Technical report
A-049/2021

Accident on 22 October 2021, involving a Eurocopter AS-350-B3 aircraft, registration EC-JEA, operated by Eliance, in the Vall d'Arán, Lérida (Spain)

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GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
UNDERSECRETARIAT
CIVIL AVIATION ACCIDENT AND INCIDENT INVESTIGATION COMMISSION

Notice

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

In accordance with the provisions of Article 5.4.1 of Annex 13 of the International Civil Aviation Convention, Article 5.5 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, 4 and 21.2 of RD 389/1998, this investigation is exclusively of a technical nature and its objective is the prevention of future aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent their recurrence. The investigation is not intended to attribute any blame or liability, nor to prejudge any decisions that may be taken by the judicial authorities. Therefore, and according to the laws specified above, the investigation was carried out using procedures not necessarily subject to the guarantees and rights by which evidence should be governed in a judicial process.

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CONTENTS

ABBREVIATIONS

° ‘ “	Sexagesimal degrees, minutes and seconds
°C	Degrees Celsius
AEMET	State Meteorological Agency
AESA	Spain’s National Aviation Safety Agency
ALF	After the last flight of the day Inspection
AMM	Aircraft Maintenance Manual
AOC	Air Operator Certificate
ARC	Airworthiness Review Certificate
BFF	Before the first flight of the day Inspection
CAMO	Continuing Airworthiness Management Organisation
SOE	Special Operator Certificate
CPL(H)	Commercial helicopter pilot license
CRM	*Crew Resource* Management
CWP	Caution and Warning Panel
DECU	Digital Engine Control Unit
E	East
EASA	European Union Aviation Safety Agency
EECU	Engine Electronic control Unit
EHEST	EASA’s European Helicopter Safety Team
ELT	Emergency location transmitter
FAA	United States Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FH	Flight hours
FLI	First Limit Indicator
FLM	Flight Manual
ft	Feet
GPS	Global Positioning System
h	Hours
HESLO	Helicopter Sling Load Operations
HMU	Hydro-mechanical metering unit

kg	Kilograms
km	Kilometres
km/h	Kilometres per hour
kt	Knots
kw	Kilowatts
l, l/h	Litres, Litres/hour
LAPL	Light aircraft pilot license
LEVH	ICAO code for Viella Heliport (Lérida)
m	Metres
mm	Millimetres
m/s	Metres/second
m^2	Metres squared
MSM	Master Service Manual
MTOP	Maximum take-off power
s/n	Serial number
N	North
N1	Rotation speed of the low-pressure compressor
Nf	Free power turbine speed
Ng	Engine gas generator speed
NR	Rotation speed of the main rotor
O	West
ICAO	International Civil Aviation Organisation
OM	Operating Manual
OPC	Operator Prooficiency Check
OSD	Operational Suitability Data
PF	Pilot flying
PNF	Pilot not flying
PIC	Pilot-in-command
PPL(H)	Private Helicopter Pilot License
RPM	Revolutions per minute
SAR	Search and rescue service
SB	Service bulletin
SMS	Operational Safety Management System
SP	Single Pilot
TA	Visual inspection of the aircraft during turn-around

TRI(H)	Type rating instructor (helicopter)
UTC	Coordinated universal time
VEMD	Vehicle and Engine Multifunction Display
VFR	Visual flight rules
VHF	Very high frequency (30 to 300 MHz)

Technical report

A-049/2021

Owner and Operator:	Eliance Helicopter Global Services
Aircraft:	Eurocopter AS-350-B3, registration EC-JEA, s/n: 3819
Date and time of accident:	Friday 22/October/2021 14:51 UTC
Site of the accident:	Municipality of Naut Aran, Lleida (Spain)
Persons on board:	2 student pilot and instructor
Type of operation:	Aerial work - Non-commercial - Others
Phase of flight:	Landing
Flight rules:	VFR
Date of approval:	01/MARCH/2023

Synopsis

Summary:

On Friday, 22 October 2021, the Eurocopter AS-350-B3 aircraft, registration EC-JEA, during a training flight with two crew members on board, while they were performing a governor failure simulation manoeuvre, a hard landing occurred that caused one of the skids to break, causing significant damage to the helicopter.

The crew were unharmed and were able to get out of the aircraft by their own means.

The investigation has revealed that the probable cause of the accident was the inadequate execution of the governor failure simulation procedure, which resulted in a loss of control of the aircraft, causing it to impact the ground.

The following factors are considered to have contributed to the event:

- inadequate supervision by the instructor pilot that did not make it possible to recover from the emergency.
- a loss of situational awareness by the pilot under instruction in the final phase of the manoeuvre, leading him to improperly execute the reversion to the automatic mode of the governor’s operation, probably due to overconfidence and poor monitoring of the flight parameters.
- the crew's confusion and inadequate understanding of the governor failure training procedure.
- the failure to select a training area that met the appropriate safety conditions for performing this type of emergency manoeuvre.

The report contains three safety recommendations, two addressed to the operator relating to the governor failure simulation training procedure and ensuring the correct functioning of the fleet tracking systems on its aircrafts. The third recommendation is addressed to the aircraft manufacturer regarding the dual control twist grip installed for training on the AS- 350-B3 2B helicopter.

1. THE FACTS OF THE EVENT

1.1. Overview of the accident

On 22 October 2021, at 14:40 UTC, the Eurocopter AS-350-B3 2B aircraft with registration EC-JEA, operated by Eliance Helicopter Global Services, took off from the Viella heliport in Lérida (LEVH) to conduct an instruction flight in the Pla de Beret area, with destination LEVH.

The crew consisted of two pilots who, on the day of the accident, were carrying out operational verification flights to train in the differences between the AS-350-B3 2B1 and 2B models. The roles of instructor pilot and pilot under instruction were alternated reciprocally between the two flights performed on the day of the event with the same scope of planned manoeuvres.

This type of recurrent training is carried out annually. The crew usually flew the 2B1 model and had not flown the 2B model in the last year.

The training on the differences between the AS-350-B3 2B1 and AS-350-B3 2B helicopters consisted of training on the start-up procedure (practising start-up and restart in flight) and simulating a governor failure.

After holding a briefing on the training to be carried out, which, according to the pilots, included defining their positions in the cockpit, they headed to the Pla de Beret area to carry out the planned exercises. According to their testimonies, they chose the area because it was habitually used and

Photograph 1: Aircraft at the site of event

known to the crew and had a large, flat expanse that was suitable for a running landing if necessary.

They performed a landing in the designated area to test the governor by switching it from AUTO (automatic) mode to MAN (manual) mode, simulating a governor failure. The test was successful, and the system recovered the RPM when it was switched back to automatic mode.

They then took off again to return to the point where they would simulate the governor failure. According to the instructor pilot's statement, their altitude during the manoeuvre was that of normal traffic, about 500 ft or higher in some sections.

With the helicopter stabilised at about 60 kt and downwind leg, they started the governor failure simulation. The instructor pilot switched the governor selector from AUTO to MAN mode, and the red governor light and the amber twist grip light on the CWP[1] (Caution & Warning Panel) illuminated. After this, according to his statement, the pilot under instruction began to control the RPM manually via the twist grip.

They maintained a speed of about 40 kt throughout the long final flight leg, with the pilot under instruction keeping the RPM within the green arc on the indicator (about 390 RPM). According to the instructor pilot's statement, in the final phase, with a descent rate of about 200 ft/min, the pilot under instruction kept the RPM above the green arc (between 400 and 410 RPM) so that when they entered a stationary hover and pulled the collective, it would allow a more significant margin of action in the face of the consequent fall in RPM.

According to the crew's testimony, at 14:51 UTC, when they approached the area selected to land at about 5 to 10 kt, with the low RPM audible warning activated (below 360 RPM) and close to the ground (about 10 ft approximately), the RPMs decreased to the bottom of the green arc. Realising that they could not reach the selected landing area, they decided to abort the landing. To this end, according to his testimony, the instructor pilot switched from MAN to AUTO mode, and they noticed the expected yaw as the RPMs momentarily recovered. But when they pulled on the collective to abort the landing, the RPMs dropped again, and the helicopter sank, making running contact with the ground with its right skid and moving horizontally about 2 or 3 m with a negative pitch (nose down).

Due to the unevenness of the terrain, the aircraft lifted and then fell again, this time onto an upward incline, again resulting in a negative pitch attitude which caused the right skid (level with the front crosstube) and the right-hand underside of the nose to collapse, broke the lower cable cutter and caused the aircraft to rotate 45º, which brought it to an abrupt halt. The impact triggered the ELT, and Palma SAR contacted the operator to confirm the emergency situation.

The crew secured the aircraft and were able to evacuate, unharmed, by their own means. They then proceeded to inform the relevant authorities.

[1] CWP: Caution & Warning Panel - Warning panel with warning and caution lights.

1.2. Injuries to persons

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

1.3. Damage to the aircraft

The aircraft sustained damage to the right skid, which collapsed and broke where it meets the front crosstube; the lower front window and mirror attachment were deformed; the lower cable cutter was severed, and the upper one was damaged. It also sustained cuts to its tail rotor drive shaft fairing, and the shaft itself was damaged.

1.4. Other damages

There was no third-party damage.

1.5. Information about the personnel

1.5.1. Instructor pilot

The 31-year-old Spanish instructor pilot, PNF and PIC, who was in the left-hand cockpit position on the event flight, held a commercial helicopter pilot licence, CPL(H), issued by the Spanish Aviation Safety Agency (AESA) on 31/08/2010 with the following ratings:

- Type rating AS-350/EC-130/SP single-pilot, valid until 31/12/2021.
- Type Rating TRI(H)/SP instructor rating AS-350/EC-130 single-pilot, valid until 30/11/2023.

English language proficiency certificate level 5, valid until 02/02/2024.

Medical certificate valid until 18/09/2022 for class 1 and until 18/09/2023 for class 2 and LAPL.

He had a total of 2,613:12 FH, of which 600:09 h were in the type of aircraft involved in the event. Other aircraft he had flown included the Robinson R22 /R-44, Cabri G2, EC-120b, AS-355F2, AS-350 (B2, B3 equipped with Arriel 2B engine, B3 equipped with Arriel 2B1 engine, B3e equipped with Arriel 2D engine), and H130 T2.

In terms of recent experience, he had accrued 43:16 flight hours in the last 3 months.

Most of his recent activity consisted of SAR watches, and on the day of the event, he was on SAR helicopter duty.

According to the pilot's logbook, since 30/11/2020, he had only flown the AS-350-B3 2B1 model, and the event flight was his first in the 2B model for almost a year.

On the flight prior to the event, the instructor pilot was the pilot under instruction, completing the same type-differences course as that being undertaken on the event flight. This previous flight lasted 32 minutes and involved 3 landings. The flights in the days immediately preceding the day of the event were performed on 19/10/2021 and consisted of 2 nine-minute flights, both with 2 landings and both flown in the AS-350-B3 2B1 aircraft that he had been flying in recent months.

