AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9939		
Aircraft Registration	ZS-OXK	**Date of Accident**	2 January 2021		**Time of Accident**	0500Z	
Type of Aircraft	AS350-B3 (Airbus H125)		**Type of Operation**		Commercial (Part 127)		
Pilot-in-command Licence Type	ATPL (H)		**Age**	49	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		6 854.0		Hours on Type	260.9	
Last Point of Departure	Cape Town International Airport (FACT), Western Cape Province						
Next Point of Intended Landing	Cape Peninsula National Park, Western Cape Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Cape Town International Airport (FACT) taxiway Hotel, Western Cape Province (GPS position: 33°58'38.32" South, 18°35'51.88" East, at an elevation of 140ft)							
Damage to Helicopter	Destroyed						
Meteorological Information	Wind: 200° at 7kt, Temperature: 18°C, Dew Point: 8°C, Cloud Cover: CAVOK, QNH: 1019 hPa, NOSIG						
Number of People On-board	1+0	**No. of People Injured**	1	**No. of People Killed**	0		
Synopsis							

On 2 January 2021 at approximately 0500Z, a pilot on-board an AS350-B3 helicopter with registration ZS-OXK was preparing to take-off from Cape Town International Airport (FACT) to the Cape Peninsula National Park in the Western Cape province on an anti-crime patrolling flight. The flight was conducted under the provisions of Part 127 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot stated that while waiting for take-off clearance from air traffic control (ATC), he momentarily removed his hand from the collective pitch lever to adjust the volume on the radio. This led to the collective pitch lever moving up to its maximum position, making the cyclic very stiff and difficult to control. The pilot did not hear any audible warning or see any warning lights illuminating on the cockpit panel. Thereafter, the helicopter lifted off to a height of approximately 30 feet above ground level (AGL) and began to yaw to the left with a slight right roll and forward pitch. The pilot attempted to stop the yaw rate by using the yaw pedals, but they were ineffective. The helicopter continued to yaw; it made two full rotations while pitching forward with a slight right roll. The main rotor blades then struck the ground and the pilot lowered the collective pitch lever. The right-side skid impacted the ground and a dynamic rollover to the right ensued with the helicopter coming to rest on its right side. A post-impact fire erupted in the engine compartment before the pilot shut down the engine and disembarked the helicopter unaided. The helicopter was destroyed by impact forces and a post-impact fire. The pilot sustained minor injuries during the accident sequence.

Probable Cause and/or Contributory Factors

It is probable that the pilot lost control following loss of hydraulic pressure as he omitted to release the “HYD TEST” push-button on the front centre console before cutting off the hydraulic assistance (using the ‘CUTOFF’ switch) on the collective stick.

SRP Date	13 July 2021	Publication Date	14 July 2021

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ABBREVIATION	DESCRIPTION
AIID	Accident and Incident Investigations Division
AGL	Above Ground Level
AME	Aircraft Maintenance Engineer
AMO	Aircraft Maintenance Organisation
AOC	Air Operating Certificate
ATPL	Airline Transport Pilot Licence
C	Celsius
CAR	Civil Aviation Regulations
CAVOK	Ceiling and Visibility OK
CVR	Cockpit Voice Recorder
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CRS	Certificate of Release to Service
DME	Distance Measuring Equipment
FACT	Cape Town International Airport
FDR	Flight Data Recorder
FM	Flight Manual
FT	Feet
GPS	Global Positioning System
H	Helicopter
hPa	Hectopascal
ILS	Instrument Landing System
kt	Knot
L	Litre
m	Metre
METAR	Meteorological Aeronautical Report
MPI	Mandatory Periodic Inspection
ml	Millilitre
n/a	Not Applicable
nm	Nautical Mile
PAPI	Precision Approach Path Indicator
QNH	Query Nautical Height
SACAA	South African Civil Aviation Authority
UTC	Co-ordinated Universal Time
VEMD	Vehicle and Engine Monitoring Device
VFR	Visual Flight Rules
VOR	Very high frequency omni-directional range
Z	Zulu

