an intermittent acoustic warning sounds.

## 2. ANALYSIS

The company that operated the helicopter carries out aerial work involving external loads and specialises in installing power line pylons, mounting antennas, repeaters and lighting. They also offer aerial pruning, selective tree extraction, the transport and assembly of anchors for avalanches and landslide protection, aerial filming for reports and several other services.

The interviews carried out with the operator's various pilots and managers revealed that the nature of their work had, to some extent, influenced them, in the sense of not attributing sufficient importance to maintaining safety margins whenever possible and always flying at a height above the ground that would allow them to react to an unforeseen event.

Therefore, during external load operations in hostile terrain, it's not uncommon for single-engine helicopters to frequently fly outside the parameters of the height-velocity curve, increasing exposure times to unsafe flight conditions.

Within the dynamics generated by making a hasty decision and creating an unnecessary emergency situation, the pilot didn't even land when collecting the operator. Instead, the operator boarded the helicopter while it hovered, almost touching the asphalt of a nearby road, and they started the flight. The safest option would have been to gain altitude straight after take-off, to fly over the surrounding mountains and then continue, either by flying in a straight line to the airfield (heading 290° as he did), or over the valley in front and to his left, with an initial heading of 270° and then turning right with an approximate heading of 310° to pass the mountain on that side[3].

The aircraft's wreckage indicated that it crashed with a high rate of descent, low horizontal speed, rolling to the right and with the front part pitching slightly down.

The minimal damage to the main rotor blades would suggest it was running with low rpms. This is usually caused by the engine not delivering enough power due to a malfunction. The only person to witness the crash said he'd seen the aircraft impact the ground after releasing black smoke. His statement is, therefore, in line with the evidence found at the crash site.

The condition of the wreckage coincides with the hypothesis that the pilot chose to fly towards the airfield in a straight line from the point where they were working and where he picked up the operator but without gaining a sufficient safety height immediately after take-off. This same evidence indicates that it was flying at the minimum height necessary to narrowly evade the mountain slope (less than 100 ft) and with a frontal elevation flight attitude, i.e. transversal to the dividing line of the terrain.

[3] See the diagram in annexe 1.

In view of all the above, it seems that if the pilot did not have time to adequately prepare the autorotation maneuver, it was because he probably could not lower the collective in time and the RPM of the main rotor quickly dropped irretrievably, but it does not seem that was flying within the shaded area of the speed / height graph, since the calculations made in relation to the conditions in which they were performing the operation indicate that it was difficult to travel with a speed lower than 50 kt, above the which is no longer within said shaded area of the aforementioned graph.

In addition to the above, we should add that the terrain was not at all conducive to making an emergency landing. The area they were flying over was steeply inclined at more than 30º and composed of old stepped cultivation terraces. We only managed to identify one small flat area in the vicinity. However, while it would have been suitable to safely complete the autorotation and was located on the path towards the aerodrome, it was higher up on the slope the helicopter was trying to climb.

As all pilots know, the autorotation manoeuvre has to be completed in three stages, each of them critical.

It's essential that during the autorotation entry phase, it doesn't take more than 1 s to lower the collective pitch lever while at the same time moving the cyclic control to increase the revolutions of the main rotor.

Afterwards, pilots must maintain an adequate speed during the glide phase.

Finally, in the last phase, the flare manoeuvre must be performed at precisely the right time.

If these actions are not carried out in the correct coordinated order, the helicopter will not land safely.

In addition to taking the actions described, the pilot has to control several variables quickly and simultaneously.

These include the revolutions of the main rotor and the helicopter's speed and descent rate, balancing all three parameters continuously. Furthermore, a successful autorotation depends on the pilot's ability to make the appropriate corrections at all times.

Another issue to take into account is that when the engine lost power, the pilot, in addition to flying over hostile mountainous terrain at low altitude and low speed, had an injured passenger on board. This may have decreased his concentration and partly diverted his attention, lengthening his reaction times and further complicating the already challenging autorotation manoeuvre.

When executing this type of manoeuvre, the descent speeds are close to 2500 ft/min, which means the decision-making process has to be incredibly fast. The autorotation manoeuvre is rarely performed safely below 500 ft.

While we've been unable to verify if he was making any kind of communications to notify that he had a casualty on board at that point, there is a high probability that he was. This, of course, would be another factor to add to those mentioned above.