The last operator proficiency checks (OPC[2]) were as follows:

- OPC LPC AS-350-B3 2B1 occupying the right-hand position, with a duration of 1:09 h, performed on 22-12-20.
- Recurrent training OPC APP AS-350-B3 occupying the left-hand position, with a duration of 29', performed on 27-07-21 together with the operational CRM.

The last recurrent training sessions received were:

- Training in the AS-350-B3 2B1 helicopter carried out on 17/12/2020 occupying the right-hand position with a duration of 53'.
- Training in the APP AS-350 helicopter and operational CRM carried out on 27/07/2021, occupying the left-hand position with a duration of 33'.
- Training in the differences between the AS-350-B3 2B1 and 2B and operational CRM, performed on 22/10/21 during the flight prior to the event, in the same AS-350-B3 2B helicopter and occupying the right-hand position. This flight departed from LEVH, conducted the training in the Pla de Beret area, and returned to LEVH without incident after a total flight duration of 32'.

The pilot had undertaken the same type-differences training as that carried out on the event flight when he joined the company in 2019. He then continued to fly the 2B1 model, and as a year had passed in which he had not flown the 2B model, he had to repeat the recurrent type-differences training.

1.5.2. Pilot under instruction

The 49-year-old Spanish pilot under instruction, PF, who was in the right-hand cockpit position on the event flight, held a commercial helicopter pilot licence, CPL(H), issued by the Spanish Aviation Safety Agency (AESA) on 18/03/1998, and a private helicopter pilot license PPL(H) since 13/01/1998 with the following ratings:

- Type rating AS-350/EC-130/SP single-pilot, valid until 31/12/2021.
- Type rating AS-355/SP single-pilot, valid until 30/04/2022.
- Type Rating TRI(H)/SP instructor rating AS-350/EC-130 single-pilot, valid until 31/10/2022.

Medical certificate valid until 06/04/2022 for class 1 and until 06/10/2023 for class 2 and LAPL.

He had a total flight experience of 8,488:00 FH, of which 7,017:00 h were in the type of aircraft involved in the event. He also had experience in AS-350 (B2, B3 equipped with Arriel 2B engine,

[2] OPC: Operator Proficiency Check.

B3 equipped with Arriel 2B1 engine, B3e equipped with Arriel 2D engine), AS-355 and B0105 aircraft.

In terms of recent experience, he had accrued 100:20 flight hours in the last 3 months.

The pilot had been with the company since 24/07/2004, and his most recent activity had primarily involved HESLO[3], for which he was also an instructor.

On the day of the event, he was carrying out aerial HESLO work.

On the flight immediately prior to the event, the pilot under instruction was the instructor pilot for the same type-differences course as that being undertaken on the event flight. This previous flight lasted 32 minutes and involved 3 landings. He had also flown another flight that day, lasting 01:05 hours with the same aircraft. His most recent flights prior to the day of the event were 3 flights in the same type of helicopter made on 30/03/21, with a total flight time of 01:39 hours.

The last operator proficiency checks (OPC) were as follows:

- OPC AS-350-B3 2B1 occupying the right-hand position, with a duration of 1:05 h, performed on 22-12-20, together with the operational CRM.
- Recurrent training OPC APP AS-350-B3 2B1 occupying the left-hand position, with a duration of 23’, performed on 30-03-21.

The last recurrent trainings received were:

- Training on 25/10/20 in the AS-350-B3 2B helicopter occupying the right-hand position and lasting 47', which was his most recent training in the 2B model.
- Training in the AS-350-B3 2B1 helicopter carried out on 20/12/20 occupying the left-hand position with a duration of 51'.

[3] HESLO: Helicopter Sling Load Operations

1.6. Information about the aircraft

1.6.1. General information

The Airbus Helicopters AS-350-B3[4] 2B aircraft, registration EC-JEA and s/n: 3819 is a light, single-engine helicopter built in 2004, with a capacity of up to six people, equipped with a Turbomeca Arriel 2B turbine (MTOP[5] 557 Kw) s/n: 22047, whose avionics include an electronic VEMD[6] (with FLI[7]) and FADEC[8].

I. Main details

- Empty weight: 1,200 kg.
- Maximum take-off weight: 2,250 kg.
- Dimensions
  - Diameter of the main rotor: 10.69 m (3 blades)
  - Diameter of the tail rotor: 1.86 m (2 blades)
  - Total length: 12.94 m
  - Fuselage length: 10.93 m
  - Width: 1.87 m
  - Total height: 3.14 m
- Performance:
  - Never-exceed speed: 155 kts
  - Cruise speed: 140 kts
- Main rotor: semi-rigid with a *Starflex* rotor head.
- Tail rotor: flexible seesaw type[9].
- Transmission system: transmits the power from the engine to the main rotor and the tail rotor drive shaft, with the peculiarity that, as it's a free turbine, there's no clutch, and the transmission is carried out through a freewheeling unit in the engine shaft module.
- Landing gear: On the AS-350 variants, the undercarriage consists of two tubular steel crosstubes (front and rear) fastened to the side beams of the structure with rubber devices inside the attachment points and two light alloy skids. Two shock absorbers are mounted on the front crosstubes, one on each side of the cabin.

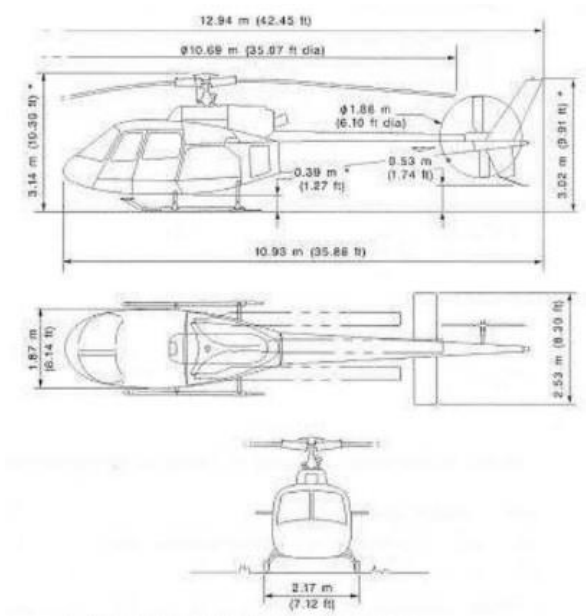


Figure 1: Aircraft AS-350-B3

[4] Model: POST-MOD 074302
[5] MTOP: Maximum take-off power
[6] VEMD: Vehicle and Engine Multifunction Display - A system consisting of two LCD multifunction displays used in flight mode to monitor the engine and helicopter, one on each display, optimising and calculating the mission parameters for the pilot.
[7] FLI: First Limit Indicator
[8] FADEC: Full Authority Digital Engine Control
[9] Flexible seesaw-type tail rotor.

On the flight in question, they were carrying approximately 240 litres of fuel, about 50% of the aircraft's capacity. Consequently, with two people on board, the equipment carried on the aircraft, dual control, etc., the aircraft's weight during the operation was below the maximum and its performance was not affected by any limitations.

The AS-350-B3 helicopter has multiple models and engines, but they all share the following characteristics:

1. Three-bladed Starflex main rotor head design.
2. Main rotor blades made of composite materials.
3. Single hydraulic system.
4. Flexible seesaw-type tail rotor, made mainly of composite materials.

The main differences between the 2B and 2B1 models, which are relevant to the investigation given that the pilots were being trained in this regard, are as follows:

A. The 2B model, which is equipped with a Turbomeca Arriel 2B turbine (MTOP 557 Kw) and electronic VEMD features, has:
    a. an engine governor supported by a single-channel FADEC,
    b. a twist grip on the collective lever, which can manually manage the fuel flow in the event of a governor failure.

B. The 2B1 model, which is equipped with a Turbomeca Arriel 2B1 turbine (MTOP 557 Kw) and electronic VEMD, has:
    a. an engine governor supported by a double-channel FADEC.
    b. A twist grip on the collective lever that can only select IDLE or flight position, with a fully independent emergency backup system that automatically engages in the event of a governor failure or for autorotation purpose. Automatic control of rotor speed according to operating conditions (noise reduction).
    c. The cockpit fuse panels have been replaced by circuit breaker panels in the AS-350-B3 helicopters from s/n: 4193 (from 01/01/2008).
    d. Optional double hydraulic system for the servo actuators.

II. Instrument panel

The flight instrument panel and auxiliary systems are based on the theory that when the helicopter is operating correctly, there's no need to capture the pilot's attention, and therefore the indication system generally only indicates any abnormal operating parameters.

Red warning lights indicate a serious operational hazard, and amber caution lights indicate an abnormal operating configuration or a reduction in system capabilities. These indicator lights are located on the CWP in front of the pilot.

The following photographs show the panels of the AS-350-B3 2B aircraft involved in the event and that of the AS-350-B3 2B1 helicopter to highlight the differences between the two that may have influenced the pilots' operation of the aircraft during the event, given that the crew were training in the 2B model when they usually flew the 2B1 model. Photographs 4 and 5 highlight the fundamental differences between the CWPs in the two models.

Photograph 2. Instrument panel in the model 2B incident aircraft

Photograph 3. Instrument panel in the model 2B1 aircraft

Photograph 4. CWP of the 2B aircraft

Photograph 5. CWP of the 2B1 aircraft

III. The helicopter's systems of interest to the investigation

Governor

The helicopter involved in the event was equipped with an engine that works with a governor, which is responsible for keeping the NR[10] within the normal operating range (green arc between 375 and 394 RPM) by automatically controlling the fuel metering unit via the electronic engine control unit (EECU[11]).

The governor's mode of operation is determined by the selector located in the upper part of the cockpit, which has AUTO/MAN options to select automatic and manual modes, respectively. In automatic mode, the governor automatically regulates the engine's fuel flow; in manual mode, fuel flow adjustments are made by manually turning the twist grip.

Photograph 6. Selector AUTO-MAN

A FADEC-type engine governor includes:

- a digital computer often called DECU[12] or, sometimes, FADEC,

[10] NR: Rotation speed of the main rotor.
[11] EECU: Engine Electric Control Unit
[12] DECU: Digital Engine Control Unit

• a pump/metering unit known as an HMU[13],
• a system of electrical and mechanical connections between the helicopter, the DECU and the HMU.

Since the operation of helicopters equipped with electronically controlled engines is very different from earlier hydromechanically controlled versions, pilots must undertake specific training to fly them safely. The training differs according to the aircraft version and must be conducted with an experienced instructor.

A governor failure, such as the one simulated in the training of this event, in the case of a real failure, can be caused by a blockage of the metering valve, by problems in the metering unit itself, or by a malfunction of the engine control system. In the event of a governor failure, the red GOV light would be displayed on the CWP, simultaneously, the audible alert would be activated (gong sounds), and according to the helicopter flight manual, the fuel flow would be set to the value it had before the failure occurred. The red GOV light also illuminates if the governor operating mode selector is set to MAN.