Reference Number	**:** CA18/2/3/9939
Name of Owner/Operator	**:** South African National Parks
Manufacturer	**:** Eurocopter
Model	**:** AS350-B3 (Airbus H125)
Nationality	**:** South African
Registration	**:** ZS-OXK
Place	**:** Cape Town International Airport (FACT)
Meteorological Conditions	**:** Surface wind: 200°/7kts; Temperature: 18°C; CAVOK
Date	**:** 2 January 2021
Time	**:** 0500Z

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or liability****.*

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Investigation Process:

The accident was notified to the Accident and Incident Investigations Division (AIID) on 2 January 2021 at about 0530Z. The investigators had travelled to FACT on 21 January 2021 to conduct a follow-up investigation. The investigators co-ordinated with all authorities on site by initiating the accident investigation process according to CAR Part 12 and investigation procedures. The AIID is leading the investigation as the Republic of South Africa is the State of Occurrence.

Notes:
1. Whenever the following words are mentioned in this report, they shall mean the following:

- *Accident – this investigated accident*
- *Aircraft – the AS350-B3 (Airbus H125) involved in this accident*
- *Investigation – the investigation into the circumstances of this accident*
- *Pilot – the pilot involved in this accident*
- *Report – this accident report*

2. Photos and figures used in this report were taken from different sources and may be adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer:

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1 On 2 January 2021 at approximately 0500Z, a pilot on-board an AS350-B3 helicopter with registration ZS-OXK was about to take-off from Cape Town International Airport (FACT) to the Cape Peninsula National Park in the Western Cape province on an anti-crime patrolling flight. The flight was conducted under the provisions of Part 127 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2 The pilot stated that he completed the engine start-up checks with the engine on idle and the collective pitch lever in the down and locked position. He then tested the hydraulic system by switching “ON” the hydraulic accumulator “HYD TEST” push-button on the centre console, as well as tested the range of the cyclic by moving it. He noticed that when he moved the cyclic to the right fore plane, the motion was not that smooth. He then switched the hydraulic accumulator “HYD TEST” push-button “OFF” and then back “ON” again. He tested the range of the cyclic again and, this time, there was full and free movement on all planes. He then switched it “OFF” again. Next, he tested the hydraulics by moving the master hydraulic switch on the collective pitch lever to the “OFF” position, tested for movement and then moved the switch back to the “ON” position.

1.1.3 The pilot then moved the throttle to flight position, carried out all the pre-take-off checks and everything was good. He then depressed the collective to release the mechanical lock and was ready for lift-off. While waiting for take-off clearance from air traffic control (ATC), he momentarily removed his hand from the collective pitch lever to adjust the volume on the radio. The collective pitch lever then moved up to its maximum position and, at the same time, the cyclic became very stiff and difficult to control. The pilot did not hear any audible warning or see any warning lights illuminating on the cockpit panel. The helicopter lifted off to a height of approximately 30 feet (ft) above ground level (AGL) and began to yaw to the left with a slight right roll and forward pitch. The pilot attempted to stop the yaw rate by using the yaw pedals, but they were ineffective. The helicopter continued to yaw and made two full rotations while pitching forward with a slight right roll. Thereafter, the main rotor blades struck the ground and the pilot lowered the collective pitch lever. The right-side skid impacted the ground and a dynamic rollover to the right ensued with the helicopter coming to rest on its right side. A post-impact fire erupted in the engine compartment before the pilot shut down the engine and disembarked the helicopter unaided. The crash alarm was activated by ATC and the Aerodrome Rescue and Fire-fighting (ARFF) personnel responded to the scene and extinguished the fire.

1.1.4 The helicopter was destroyed by impact forces and the post-impact fire that erupted. The pilot sustained minor injuries.

1.1.5 The accident occurred during daylight on a taxiway Hotel at FACT in the Western Cape province at Global Positioning System (GPS) co-ordinates determined to be: 33°58'38.32" South, 018°35'51.88" East, at an elevation of 140ft.