To prevent unintended altitude losses, one simple and effective piece of onboard equipment is a radar altimeter with adjustable altitude and auditory warning systems.

The investigation didn't find any anomalies to indicate an engine malfunction. The maintenance that the operator had carried out was as stipulated and in compliance with the established deadlines.

The manufacturer had replaced one of the engine modules in accordance with a service bulletin 292 72 0347 and correctly issued the necessary documentation for its commissioning.

When the engine was removed from the helicopter airframe for parts replacement, its state in the SAFRAN HELICOPTERS database was recorded as non-airworthy. Following the SB appliance, the operator reinstalled the engine in the helicopter airframe and performed all the adequate controls and checks. The helicopter returned to service. The operator did not inform SAFRAN HELICOPTERS of this return to service or SHE failed to record the operations performed and the state of the engine remained non-airworthy in the SHE database.

A few hours after the accident occurred, the engine manufacturer informed the operator that the engine was listed in its database as non-airworthy. It is most likely the result of a lack of communication between SAFRAN HELICOPTERS and the operator. As previously noted, the evidence found at the crash site clearly indicated that the rotor was turning slowly, suggesting that the engine had experienced some type of failure, albeit one that we have been unable to determine.

However, the inspection also confirmed that the throttle was in its correct position. Although this helicopter has its fuel control levers on the cabin floor, they're protected by a screen to avoid possible inadvertent actuation. We have, therefore, ruled out an accidental power cut-off because it seems highly improbable.

To summarise the above, we can establish that the accident occurred due to the multiple adverse circumstances listed below:

- A low perception of the risks of operating at low altitude among the company's pilots.
- Over-confidence, among the company's pilots, in the high reliability of the engines they operate.
- The decision, taken in a somewhat hasty manner, to transfer a person who only had a minor injury to his hand. Given that the pilot was the owner of the company, he probably felt under pressure to take responsibility and would not have needed to consult with anyone before making the decision.

- A lack of adherence to the procedures in the operations manual with regard to maintaining the safety height margins and not flying in the 'avoid zone' of the height-velocity diagram.
- The flight was being carried out over extremely rugged and precipitous terrain.

# 3. CONCLUSIONS

## 3.1. Findings

- The helicopter departed from La Seu d'Urgell Airport with just one pilot onboard to carry out construction work on a high voltage power line in the municipality of La Vansa i Fórnols (Lleida).
- The pilot was being assisted from the ground by an operator from an electrical company and another operator from his company, who had travelled by vehicle to the place where they were carrying out the work.
- The operator employed by the helicopter operator incurred a minor injury to his hand.
- The pilot landed on a nearby road, picked up the operator, and began returning to the departure aerodrome, flying in a straight line with a heading of 290º, so that the ground operator could receive medical attention.
- The helicopter crashed as it was climbing up a steep slope over rugged and precipitous terrain.
- A fire broke out after the impact, engulfing and burning the entire front part of the aircraft.
- The aircraft impacted the ground with a high rate of descent, a low horizontal speed, a right-hand roll attitude, and its nose pitched uphill.
- The rotor blades were not severely damaged.
- We have not been able to determine the specific cause of the possible loss of engine power.
- The company's pilots have a low perception of the risks of operating at low altitude and a high level of confidence in the reliability of the engines they operate.

## 3.2. Causes/contributing factors

The investigation has concluded that the accident occurred due to the impossibility of preparing and executing an autorotation manoeuvre after suffering a sudden loss of engine power due to the low altitude a witch the helicopter was flying.

## 4. RECOMMENDATIONS

The following recommendation was to be proposed:

REC. XXX/2021. It is recommended that SAFRAN should review its documentary control procedures for the maintenance work they carry out on their engines outside of their facilities.

Neverless, following a Quality audit that was carried out at the beginning of 2020 and the observations made in the context of this accident, Safran launched a progress action which consists, in a first, to update the General Alert Service Letter n ° 2266/03 (initial edition dated January 23, 2007) addressed to all the operators and repairs centers that are Safran HE customers. This update (in force since June 23, 2021) will allow Safran in a second step to initiate the update of the repair / overhaul process, the performance of maintenance operations, in order to be more robust in the follow-up of damaged equipment.

## ANNEXE 1. ACCIDENT SCENE