If the governor or fuel control unit fails[14], any change of the collective pitch requires manual adjustment of the twist grip to maintain correct NR. If the situation, for any reason, cannot be managed correctly with the twist grip, then the appropriate solution will be to perform an autorotation.

A governor failure can be indicated in two ways: red or amber GOV light illumination. A red GOV light indicates a total failure of the control system, and the amber GOV light indicates a degraded operation of the control system; this light may also indicate a minor failure by flashing during engine start-up, at idle or during engine shutdown (if N1[15] is below 20%).

Twist grip

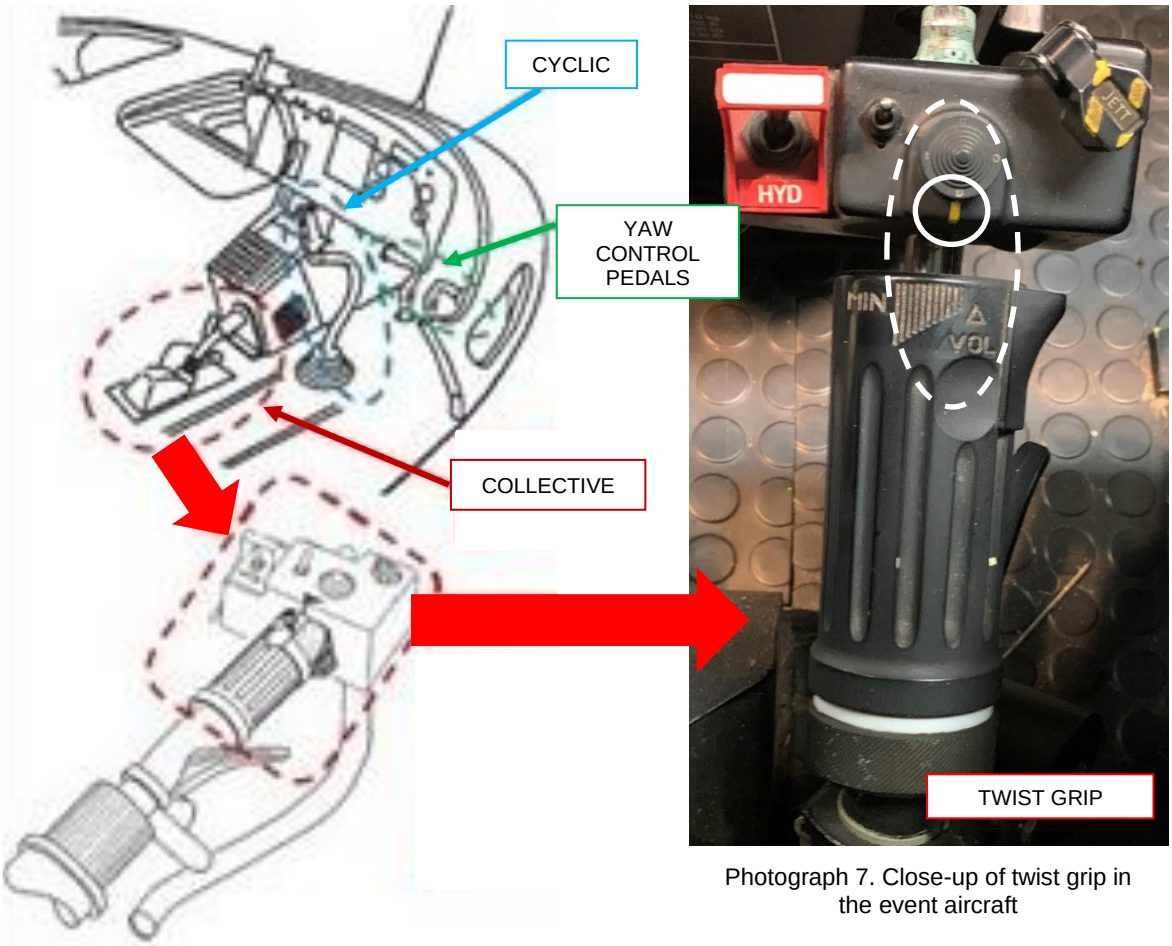
The twist grip at the end of the collective pitch lever acts as a manual fuel flow control. The design incorporates a locking pin to lock the emergency range of the twist grip. In AUTO mode, the NR is automatically adjusted by the EECU, thus limiting inadvertent turns of the twist grip and preventing potential exceedances of the various engine parameters.

When this position is unlocked, the amber TWT GRIP light on the alert panel illuminates, indicating that fuel flow management is being performed manually by turning the twist grip.

In normal operation, the yellow mark of the twist grip is always aligned with the FLIGHT (ΔVOL) position, if the twist grip is not in the flight position, so not aligned, as shown in photo 7, then the amber TWT GRIP light on the CWP will illuminate, indicating.that the fuel flow can be managed manually, turning it to the right to decrease the fuel flow and to the left to increase it.

[13] HMU: Hydro-mechanical metering unit
[14] Helicopter Flying Handbook of FAA (FAA-H-8083-21A 11-21 on page 151)
[15] N1: Rotation speed of the low-pressure compressor.

The twist grips on the 2B and 2B1 models (photos 8 and 9) differ in the following ways:



Photograph 7. Close-up of twist grip in the event aircraft

Figure 2. Distribution of the helicopter's controls.

- Model 2B: MIN and VOL positions or flight position can be selected on the twist grip. Older serial numbers (PRE MOD 073084) were equipped with a manual locking and unlocking device to set the emergency range taking the form of a red push-button, while those manufactured after 01/01/2003 (POST MOD 073084) have an automatic electrical release that activates when the red GOV light on the CWP comes on.

- Model 2B1: IDLE and FLIGHT positions can be selected on the twist grip or flight position, and it has a fully independent emergency backup system that automatically engages in the event of a governor failure.

Photograph 8. Collective in the 2B accident model

Photograph 9. Collective in the 2B1 model and close-up of the twist grip

IV. Operational procedures

The operational procedures relevant to the investigation are, firstly, the standard take-off, approach and landing procedures to examine the crew's performance following the decision to abort the landing; and lastly, the emergency procedure to be applied in the event of a governor failure, given that this was the situation being simulated for training when the accident occurred.

Normal procedures

- **Take-off**

For take-off, gradually raise the collective pitch and maintain a hover, facing into the wind, at a height of about 5 ft.

Check that the transmission and engine monitoring instruments are within normal operating values.

To transition from the hover, increase speed without increasing power demand and do not climb until the speed is 40 kt.

- **Approach**

The final approach should be made into a headwind at a low rate of descent and a recommended speed of 65 kt (120 km/h).

- **Landing**

From a hover, reduce the collective pitch gradually until touchdown is achieved; it can then be cancelled completely.

If landing on a slope, the cyclic control lever must be returned to neutral before setting the collective pitch to its lowest position.

Emergency procedure for governor failure

According to section 3.3 of the helicopter flight manual, the following emergency procedure should be applied when the red "GOV" light is illuminated on the CWP panel, activating the governor failure warning or when MAN mode engaged.

The fuel flow is frozen at the value prior to failure and automatic unlocking of the FLIGHT detent (VOL):

1. Check flight parameters.
2. Keep the NR within the green range on the indicator.
3. The twist grip is automatically released (for aircraft design POST MOD 073084 as it is in this event) so the fuel flow can be modified by turning the twist grip clockwise to decrease the flow and anticlockwise to increase the flow. The NR must be controlled to ensure the MAX NR alarm is never activated.
4. Only make smooth synchronised adjustments with the collective pitch control to maintain NR in the green range.
5. The approach must be made at 40 kt, and the fuel flow adjusted to maintain NR in the upper section of the green range.
6. If necessary, slowly reduce speed by slightly adjusting the fuel flow with the twist grip to maintain NR within the green range.
7. On the final approach, when the collective pitch is raised to reach a hover[16], allow the NR drop for touchdown. Next, reduce the fuel rate before lowering the collective pitch.

This failure may also result in a loss of Ng[17] and the torque parameters shown on the VEMD. In all cases, the NR must be controlled so that the maximum NR alarm is never activated.

To switch back from MAN mode to AUTO mode, the pilot must return the "AUTO/MAN" selector to the AUTO position, regardless of the NR value. The twist grip must then be returned to the FLIGHT (VOL) position, which will extinguish the red and amber GOV and TWT GRP lights.

[16] The operation does not actually correspond to a hover itself, but rather a transition through hover conditions with the recommended NR for contact with the ground.
[17] Ng: Engine gas generator speed

V. Training procedure for governor failure

According to Flight manual SUP 6, point 2.4.2:

In steady flight conditions, set the "AUTO/MAN" selector to "MAN".

- Apply the appropriate emergency procedure (red "GOV" warning light) SECTION 3.3 page 4 of the present Flight Manual.
- At the end of the training procedure or when needed, reset the "AUTO/MAN" selector to "AUTO" (red "GOV" light extinguishes), bring back the twist grip into the FLIGHT detent (VOL) ("TWT GRP" and amber "GOV" lights extinguish). Check that the FLIGHT detent (VOL) stop is automatically back in position.

IMPORTANT : It is possible to switch back the AUTO/MAN selector to the automatic fuel control mode (AUTO mode) at any time and for any NR value.

WARNING : RESETTING TO "AUTO" MODE AFTER MANUAL FUEL FLOW TRAINING MAY ACTIVATE THE IDLE SWITCH LEADING TO A LOSS OF POWER. RESELECTION TO AUTO SHOULD ONLY BE MADE ON GROUND AFTER LANDING OR IN A FLIGHT CONDITION ALLOWING A LANDING IN AUTOROTATION.

1.6.2. Maintenance information

The aircraft was built in 2004 with serial number: 3819. The helicopter was maintained by AESA approved organisation, ELIANCE SERVICE & SUPPORT, S.L. (ES.145.036) and the management of continuing airworthiness was in charge of CAMO ELIANCE HELICOPTER GLOBAL SERVICES, S.L.U. (ES.MG.H17). . Likewise, it had a Maintenance Program approved on June 28, 2021, with reference AH-AMP-AS350B3.

According to this maintenance programme, periodic airframe inspections of varying scope and depth must be performed daily, every 10 FH or 7 days, 150 FH or 12 months, 600 FH or 24 months, and 1,200 FH or 48 months (whichever occurs first); and engine inspections are to be performed daily, every 150 FH and every 600 FH.

In addition, following an operational incident or in unusual weather conditions, unscheduled inspections defined in the MSM[18] must be carried out. The daily inspections include:

- BFF: Before the first flight of the day
- TA: Turn around
- ALF: After the last flight of the day

[18] MSM: Master Service Manual

The attached table shows the line and base maintenance inspections for the AS-350-B3 helicopter type.