Figure 1: Position of accident site relative to the airport. (Source: Google Earth)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-Board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	1	-	-	1	-
None	-	-	-	-	-
Total	1	-	-	1	-

Note: Other means people on ground.

1.3. Damage to Aircraft

1.3.1 The aircraft was destroyed by impact and post-impact fire during the accident sequence.

Figure 2: The helicopter post-accident. (Source: Operator)

1.4. Other Damage

1.4.1 The Cessna C172 that was parked nearby was damaged by the flying debris from the accident helicopter.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	49
Licence Number	**********	Licence Type	Airline Transport Pilot Licence (H)		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Night, Winching, Sling Load, Instrument, Test Pilot Class 2				
Medical Expiry Date	30 June 2021				
Restrictions	None				
Previous Accidents	2001, tail rotor failure				

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	6854.0
Total Past 24 Hours	0.1
Total Past 7 Days	11.2
Total Past 90 Days	19.4
Total on Type Past 90 Days	19.4
Total on Type	260.9

1.5.1 The pilot completed his proficiency check ride with a Grade II instructor on 22 December 2020 for a total of 2.8 flying hours. On the pilot's logbook, a flight was recorded on 22 December 2020 with a total of 2.48 flying hours. The flight was entered under dual time with remarks of anti-poaching and crime patrol flight. The flight was also signed off by the pilot on the flight folio.

1.5.2 The pilot flew a total of 19.4 hours from the proficiency check flight until the accident flight. Prior to the check flight, the pilot had last flown the helicopter type in January 2007.

1.6. Aircraft Information

1.6.1 The Eurocopter AS350 Écureuil (or Squirrel), now Airbus Helicopters H125, is a single-engine light utility helicopter originally designed and manufactured in France by Aerospatiale and Eurocopter (now Airbus Helicopters). The AS350 is powered either by a Lycoming LTS101 or Turbomeca Arriel powerplant that drives a three-blade main rotor, which is furnished with a Starflex rotor head. The type is known for its high-altitude performance and has been used by operators in such environments. Both the main and tail rotors make use of composite material and are designed to minimise corrosion and maintenance requirements. The AS350 was also developed to comply with the noise requirements in place, in locations such as national parks. The in-cabin noise levels are such that passengers may also readily converse during flight. The aircraft can also be quickly started up and shut down, which is often useful during emergency medical services roles. It is equipped with hydraulically-assisted flight controls; these controls remain operational, albeit operated with greater physical effort, in the event of a hydraulic failure. (Source: Airbus Helicopters)

Airframe:

Manufacturer/Model	Eurocopter AS350 B3	
Serial Number	4139	
Year of Manufacturer	2006	
Total Airframe Hours (At Time of Accident)	6152.3	
Last MPI (Date & Hours)	29 October 2020	6068.6
Hours Since Last MPI	83.7	
C of A (Issue Date)	22 December 2020	
C of A (Expiry Date)	31 December 2021	
C of R (Issue Date) (Present Owner)	14 November 2006	
Type of Fuel Used in the Aircraft	Jet A1	
Operating Categories	Standard Part 127	
Previous Accidents	None	

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

Engine:

Manufacturer/Model	Safran Turbomeca/Arriel 2B1
Serial Number	23291
Part Number	0292005410
Hours Since New	6818.58
Hours Since Overhaul	3023.6

1.6.2 The last Mandatory Periodic Inspection (MPI) prior to the accident flight was carried out on 29 October 2020 at 6068.6 airframe hours. The helicopter was issued a Certificate of Release to Service (CRS) on 29 October 2020 with an expiry date of 29 October 2021 or at 6168.6 hours, whichever occurs first.

1.7. Meteorological Information

1.7.1 A weather report for 2 January 2021 at 0500Z was obtained from the meteorological aeronautical report (METAR) which was made available for FACT.

Wind Direction	200°	Wind Speed	7 knots	Visibility	CAVOK
Temperature	18°C	Cloud Cover	Clear	Cloud Base	Clear
Dew Point	8°C	QNH	1017hPa		

1.8. Aids to Navigation

1.8.1 The helicopter was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no recorded defects with the navigation equipment prior to the flight.