MODELO DE AERONAVE	LIMITACIÓN	NIVEL DE MANTENIMIENTO	
		LÍNEA	BASE
Eurocopter AS 350 (Turbomeca Arriel 2)	**AS 350 B3**	**Inspecciones Programadas de célula:** **Horas:** Hasta 600H (600FH/24M, MSM 05-22-00; 600FH, MSM 05-22-01), excluida. **Calendario:** Hasta 24 M (600FH/24M, MSM 05-22-00; 24M, MSM 05-22-02), excluida. **Otras inspecciones:** • Servicing AMM 12-10-00, 12-30-00 • Mantenimiento programado (hasta 600H excluidas), preventivo y correctivo de Nivel 1, según el Manual de Mantenimiento de Turbomeca.	**Inspecciones Programadas de célula:** **Horas:** Hasta 1200H (1200FH/48M, MSM 05-23-00; 1200H, MSM 05-23-01), incluidas. **Calendario:** Hasta 144 M, MSM 05-24-02, incluido. **Otras inspecciones:** Mantenimiento programado (hasta OVH/HSI excluido), preventivo y correctivo de Nivel 1, según el Manual de Mantenimiento de Turbomeca.
		Otras inspecciones: • Specific periodic interval MSM 05-25-00, 05-26-00, 05-3X-XX (Optional equipments) • Inspecciones especiales Condicionales según MSM 04.20.00, sin intervalo específico • Inspecciones especiales sin margen de tolerancias Según MSM 04-20-00, MSM 05-25-00, MSM 05-22-0 • Inspecciones especiales "one-off time limits" a realizar un número limitado de veces, según MSM 05-26-00, MSM 05-25-00. • Inspecciones especiales de equipos opcionales según 05-3X-XX • Las inspecciones especiales después de un incidente según: AMM 05.50.00 (Unscheduled maintenance checks) • Calendar Inspections – Main Rotor Drive/Tail Rotor Drive según AMM 05-60-00	

The aircraft was up to date as regards the implementation of the manufacturer's applicable service bulletins and airworthiness directives. With regard to the type of twist grip installed, which had undergone multiple modifications by the manufacturer given that it was a POST-MOD 073084 and PRE-MOD 073222, on 18/01/2010, modification AMS 073222 was implemented with the installation of the new SB 67.00.33-compliant solenoid when the aircraft had 2,437:27 hours of flight time.

The SB 67.00.33 modification dated 07/07/2008 consisted of a functional improvement to the twist grip, as it was found that its solenoid was overheating when in continuous operation for a prolonged period of time, causing the locking pin (lock finger) to jam, with the consequent loss of the governor function.

To address this problem, SB 05.00.44 issued specific solenoid inspection instructions, stating that if the operating time exceeded 15', the waiting time between two operations was less than 15', or an actual governor failure had occurred, the twist grip's solenoid should be replaced before the next flight.

Eventually, with the implementation of SB 67.00.33, it was decided that a new higher resistance solenoid should be installed through modification 073222.

The FAA issued a special airworthiness information bulletin (ref. SW-06-48 of 21/06/2006) on this matter, stating that in the case of total governor failure training flights, the following should be specifically addressed:

- that they should be conducted with an experienced instructor,
- that training should be conducted at a safe altitude that allows sufficient time to revert to AUTO mode, if necessary,
- and that if any difficulty arises during operation in manual mode, the AUTO mode should be reverted to immediately.

At the time of the event, the helicopter had accumulated 6,142:06 hours of flight and 30,692 landings.

The last scheduled maintenance overhaul was carried out on 19/10/2021 when the aircraft had 6,137:04 operating hours and 30,679 landings. This was a 600-hour overhaul, which included the following tasks of interest to the investigation:

- the functional check of the twist grip solenoid (AMM task 76-12-02, 6-1), which, being a POST-MOD 073222 (and PRE-MOD 073261) model, was not carried out on the helicopter involved in the event, as it was not applicable, and
- the inspection of the FADEC unit, with self-test according to engine task AMM 73-20-00, 6-1.

The maintenance tasks performed on the day of the accident consisted of carrying out the established BFF and TA inspections, as well as configuring the dual controls for training.

On the day of the event, the aircraft performed five flights prior to the accident. The flight immediately preceding the event flight was the flight in which the two pilots had exchanged the roles of instructor pilot and pilot under instruction for training in the differences between the 2B1 and 2B models. It commenced at 14:03 h, involved 3 landings, and lasted for a total of 32 minutes. The four previous flights, which commenced at 6:07 h and ended at 12:05 h, involved 3:28 hours of flight time and 8 landings. None of these flights reported any type of aircraft failure or incident.

1.6.3. Airworthiness status

According to AESA's record of active registrations, the aircraft with serial number 3819 and registration EC-JEA was registered on 01/02/2021, with registration number 7190 and the operator involved in this event listed as the lessee.

The aircraft had Airworthiness Certificate No. 5726, issued by AESA on 20/11/2009 with indefinite validity, in the "Small Helicopter" category with designation as a "Eurocopter SA AS-350-B3". It also had an airworthiness review certificate with ref: ES.ARC-JEA-004, valid until 17/12/2021 and issued when the aircraft had 6,032 flight hours.

The aircraft also had the following available authorisations:

- Noise certificate issued on 05/05/2010, with indefinite validity.
- Aircraft station licence ref: 5.726/05-3 issued by AESA on 21/01/2010 and ELT.

1.7. Meteorological information

The crew consulted the weather forecast for the municipality of Vielha e Mijaran (Lleida) at an altitude of 974 m, which indicated a light south-southwesterly wind with drizzle at speeds of less than 5 kt; visibility of more than 10 km and a temperature between 10 and 11ºC.

According to the crew's statement, the weather was not relevant at the time of the event, noting that there was some drizzle with visibility of more than 10 km and that, although the prevailing wind in the early hours of the morning was light from the south-southwest, at midday it changed direction, coming from the north-northwest.

We consulted AEMET to obtain meteorological information for the time of the event and during the previous week to assess the possibility that the condition of the terrain, due to possible precipitation, may have contributed to the damage to the helicopter.

As there is no weather station at the site of the accident, AEMET provided the parameters recorded at three nearby stations, whose values have been analysed.

No precipitation was recorded during the week before or on the date of the event.

The maximum recorded wind speed was about 14 kt. The wind direction was west-northwesterly. The relative humidity at the station closest to the accident site was almost 100%, and the temperature was 0ºC, but the fact that this station's altitude (2,467 m) is 600 m higher than that of the accident site, at a little over 1,800 m, must be taken into account.

According to the low-altitude map forecast, there could have been low cloud cover and reduced visibility due to obscured mountains in the area of the accident. In addition, as the relative humidity was almost 100%, fog was likely to have formed.

1.8. Aids to navigation

The flight was operating under visual flight rules (VFR).

1.9. Communications

The aircraft was equipped with a Garmin GNS430 VHF COMM 1 system, a BENDIX KING KX 165 VHF COMM 2 system, and a NAT.NPX VHF-FM1 COMM system. All three systems were working correctly and are not relevant to the causes of the event.

After the accident, the crew made the relevant calls following the company's procedures for event management and notified the CIAIAC of the event.

As a consequence of the helicopter's impact with the ground, the emergency beacon (ELT) was activated, alerting the SAR unit at Palma de Mallorca, which was informed that the event did not involve casualties and that there was no need for its services.

According to the information provided by the crew, as is usual in the organisation, when they begin a flight, they inform their coordination centre via Telegram, as they did in this event, connecting with the Viella heliport frequency and the air-to-air frequency used by the air resources in the area.

1.10. Information about the accident site

The aircraft took off from the Vielha helicopter base (LEVH) to conduct a training flight in the Pla de Beret area, which offers a large, flat expanse suitable for performing a running landing if necessary.

Photograph 10. Helicopter at the accident site

The operator frequently conducts this type of training in this area due to the proximity to its operational base. It also has an asphalted area and, further south, one of the flattest areas to be found in the Valle de Arán operations area, at an altitude of around 1,800 m.

Photograph 11. Orography of the accident site

The geographical coordinates of the crash site, where the aircraft came to a halt, are 42° 43' 8.09" N - 0° 57' 33.14" E, elevation 1,851 m.

1.11. Flight recorders

The aircraft was not equipped with a flight data recorder or cockpit voice recorder, as the current aviation regulations do not require a flight data recorder to be carried on this type of aircraft, although it did have a VEMD, a DECU and fleet tracking system.

1.11.1. VEMD (Vehicle and engine management display)

The helicopter has a vehicle and engine management monitoring system, consisting of a multifunction display in the central part of the instrument panel, which shows the engine and aircraft parameters.

This system records any exceedances that may have occurred in the parameters it monitors, such as main rotor speed, torque, compressor and free turbine rotation speeds, etc.

The data corresponding to the accident flight was downloaded, confirming that no exceedance had been recorded.

The GPS log for 22/10/21 at 14:40 h showed a flight duration of 11', ending the flight at 14:51 h, registering engine cycles with the following Ng values: 0.81 and Nf[19]: 0.56, in both the right module and the left. The remaining registered values were 0.

[19] Nf: Speed of the free power turbine.

1.11.2. Fleet tracking system

Although the helicopter was equipped with the V2Track fleet tracking system, on the day of the event, the crew stated that they had noticed that it sometimes stopped working, possibly due to an electrical contact fault in its power supply.

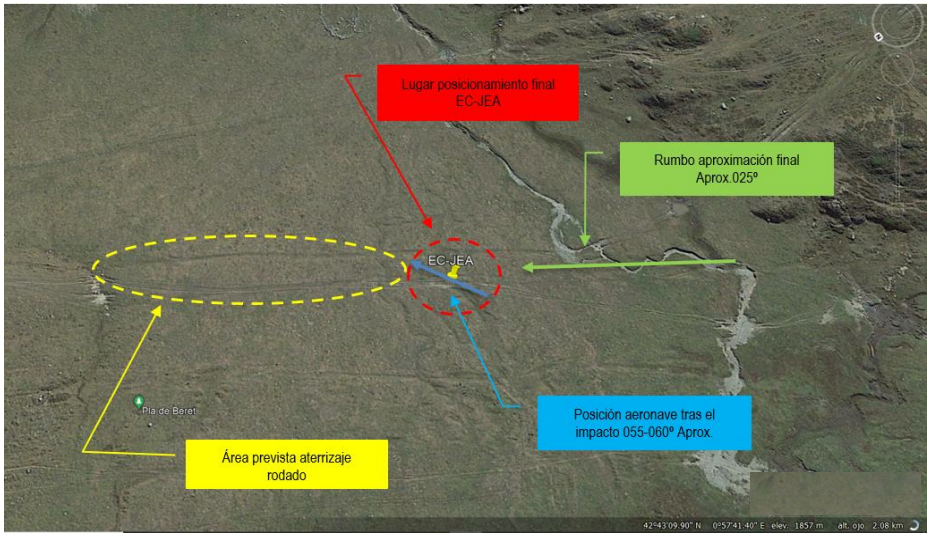


Figure 3. Sketch of the incident flight

It was indeed found that the system was experiencing intermittent failures, which meant that the event flight was not recorded, and there was no way of recovering the data.

The flight before the event in which the same type of training was carried out but with the crew taking alternate positions, was, however, recorded, and after assessing the cockpit's directional gyro after the impact and the testimonies provided by the crew, the operator produced an approximate sketch of the event flight, which is shown in Figure 3.

1.12. Information about the damage to the aircraft and the area of the accident

After two successive impacts with the ground, the aircraft came to rest at 42° 43' 8.09" N - 0° 57' 33.14" E, with its longitudinal axis oriented on an easterly heading, resting on the damaged landing gear. As a result of the accident, the helicopter suffered significant damage that rendered it unairworthy. Consequently, it was withdrawn from service and transferred to the operator's maintenance centre in Sabadell.

According to the crew’s statement, the first impact with the ground occurred while moving at a speed of about 10 kt and negligible vertical speed. Ground marks were identified, covering a distance of 2 to 3 m and becoming increasingly shallower in direction of the aircraft's forward movement.

Then, according to the crew, the helicopter once again lifted and fell back to the ground (which now presented an upward slope) at a forward speed of about 5-10 kt and again with negligible vertical speed, causing the lower right part of the nose and the right skid to collapse (where it meets the front crosstube). At that moment, according to the crew's testimony, the lower cable cutter and mirror support broke, and there was an impact on the tail drive shaft's protective fairing due to the aircraft pitching negatively again. The aircraft came to an abrupt stop rotating 45º clockwise. The marks on the ground produced by these movements are shown in the set of images labelled photograph 12.

The damage identified on the helicopter after the event was as follows:

- Rupture of the right skid where it meets the crosstube.
- Deformation of the left skid.



Photograph 12. Marks on the ground at the accident site

Photograph 13. Helicopter at the accident site - Landing gear

Photograph 14. Left skid

Photograph 15. Right skid

- Cuts to the tail rotor drive shaft fairing.
- Deformed tail rotor drive shaft.

Photograph 16. Tail rotor drive shaft fairing

- Deformed upper cable cutter.
- Breakage of the lower cable cutter.
- Damaged lower-right front fairing.
- Mirror support.
- Damage to the tips of two of the three main rotor blades (red and blue).
- Structure reinforcement bar left side transmission area damaged.

Photograph 17. Tail rotor drive shaft

Photograph 18. Left, upper cable cutter

Photograph 19. Right, lower cable cutter

Photograph 20. Lower right fairing

Photograph 21. Mirror support

Photograph 22. Tips of the main rotor blade

After the aircraft was transferred to the operator's maintenance facilities in Sabadell, an additional detailed inspection did not identify any further damage.

Both the aircraft and engine manufacturer determined that the helicopter's limitations resulted from the damage mentioned above, the engine being affected by damage to the rotor with hardly any to the blades, and the repercussions of making a hard landing with the engine running.

The manufacturer's damage identification found the aircraft's condition to be as shown in figure 4.

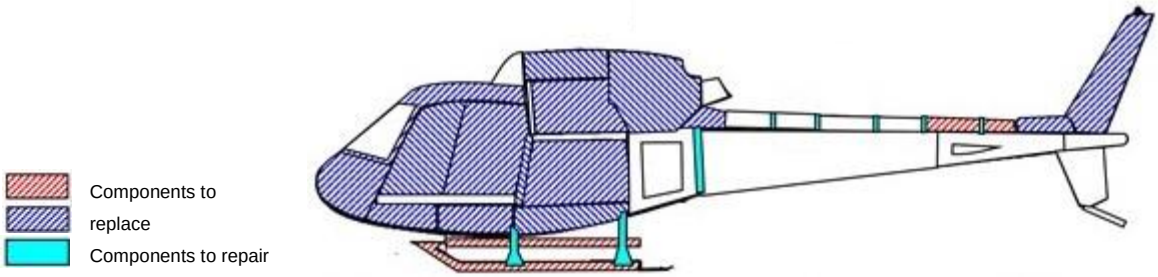


Figure 4. Identification of damage to the structure of the aircraft involved in the event

1.13. Medical and pathological information

N/A.

1.14. Fire

N/A.

1.15. Survival aspects

The helicopter cabin remained its structure intact and the safety belts worked effectively. As a result of the impact, the ELT emergency beacon was triggered, and the appropriate communications were generated.

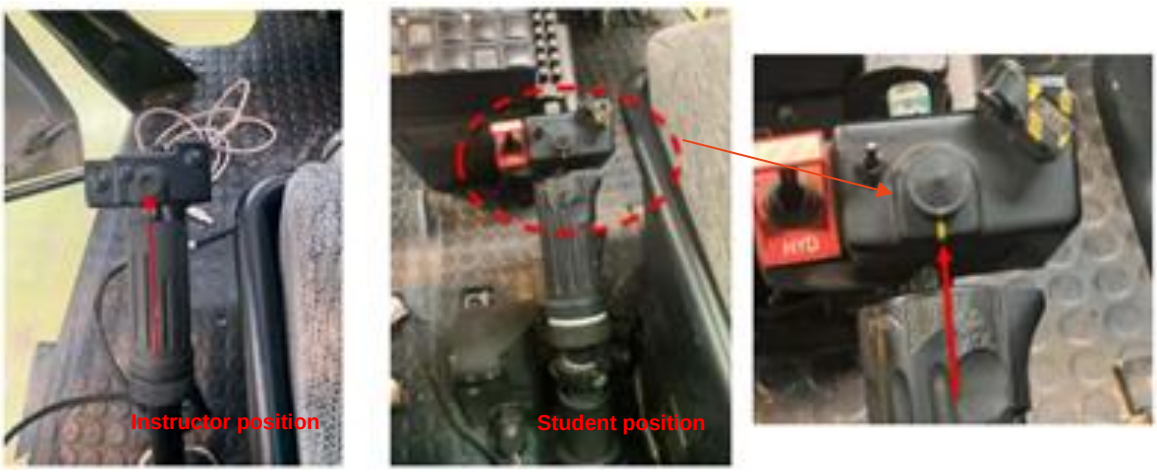
The crew were unharmed and exited the aircraft without assistance.

1.16. Tests and research

1.16.1. Technical inspection conducted by the operator

According to the information provided by the operator and the statements submitted by the crew, after simulating the governor failure, deciding to abort the landing and resetting the system to AUTO mode, the crew did not put the twist grip back into the flight position, as required by the governor failure training procedure described in FLM Supplement 6.

This procedure stipulates that the system can be reset from MAN to AUTO at any time and at any NR value but warns that this may result in a loss of power and should, therefore, only be done when the aircraft is on the ground after completing the training, or in flight, in conditions that allow for an autorotation landing.



Photograph 23: Position of left twist grip, right twist grip and close-up of right.

After the impact, it was established that the twist grips were not in the flight position, as shown in photo set 23. The operator's interviews with the crew identified confusion around the procedure described in FLM Supplement 6 and when to abort the simulated governor failure manoeuvre.

1.16.2. Information about the dual-control configuration for training

The collective pitch control installed in the left-hand cockpit position for training differs from the one in the right-hand position. The left-hand control is a standard control without any position mark on it, which is mechanically linked with the other control. So both twist grips are released at the same time when red GOV alert is illuminated or for training purposes when MAN mode is selected. Consequently, the instructor in the left-hand seat can actuate also over the twist grip in this situation.

Photograph 24: Twist grip installed for training in the left-hand position occupied by the instructor. Absence of yellow mark highlighted with a red circle.

The control installed for training purposes has no position markings on the twist grip, making it difficult to interpret its position visually.

The helicopter involved in the event was equipped with the POST-MOD No. 073084 twist grip with the AMS 073222 modification according to SB 67.00.33, which incorporates an electric trigger that automatically releases the throttle locking pin when MAN mode is selected or when the red GOV light is on. This safeguard ensures that, in an emergency, the locking pin releases, allowing the fuel flow to be controlled manually for any power setting.

In flight position, the POST-MOD No. 073084 twist grip is automatically released in both cockpits when the red "GOV" light illuminates in the following cases:

- In a real GOV failure, where the system automatically releases to allow the NR to be managed from both pilot positions.
- In a simulated GOV failure, after setting MAN mode, the system automatically releases to allow the NR to be managed from both pilot positions.

The locking pin on MOD No. 073084 returns to its normal position when the red "GOV" light goes out, i.e. in governor failure training, at the end of the exercise when the "AUTO/MAN" switch is set to AUTO, and as soon as the twist grip has returned to its FLIGHT position.

According to the manufacturer, and as per section 2, chapter 17 of the FLM, the AS-350-B3 helicopter is designed to be flown by a single pilot in the right-hand cockpit position. However, dual controls and an additional twist grip throttle can be fitted in the left-hand position as an option.

During training, the instructor sat in the left-hand seat, and the pilot under instruction was in the right-hand seat. The twist grip in the left-hand position did not have a yellow position marking, makingdifficult to identify its exact position.

1.17. Organisational and management information

The operator had a valid Air Operator Certificate (AOC) issued by AESA, with special limitations allowing it to fly only VFR in daylight, never above 10,000 feet and not over water or in a hostile environment.

The EC-JEA aircraft was withdrawn from AOC operations on 22/12/2020 and, since then, had been used for operations conducted within the scope of the SOE[20]. Under the SOE, the aircraft was assigned to Special Operations Specification B, Firefighting and Search and Rescue, as of 02/06/2021.

Additional approvals associated with both the AOC and the SOE allow the organisation to conduct type-differences courses for its flight crew and operational personnel.

The training being conducted when the event occurred was in accordance with the training procedures set out in the SOE Operations Manual rev. 11, Part D, Sections 2 and 3, on the recurrent training that the organisation provides to the flight crew, both on the ground and in flight, to ensure that operating standards are maintained at an appropriate level to operate safely.

These trainings cover the limitations and normal, abnormal and emergency procedures on the different types of helicopters operated within the fleet and provide training on the main failures likely to affect the aircraft systems and their associated procedures.

In the case of the AS-350-B3 helicopter, the flight crews operating different variants receive training and competency verification on the variant chosen as the "Base Helicopter" and on the differences between that and the other types of aircraft.

The AS-350-B3 2B1 to 2B differences course involves both in-flight training and a 30-minute simulator session. Specifically, crew members who complete training and simulator checks for the 2B1 variant must also complete in-aircraft difference training to operate the 2B variant according to the OSD[21].

The section below provides a detailed description of the training on the differences between the 2B1 and 2B models according to the operator's COE and the aircraft's FLM.