1.9. Communication

1.9.1 The helicopter was equipped with standard communication equipment as approved by the Regulator. No defects that could render the communication system unserviceable were recorded before the flight.

1.10. Aerodrome Information

1.10.1 The accident occurred during daylight on taxiway Hotel (FACT) in the Western Cape province at Global Positioning System (GPS) co-ordinates determined to be: 33°58'38.32" South 018°35'51.88" East, at an elevation of 140ft.

Aerodrome Location	Cape Town, Western Cape Province	
Aerodrome Status: Registered	Licensed	
Aerodrome Co-ordinates	S33°58'16.93" E018°36'15.45"	
Aerodrome Altitude	151 ft	
Runway Headings	01/19	16/34
Runway Dimensions	3 201m X 61m	1 701m X 46m
Runway Used	n/a	
Runway Surface	Asphalt	
Approach Facilities	PAPI lights, ILS, VOR, DME	
Radio Frequency	118.10 MHz	

1.11. Flight Recorders

1.11.1 The helicopter was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to this aircraft type. The helicopter was fitted with a Vehicle and Engine Monitoring Display (VEMD) and Digital Engine Control Unit (DECU) systems which were both serviceable at the time of accident.

1.12 Wreckage and Impact Information

1.12.1 While the helicopter was still on ground, the pilot momentarily removed his hand off the collective lever to lower the volume on the radio. The collective immediately shot up to its maximum lift and, together with the cyclic, became stiff and difficult to control. The helicopter lifted off the ground and began to yaw to the left with a slight right roll and a forward pitch. The pilot attempted to stop the yaw by using the pedals, but these were ineffective. The pilot tried to regain control of the collective to arrest the gain in height at approximately 30ft AGL, however, the helicopter continued to yaw through two full left turns while pitching forward with a slight roll to the right.

1.12.2 One of the main rotor blades impacted the ground and the pilot lowered the collective fully down. The helicopter impacted the ground on its right-side and the remaining main rotor blades impacted the ground. A post-impact fire ensued in the engine compartment before the pilot shut down the engine and disembarked the helicopter unaided. The fire-fighters responded to the scene shortly thereafter and extinguished the fire.

1.12.3 The main rotor section:

All main rotor blades showed signs of impact damage on the tips but were still attached to the hub via rigid sleeves. All three arms of the Starflex were severed due to the impact of the rotor blades with the ground. All three frequency adapters had cracks on them due to impact forces.

Figure 3: The main rotor blades post-accident.

1.12.4 The engine section:

The engine was still attached to its mounts and showed signs of fire damage. The oil and fuel pipes were still intact and there were no visible ruptures or punctures. Some of the attachment bolts of the exhaust were severed due to impact forces. Most of the post-impact fire was contained within the engine bay.

Figure 4: The engine compartment after fire damage.

1.12.5 The hydraulic system:

The hydraulic pump and reservoir were both found intact with no signs of impact damage. The hydraulic oil within the tank was 600 millilitres out of a total of 3 litres because most of the oil seeped out of the tank when the helicopter was resting on its right side.

Figure 5: Hydraulic reservoir and pump found intact post-accident.

1.12.6 The skids:

The entire left skid broke off from the attachments, but the right skid was still partially attached to the helicopter with the upper section and was bent upwards.

Figure 6: The left skid gears (left image) and the right skid gear (right image).

1.12.7 Tail section:

The tail drive shaft assembly was severed by the main rotor blade at its mid-section. The right horizontal stabiliser was bent during impact and the vertical stabiliser showed signs of impact damage caused by the main rotor blades. The tail rotor blades were still attached to the tail rotor output shaft but showed signs of impact with the ground on both tips.

Figure 7: Damaged tail boom and tail rotor.

1.13 Medical and Pathological Information

1.13.1 Not applicable.

1.14 Fire

1.14.1 Shortly after the helicopter impacted the ground, a fuel-fed fire ensued around the engine compartment area. The fire was extinguished by the Airport Rescue and Fire-fighting (ARFF) personnel.