[20] SOE: Special Operator Certificate
[21] OSD: Operational Suitability Data

Furthermore, regarding the functions of the instructor pilot, the operator establishes in its manual that during training, the person exercising the functions of instructor is assigned as the commander, with the role of PIC. Therefore, in a training session, the instructor (PIC) sits in the co-pilot's seat, and the student (PF) sits in the commander's seat.

1.17.1. Training on the differences between the 2B1 and 2B variants

The operator regularly conducts training on the operational differences between the various models of AS-350-B3 helicopters, particularly the 2B and 2B1 variants.

The training consists of instruction in the start-up procedure (practising start-up and restarting in flight), selecting take-off power for FLIGHT mode and simulating a governor failure.

According to the aircraft flight manual, on the 2B model, the twist grip must be in the FLIGHT position before the start procedure is carried out, and the three-position selector (OFF-IDLE-FLT/AR-RAL-VOL) located on the cockpit roof must be set to the IDLE mode.

Then, to start the flight phase, the flight position (FLT/VOL) must be selected on the three-position selector (OFF-IDLE-FLT/AR-RAL-VOL) without moving the collective twist grip, which must be kept on flight mode during normal operations.

On the other hand, in variant 2B1, before performing the start-up procedure, the twist grip must be in the IDLE position, selecting the flight mode using the two-position selector (OFF/ON) also located on the cockpit roof, and then turn the twist grip from the IDLE position to the FLIGHT/VOL position.

In regard to the training simulating the FADEC governor failure in variant 2B, the procedure to be followed in the training is identical to the procedure that should be followed in an actual governor failure. FLM Supplement 6 indicates that this procedure should be performed in stable flight, with the AUTO/MAN selector set to the MAN position. During the training, regardless of the manoeuvres being performed, the simulation can always be ended by resetting the selector to the AUTO position[22].

As soon as the manual position is engaged, the system reacts exactly as it would in the case of a real governor failure; therefore, the actions described in the emergency procedure in section 3.3. p.4 of the flight manual must be applied. The red "GOV" warning light on the CWP will illuminate, and the audible warning will sound. The fuel shut-off valve will remain fixed in the position it was in at the time of the failure or simulated failure, the locking pin that keeps the twist grip in the FLIGHT position will automatically release, and the amber "TWT GRIP" and "GOV" lights will illuminate on the CWP.

In a real governor failure scenario, the failure is irreversible, and therefore the crew should attempt to land as soon as possible. As a result, the simulation should proceed in the same way. The pilot must manually adjust the fuel flow using the twist grip to keep the NR within the green arc on the indicator, ensuring the maximum NR alarm is never activated.

[22] Flight Manual Training Supplement and Service Letter No. 1702-71-05

At the end of the training procedure, the AUTO/MAN selector should be returned to the AUTO position (the red "GOV" light will go out), the twist grip should be returned to the FLIGHT (VOL) position (the amber "TWT GRIP" and "GOV" lights will go out), and the crew should check that the FLIGHT (VOL) position locking pin has automatically returned to its position (in the case of the post-MOD No. 073084 twist grip installed in the helicopter involved in the event). The automatic system activates immediately as long as it has not been reduced by more than 30º. During this training, the pilot must be careful not to move the twist grip in the opposite direction.

The procedure indicates that in case of uncertainty or necessity during a governor failure simulation, the RPM can be recovered and an undesirable situation terminated by selecting the AUTO mode again so that the governor can manage the helicopter's RPM. This can be done at any time and with any NR value.

The applicable emergency procedure and limitations during this training are those specified in the FLM and its supplements[23]. This type of training may only be conducted during daylight hours.
During training, particular attention must be paid to ensure that the twist grip is used correctly, that only slight variations are applied to the collective's position when on short final, and that after landing, the collective pitch is lowered after reducing the fuel flow. The instructor must be prepared for excessive movements of the twist grip by the student when operating in manual mode. Governor failure should only be practised in stabilised flight.

The manual mode should be engaged while in stable flight, and before attempting a full landing, it should be ensured that the student has mastered the operation of the helicopter in "MAN" mode.

For landing, it is preferable to make a long final approach, with less power than in level flight, monitoring the NR and increasing the fuel flow using the twist grip as the speed decreases until reaching a hover, allowing the NR to reduce sufficiently to land.

1.17.2. Safety improvement measures

1.17.2.1. Actions taken by the operator

During the course of the investigation, the operator, through its SMS[24], conducted an analysis of the event that led to a series of internal recommendations that this Commission has identified as being suitable safety improvement measures.

The following measures were implemented immediately after the event:

I. The suspension of training between the two flight crew members until another company instructor could reassess them.
II. It was recommended to the training department that all pending in-flight training be conducted at airfields/airports to ensure safety in emergency manoeuvres.

[23] During the investigation of the event, as a consequence of a safety recommendation proposal in relation to the improvement of the wording of the governor failure training procedure, Airbus Helicopters acknowledged its possible improvement, modifying the text during the investigation process, considering hereby Commission as a measure taken satisfactorily by the manufacturer.

[24] SMS: Operational Safety Management System

The following recommendations were subsequently issued to the addressees specified below:

Training Department

1. Reinforce the simulated governor failure procedure for AS-350-B3 2B helicopter instructors in training.
2. Re-evaluate the established training locations and define them correctly.
3. Review the ground minimums described in the training document to ensure the safety of aborted landings during simulated emergency manoeuvres.

Operations Department

4. Coordinate with the training department to incorporate the locations established for in-flight training in its list of aerodromes and operational areas.

Organisation of the operator

5. Although the use of flight helmets is not considered mandatory, it was recommended that the policy on their use in different operations should be defined and that they should be provided to all flight crews.

Operational control office

6. As soon as faults are detected in the fleet tracking beacons installed on aircraft, the necessary measures must be taken promptly, and the crews and departments concerned must be informed as soon as possible so that they can be assessed and made aware of them.

All crews

7. As a consequence of the fact that the majority of instructed pilots reduce their preventive visualisation when flying with an instructor on board, it was recommended to all crew members that during training, they should maintain their focus and understanding of the procedures during the briefing and when executing the manoeuvres, particularly during emergency manoeuvres.
8. In relation to the use of flight helmets, it was recommended that all crews with helmets should use them unless they are incompatible with the communications system or the type of cockpit or operation or they have a medical reason not to.

The aircraft manufacturer

9. Considering that it was identified as a latent fault, it was recommended that the manufacturer revise the confusing descriptions in the flight manual and the OSDs relating

to the simulated governor failure manoeuvre for the different variants of twist grip available for the AS-350-B3 2B model. [25]

10. Similarly, as the fact that the dual control on the 2B variant does not have clear markings to facilitate the visual interpretation of its position was also considered a latent fault, it was recommended that the manufacturer study this situation.

1.17.2.2. Actions taken by the aircraft manufacturer

During the investigation Airbus Helicopters proposed to CIAIAC a modification of the flight manual Section 3.3, corresponding to the emergency procedure to be applied when MAN mode is engaged or governing failure is produced, as well as the training procedure according to SUP 6. Point 2.4.2. This measure was considered acceptable and was closed as a safety action taken.

The procedures were modified as follows, new text included shown in cursive and removed text shown as crossed text:

Emergency procedure for governor failure (Flight manual section 3.3.):

This failure can also result in a loss of Ng[26] and torque parameters displayed on the VEMD. In all cases, the NR must be controlled so that the maximum NR alarm is never triggered.

The fuel flow is frozen at the value prior to failure and automatic unlocking of the FLIGHT detent (VOL):

1. Check flight parameters.
2. Maintain NR in green range.
3. The fuel flow can be modified by turning the twist grip:
   - To the left to increase fuel flow
   - To the right to decrease fuel flow
4. Only apply small amplitude adjustments, synchronized with the collective pitch control in order to maintain NR in the green range.
   New text included:
   Caution: There is a risk to disengage the twist grip, if the twist grip is handled too quickly. In order to re-engage it, put back the twist grip in the FLIGHT detent (VOL) and then handle it more slowly.
5. Fly the approach at 40 kt and adjust the fuel flow rate to maintain NR within the upper section of the green range.
6. Slowly reduce the speed if necessary adjust the fuel flow rate slightly on the twist grip to maintain NR within the green range.
7. On the final approach, when the collective pitch is increased on reaching the hover, let the NR drop for touchdown. After touchdown, reduce the fuel flow rate before lowering the collective pitch.

[25] See foot note 23. Measure taken revising the wording of the Flight Manual Chapter 3.3 and supplement chapter 6 for a clearer understanding of the automatic mode recovery requirements.
[26] Ng: Engine gas generator speed

NOTE 1: This failure can also result in loss of Ng and torque parameters on the VEMD. Refer to 3.3 for compliance with limitations.
NOTE 2: in all cases, the NR must be controlled so that the max NR alarm is never activated.

Return from MANU mode to AUTO mode. The AUTO/MANU selector can be replaced in the AUTO position irrespective of the NR value. Then return the twist grip to the FLIGHT detent (VOL) (red and amber GOV and TWT GRP warning lights should be extinguished).

Training procedure for governor failure (Flight manual SUP 6, point 2.4.2):

In steady flight conditions, set the "AUTO/MAN" selector to "MAN".

- Apply the appropriate emergency procedure (red "GOV" warning light) SECTION 3.3 page 4 of the present Flight Manual.
- ~~At the end of the training procedure or when needed, reset the "AUTO/MAN" selector to "AUTO" (red "GOV" light extinguishes), bring back the twist grip into the FLIGHT detent (VOL) ("TWT GRP" and amber "GOV" lights extinguish). Check that the FLIGHT detent (VOL) stop is automatically back in position.~~

CAUTION: THERE IS A RISK TO DISENGAGE THE TWIST GRIP, IF THE TWIST GRIP IS HANDLED TOO QUICKLY. IN ORDER TO RE-ENGAGE IT, PUT BACK THE TWIST GRIP IN THE FLIGHT DETENT (VOL) AND THEN HANDLE IT MORE SLOWLY.

- *At the end of the training procedure or when needed, reset the "AUTO/MAN" selector to "AUTO" (red "GOV" light extinguishes), bring back the twist grip into the FLIGHT detent (VOL) ("TWT GRP" and amber "GOV" lights extinguish). Check that the FLIGHT detent (VOL) stop is automatically back in position.*

~~IMPORTANT : It is possible to switch back the AUTO/MAN selector to the automatic fuel control mode (AUTO mode) at any time and for any NR value.~~

~~WARNING : RESETTING TO "AUTO" MODE AFTER MANUAL FUEL FLOW TRAINING MAY ACTIVATE THE IDLE SWITCH LEADING TO A LOSS OF POWER. RESELECTION TO AUTO SHOULD ONLY BE MADE ON GROUND AFTER LANDING OR IN A FLIGHT CONDITION ALLOWING A LANDING IN AUTOROTATION.~~

IMPORTANT: The AUTO/MAN selector can be switched back to automatic fuel control mode (AUTO mode) at any time and for any NR value. This action has to be followed by the return of the twist grip to the FLIGHT detent (VOL) in order to avoid any high/low NR and to recover the automatic fuel control mode (AUTO).

1.18. Additional information

1.18.1. Assessment of the execution of the emergency and training procedures

The table below shows the checklist available to the crew and the degree to which they complied with the governor failure training procedure and the emergency procedure to which it corresponds.

The operator's procedures and checklists are transcribed from those established by the aircraft manufacturer.

With regard to executing an aborted landing, we have been unable to identify any specific procedure or applicable checklist established by the manufacturer or the operator.

EMERGENCY PROCEDURE "GOVERNOR FAILURE"	CHECKLIST (aircraft's abnormal and emergency procedures)	TRAINING PROCEDURE "GOVERNOR FAILURE"	EXECUTION OF THE TRAINING PROCEDURE AND ABORTED LANDING	
An actual governor failure occurs in flight		Must be initiated from stable flight	PIC/TRI: Correct execution	✓
On the CWP: • red GOV light illuminated • activation of audible alarm	GOV ON RED	Position the AUTO/MAN selector to MAN: • red GOV light will illuminate on CWP, and, • audible alarm will sound	PIC/TRI: Correct execution CWP: • Red GOV light illuminated • Audible alarm activated	✓
1. Check flight parameters	1. Check flight parameters	1. Check flight parameters	PF: Correct execution	✓
Fuel flow is maintained at the last governed value at the time of failure	Fuel flow is maintained at the last governed value. There is a small gap in which the moving the twist grip is ineffective, especially when switching from acceleration to deceleration or vice versa	Fuel flow is maintained at the last governed value when switching to MAN mode	Aircraft: correct operation	✓ ✓
2. FLIGHT (VOL) position unlocked on twist grip: • amber TWT GRP light illuminates on CWP	2. Automatic release of the twist grip FLIGHT (VOL) position. - Turn the twist grip to the left to increase RPM - Turn the twist grip to the right to decrease RPM	2. Release the twist grip from the FLIGHT (VOL) position: • amber TWT GRP light will illuminate on CWP	PF: Correct execution CWP: Amber TWT GRP light illuminated NOTE: The PIC/TRI collective control installed for training purposes does not have a FLIGHT position release mechanism; therefore, they cannot initiate manual throttle control and can decrease the NR but not increase it.	✓
3. Control the NR so that the MAX NR alarm is not triggered		3. Control the NR so that the MAX NR alarm is not triggered	PF: Correct execution	✓
4.Keep the NR within the green arc	3.Keep the NR within the green arc	4.Keep the NR within the green arc	PF: Correct execution Low NR audible warning activated, lower part of green arc	✓

EMERGENCY PROCEDURE "GOVERNOR FAILURE"	CHECKLIST (aircraft's abnormal and emergency procedures)	TRAINING PROCEDURE "GOVERNOR FAILURE"	EXECUTION OF THE TRAINING PROCEDURE AND ABORTED LANDING	
5. Land as soon as possible. On the final approach, when the collective pitch is increased to reach a hover, allow the NR to reduce to make contact with the ground.	4. Land as soon as possible with landing site and flight duration at the pilot's discretion. - Approach: shallow. Avoid a deep approach angle. Select 40kt, especially in the last phase. Maintain RPM in the upper part of the green range - Landing: Do not adjust RPM, allow them to decrease as you apply collective Once on the ground, stopped - Collective: Reduce throttle before gently lowering collective - Perform a normal engine shutdown NOTE: This failure can also lead to a loss of dNg and Tq in the VEMD. In all circumstances, keep Nr below 410 RPM.		PIC/TRI: aborted the landing (realising the impossibility of reaching the selected landing area) Neither the operator nor the aircraft manufacturer has a procedure for an aborted landing during a governor failure emergency or training. NOTE: The PIC/TRI collective control installed for training purposes does not allow the PIC/TRI to initiate manual control of the fuel flow rate to increase the power and abort the landing after reverting to AUTO mode; it would have allowed him to decrease the flow rate but not increase it.	×
6. Next, reduce the fuel rate before reducing the collective pitch.				
7. Switch back from MAN mode to AUTO mode, returning the "AUTO/MAN" selector to the AUTO position regardless of the NR value. It can only be reset to AUTO mode if the aircraft is already on the ground or in flight conditions that would allow an autorotation landing as it causes a loss of power		5. At the end of the training, switch back to the AUTO position, returning the "AUTO/MAN" selector to the AUTO position regardless of the NR value. It can only be reset to AUTO mode if the aircraft is already on the ground after the training or in flight conditions that would allow an autorotation landing as it causes a loss of power	PIC/TRI: returned the "AUTO/MAN" selector to the AUTO position. The NR value was low, although the AUTO position can be selected regardless of the NR value. The aircraft was not on the ground or in a situation that would allow for an autorotation landing. Incorrect execution.	✓ ×
8. Re-lock the twist grip in the FLIGHT (VOL) position, which will de-illuminate the red and amber GOV and TWT GRP lights.		6. Re-lock the twist grip in the FLIGHT (VOL) position, which will de-illuminate the red and amber GOV and TWT GRP lights.	PIC/TRI: Correct execution. The twist grip was not locked in the FLIGHT (VOL) position. NOTE: The control installed for training purposes has no position markings on the twist grip, making it difficult to interpret its position visually.	×

From the above comparative table, it can be deduced that the training procedure (which coincides with the emergency procedure in the event of governor failure) was followed correctly until the moment when, instead of landing, the landing was aborted.

From that moment on, although the "AUTO/MAN" selector was returned to the AUTO position, it should be done, if the conditions had been adequate, that is, the aircraft had been on the ground or in a situation that would allow a landing in autorotation, however, the twist grip was not re-locked in the FLIGHT (VOL) position, which is also a requirement of the procedure.

1.18.2. Related EASA studies

According to studies conducted by EASA's EHEST[27] group, analysis of helicopter accident data in Europe between 2007 and 2011 showed that 18% of the accidents occurred during in-flight training. This figure is commensurate with the data provided by Canada and the USA.

Whilst the approach and landing phases generally account for 25% of accidents, in training accidents, the approach and landing phases account for 44% of accidents, given that these manoeuvres are carried out more frequently during training. The primary causes of accidents during the approach and landing phases were dynamic rollover and inadequate autorotations.

The main problems identified in the accidents that occurred during training were:

- inadequate and untimely flight instructor action to correct student action,
- poor pilot decision making,
- pilot in training phase,
- perceptual errors,
- inadequate preparation and planning by the flight instructor,
- training program management,
- inadequate consideration of meteorological conditions,
- inadequate autorotation exercise, or inadequate autorotation,
- selection of an inappropriate landing site,
- pilot control/handling deficiencies,
- inadequate flight crew briefing,
- inadequate consideration of the aircraft performance,

In addition, an increased risk of an unsafe landing was identified in training operations where the briefing failed to emphasise information about crew roles and coordination in real emergencies.

1.19. Special investigation techniques

N/A

[27] EHEST: EASA's European Helicopter Safety Team.

2. ANALYSIS

2.1. Analysis of the meteorological conditions

The meteorological conditions in the area and time of the event were suitable for the flight; the wind was not significant, the visibility was acceptable, and, given the high relative humidity, there was a high probability of fog which manifested in the form of drizzle.

Therefore, no adverse meteorological phenomena that could have contributed to the causes of the accident were recorded.

2.2. Analysis of the aircraft wreckage

The marks identified at the accident site were consistent with the information provided by the crew, with 2 to 3 m of grooved tracks of varying depth, going from deeper to shallower in the aircraft's direction of travel, confirming that the right skid made an initial travelling impact with the ground. The difference between these marks' initial and final depth shows that the aircraft lifted again in its final part.

It then fell back to the ground, resulting in a second impact, this time on an upward slope, causing the right skid to collapse, breaking the lower cable cutter and mirror bracket and causing the aircraft to pitch negatively. The rolling of the aircraft, with its engine running, caused the main rotor blades to hit the upper cable cutter, and due to their bending, strike the protecting fairing of the tail rotor drive shaft, slicing into it and damaging the shaft.

As a result of this impact, the aircraft came to an abrupt halt and rotated 45º clockwise as the collapsed right skid partially anchored it to the ground while its engine was still running, and its rotor was turning anticlockwise.

The inspection of the aircraft at the operator's maintenance facility determined that the helicopter's impairments resulted from the damage detailed above and the harm caused to the engine during the hard landing.

2.3. Operational analysis

On the day of the event, the crew of the EC-JEA had carried out two AS-350-B3 2B1 to 2B difference training flights with the same scope of manoeuvres, in which the roles of instructor pilot and pilot under instruction were alternated between them. The second of these flights was the event flight.

The operator's rules state that if a pilot has not flown one of the fleet models for more than a year, as was the case with the 2B model because the crew had been flying the 2B1, he/she must complete this type of recurrent training to refresh their knowledge of the differences between models. Carrying out this type of training course was, therefore, appropriate, and it had the necessary authorisation from the organisation.

According to the crew, they planned the training flight at the base, defining, during the briefing, the positions in the cockpit and the area selected for the exercises. The Pla de Beret area was

chosen because it was habitually used and known to the crew and because, according to their information, it had a large, flat expanse that was suitable for a running landing if necessary.

The training session preceding the flight involved in the event took place without incident, and they performed the same manoeuvres as those planned for the accident flight. After completing the training, they simply alternated the roles and functions of instructor pilot and pilot under instruction in the cockpit, physically changing positions and preparing for the next training session.

Both pilots had extensive flight experience: in the helicopter involved in the event, the instructor pilot had 600:09 hours in type, and the pilot under instruction had 7,017:00 hours. In terms of recent experience, the instructor pilot had flown 43:16 h in the last 3 months, mainly on SAR guards, and the pilot under instruction had flown 100:20 h, mostly on HESLO, for which he was also an instructor. Consequently, as inferred by the statements from both pilots, the pilot under instruction was the more experienced of the two and, therefore, the instructor pilot's confidence in his ability was high, and he did not feel that he required exhaustive supervision.

The scope of tasks and activities to be conducted for the training on the differences between the AS-350-B3 2B1 and AS-350-B3 2B helicopters was already known to the crew, as it was a recurrent training they had undertaken on previous occasions. According to the information provided by both pilots, they correctly identified the procedure to be followed.

The previous training flight had had the same objectives, so, as it was the first of the two, their preparation for it was more exhaustive than for the second flight, which, moreover, was carried out with the more experienced pilot as the pilot under instruction. These circumstances may have led to it being conducted more hastily. It should be noted that the instructor pilot was on SAR duty at the time of the event, and the pilot under instruction had been carrying out aerial HESLO work before the previous flight in which he had been the instructor.

Before initiating the governor failure simulation, they made a normal landing in the designated area to ensure the governor was working correctly. To do this, they switched from AUTO mode to MAN mode and vice versa, checking that the system recovered the RPM properly. As was subsequently verified during the post-accident inspection, the system was functioning correctly.

The crew then followed the final approach procedure as per the FLM, and with the helicopter stabilised and downwind, they switched to manual mode and initiated the governor failure simulation. The system worked as expected; the alerts on the CWP panel came on, and on long final at a speed of about 40 kt, with the pilot under instruction controlling the RPM manually with the twist grip, the RPM was kept within the green arc of the indicator, as required during this exercise. Everything proceeded normally.

In the final phase, the pilot under instruction kept the RPM above the green arc so that, according to his statement, when they entered a stationary hover and pulled the collective, it would allow a more significant margin of action in the face of the consequent fall in RPM.

The governor failure emergency procedure stipulates that after checking the flight parameters and maintaining the NR in the green arc of the indicator, the twist grip should be disengaged from the FLIGHT position by releasing the locking pin, allowing the fuel flow to be controlled manually by turning it, always making sure that the MAX NR alarm is not activated; the approach should then be made at 40 kt and the fuel flow adjusted to maintain the NR in the upper section of the green arc. Accordingly, the procedure in this phase was rigorously followed by the crew.

Next, the procedure states that the speed should slowly be reduced while keeping the NR within the green arc, and on the final approach, after raising the collective pitch control to reach a hover[28], the NR should be dropped to make contact with the ground. It was at this stage of the flight that the deviation from the procedure and failure to properly monitor the flight parameters must have occurred. According to the testimonies of the crew (the only information available as there was no flight recorder), the PF had reached a speed between 5 and 10 kt, the low RPM audible warning was sounding (lower part of the green arc), and they were very close to the ground (10 ft). They realised they wouldn't make it to their chosen landing site and, consequently, decided to abort. Given the parameter values indicated, and apart from the fact that they were in an area of uneven terrain, this decision was appropriate.

According to the manufacturer's OSD, the governor failure simulation situation is recoverable at any time with any NR value. Therefore, after they decided to abort the landing, their decision to immediately switch into AUTO mode to try to recover the RPM was also appropriate. However, the document also warns that reverting to automatic mode may cause a loss of power, so it should only be done on the ground after completing the training, or in flight, in conditions that would allow for an autorotation landing. Neither of these two scenarios applied to their situation at the time, and therefore at this point, the training procedure was not followed correctly. As subsequently reported by the operator, the crew exhibited confusion in their interpretation of this section of the document.

The governor failure training procedure specifies that after setting the AUTO/MAN selector to the AUTO position, the twist grip must be returned to the FLIGHT position, checking that the locking pin has automatically re-engaged[29], which should always happen so long as the twist grip hasn't been turned by more than 30º, which cannot be known because the markings on the twist grip make it hard to establish exactly how far it was turned.

According to the crew, the RPM momentarily recovered when they switched to automatic mode, but on pulling the collective, the RPM dropped again to a level that was insufficient to abort the landing, and the helicopter lost its lift and sank hitting the ground. Therefore, their execution of the operation and perception of the existing parameters was erroneous. This situation may have been caused by a failure to adequately prepare for the flight and foresee the management of a real emergency during the training.

After the accident, it was verified that the twist grip had not been returned to its FLIGHT position after returning to automatic mode as required by the procedure, which meant that they would only have been able to recover the RPM by manually regulating the fuel flow with the twist grip. Unfortunately, however, their speed and altitude were already too low for this to work.

According to the pilot under instruction testimony, he considered that he had reacted too late to be able to recover the RPM and abort the landing. However, given that he was sufficiently familiar (7,017:00 h flight time) with the aircraft to have reacted in time, it's possible another factor played a role in the failure to recover power in time to prevent the accident.

[28] The operation does not actually correspond to a hover itself, but rather a transition through hover conditions with the recommended NR for contact with the ground.
[29] As it was the post-MOD 073084, the locking pin automatically returns to position, securing flight mode.

It may have occurred because of a failure to properly monitor the NR and/or adequately manage the twist grip and collective pitch, possibly due to being overconfident in his knowledge of the exercise, the location, and the helicopter.

On the other hand, the instructor pilot also failed to adequately supervise the pilot under instruction, presumably due to being overconfident in the operational capability of the more experienced pilot, which probably led to him failing to consider the possibility of rectifying his actions. However, given that he also had extensive knowledge of the aircraft, it's likely that another factor was also at play here, contributing to his inability to react in time to manage the emergency.

The fact that the dual control installed for training did not have any kind of position mark could have influenced in a faulty interpretation by the instructor pilot of whether or not the twist grip was returned to the FLIGHT position after returning to AUTO mode by the pilot under instruction. This may have contributed to the instructor not being aware of whether the automatic mode was successfully reset and therefore not acting on the controls.

Considering that they did not have sufficient time and acceptable flight parameters to coordinate the necessary actions to make a safe landing, the decision to abort the landing was appropriate and, indeed, would have been successful had their misunderstanding of the procedures involved in reverting to automatic mode not contributed to the event. The result was an improperly executed restart of the automatic mode, since the twist grip was not returned to the FLIGHT position as prescribed by the procedures, in addition to the fact that it should only have been performed, according to both the emergency and training procedures, just if the aircraft is already on the ground after completing the training or in flight conditions that allow for an autorotation landing.

The uneven terrain in the area selected for the training exercise also contributed to the damage to the aircraft. In the final phase, when the pilot under instruction realised he could not reach the area chosen for the landing, he pulled the collective up to avoid the uneven terrain, given the low flight altitude, without having completed the AUTO mode restart. Unfortunately, this action destabilised the aircraft, causing it to lose lift and leading to its first impact with the right skid, resulting in a negative pitch. The uneven terrain caused the helicopter to lift again before impacting for the second and last time, causing significant damage and bringing it to a definitive stop. It can be concluded that the area selected for the landing had too many irregularities in the pre-touchdown zone and was, therefore, inappropriate.

Although not a factor in the event, it has been noted that the crew, despite, according to their own testimony, detecting that the fleet tracking system was experiencing intermittent malfunctions during previous flights, did not immediately report the anomaly for rectification. It was established that the system did not record the event flight, and therefore a more exhaustive analysis of the manoeuvre could not be performed, leaving the investigation to rely exclusively on the pilots' statements and the inspection of the aircraft after the event.

2.4. Analysis of the aircraft's maintenance

The aircraft inspections carried out by the airframe and engine manufacturers did not identify any potential operational failures in the helicopter.

Based on the analysis of the available maintenance records, it has been concluded that the aircraft was up to date with the inspections scheduled by the maintenance programme and the updates corresponding to service bulletins and applicable directives.

Furthermore, after the investigation, no malfunction of any mechanical element or technical flight system failure has been identified as the cause.

Therefore, the overall condition of the helicopter from a maintenance point of view was acceptable and did not contribute to the accident.

2.5. Analysis of the organisation and management

The operator had the necessary authorisations to conduct the operation involved in the event. The instructors met the requirements of the SOE operations manual for conducting the scheduled training, and said training complied with the operating procedures set out in the manual.

In relation to the criteria for determining recurrent training sites, the procedures described in the SOE operations manual do not specify any restrictions; therefore, the selection of the site did not contravene any instructions from the organisation.

During the investigation, the operator acted proactively, identifying several preventive safety measures which were analysed by this Commission and found to be adequate in terms of reducing the risk of similar events in the future.

3. CONCLUSION

3.1. Findings

- The meteorological conditions at the time of the event were suitable for conducting the training flight.
- The aircraft's fleet tracking system was not operational during the event flight.
- The area selected for the governor failure simulation training had uneven terrain, rendering it unsuitable for this type of training.
- The damage to the aircraft was consistent with two successive impacts with the ground.
- The investigation determined that there was no malfunction or technical failure of any mechanical element or flight system.
- The collective pitch control installed for training had no FLIGHT position markings on the twist grip.
- After the accident, it was established that the instructed pilot's twist grip was not in the FLIGHT position, as required by the automatic governor reset procedure.
- After aborting the landing during a governor failure simulation, the aircraft lost lift, triggering the low RPM warning, and crashed into the ground.
- There were no injuries.

3.2. Causes/contributing factors

The investigation has revealed that the probable cause of the accident was the inadequate execution of the governor failure simulation procedure, which resulted in a loss of control of the aircraft, causing it to impact the ground.

The following factors are considered to have contributed to the event:

- inadequate supervision by the instructor pilot that did not make it possible to recover from the emergency.
- a loss of situational awareness by the pilot under instruction in the final phase of the manoeuvre, leading him to improperly execute the reversion to the automatic mode of the governor’s operation, probably due to overconfidence and poor monitoring of the flight parameters.
- the crew's confusion and inadequate understanding of the governor failure training procedure.
- the failure to select a training area that met the appropriate safety conditions for performing this type of emergency manoeuvre.

4. RECOMMENDATIONS

During the investigation, the operator proposed several safety measures addressed to its different departments and to the aircraft manufacturer, which have been deemed appropriate by this Commission.

The findings and potential operational safety improvement opportunities are consistent with the main conclusions drawn by the EASA EHEST group detailed in section 1.18.2. of this report, which supports the need for safety measures to be implemented by the operator.

In the wake of the event, the operator immediately implemented the following safety measures:

1. Training between the two flight crew members was suspended until another company instructor could reassess them.
2. It was recommended to the training department that all pending in-flight training be conducted at airfields/airports to ensure safety in emergency manoeuvres.

The safety measures recommended were those described in section 1.17.2.1. of this report. Given that the operator identified the same operational safety improvements as those that would have been the subject of a recommendation, a recommendation in this regard was not considered necessary. However, recommendations have been deemed necessary in relation to the following aspects, whose contribution to the event requires specific monitoring to reduce the risk of similar occurrences in the future.

REC 15/2023: It is recommended that Eliance Helicopter Global Services review its governor failure simulation training procedures to define the minimum parameters required to ensure the manoeuvre can be aborted safely during a real emergency.

REC 16/2023: It is recommended that Eliance Helicopter Global Services put in place appropriate measures to ensure that when a malfunction is detected in the fleet tracking system, it is immediately reported and rectified as soon as possible to guarantee the availability of flight data that contributes to the improvement of aviation safety.

Likewise, the aircraft manufacturer Airbus Helicopters during the investigation proposed a modification of the flight manual Section 3.3, corresponding to the emergency procedure to be applied when MAN mode is engaged or governing failure is produced, as well as the training procedure according to SUP 6. Point 2.4.2. CIAIAC identified these modifications as improvements of the procedures and instead of proposing a safety recommendation in this report, the measure was considered acceptable and was closed as a safety action taken.

The modifications are described in section 1.17.2.2. of this report.

However, a recommendation has been deemed necessary in relation to the dual control twist grip installed for training, as follows:

REC 17/2023: It is recommended that Airbus Helicopters evaluate the possibility of upgrading the dual control twist grip installed for training purposes on the AS-350-B3 2B helicopter to facilitate the visual interpretation of its position.