1.15 Survival Aspects

1.15.1 The accident was considered survivable as the helicopter was hovering and the cockpit area was not damaged at the time of impact. The pilot was also wearing a safety harness. The helicopter caught fire after impact, damaging only the engine section of the helicopter.

1.16 Tests and Research

1.16.1 Hydraulic test on helicopter

A test on different hydraulic parts was performed on the helicopter at FACT on 21 January 2021. The helicopter manufacturer was involved as per the provisions of Annex 13.

The hydraulic filter was removed and was found to be free of contaminants. All hydraulic accumulators were tested and had sufficient pressure (15 bars) each in the cylinders. The hydraulic pump drive belt was tested for tension and it was found to be in satisfactory condition with no impact damage. All four solenoids were functioning. The hydraulics warning light and audible "gong" sound both functioned normally. The hydraulic switch was in the 'ON' position and the hydraulic accumulator test push-button was in the 'OFF' position. There was 600ml out of a total of 3 litres of hydraulic fluid left in the reservoir as most of the fluid had seeped out when the helicopter was lying on its right-side post-accident.

1.16.2 The VEMD and DECU components were removed from the accident helicopter on 21 January 2021 and shipped to the helicopter manufacturer facility. Below are the conclusions from the readout:

Conclusion

- *The accident flight was found closed and recorded as flight number #2544.*
- *The accident flight duration was equal to 0h04min (between 3min 30s and 4min 29s).*
- *The 5 failures recorded during the accident flight corresponds to:*

  - The first failure recorded at 3min 14s corresponds to a free turbine speed measurement issue with a value coherent with the main rotor speed recorded but a little higher than the nominal value with an engine delivering power.

  - The second failure recorded at 3min 15s is triggered by the Fadec and corresponds to a free turbine speed measurement issue. The engine system control was still in flight & automatic mode.

  - The third failure recorded at 3min 15s as well is triggered by the Fadec and corresponds to a collective potentiometer issue. The associated parameters recorded were consistent with an engine delivering power when the main rotor blades impacted the ground. During the crash sequence due to the ground contact, resulting structure

deformation or/and main rotor blade contact with ground, Airbus Helicopters experience that failure was usually one of the first failures recorded. The engine system control was in total failure (RED GOV) and the Engine Back-up Ancillary Unit (EBCAU) took over the engine control.

- The fourth failure recorded at 3min 41s is triggered by the Fadec and corresponds to a T4 temperature measurement. The engine was delivering power, T4 temperature is high and the torque is close to zero, which is consistent with a loss of engine / main gear box transmission. The NF value seems not consistent and most probably frozen to the last valid value.

- The fifth failure recorded at 3min 43s is triggered by the Fadec and corresponds to a torque conformation failure.

- *The 3 over-limits recorded corresponds to:*

  - An over-torque of 150% (10s higher than 118%) corresponding to the maximum value recordable by the VEMD, consistent with the recorded failure of the collective pitch potentiometer and with an engine delivering power when the main rotor blades impacted the ground before the complete roll over of the aircraft,

  - An over T4 temperature of 1153°C consistent with the recorded failure of the T4 temperature,

  - No over-limit has been recorded for the free turbine speed (NF) as the value has been most probably frozen at 408 rpm corresponding to the last valid value.

  - No over-limit has been recorded for the main rotor speed (NR) despite the most probable NF over-speed due to the probable loss of engine / main gear box transmission.

1.16.3 Safety Information Notice No. 2630-S-29 (see Annexure A); Source: Airbus Helicopters

Recent events (incidents and accidents) which occurred during hydraulic failure training, have led Airbus Helicopters to remind you of the procedures and precautions specified in the Flight Manual.

- Non-release of the "HYD TEST" push-button located on the front centre console before cutting off the hydraulic assistance using the "CUTOFF" switch on the collective stick. This phase described in the hydraulic failure training procedure of the Flight Manual supplement is essential for helicopters equipped with a load compensator on the yaw channel. This operation enables the hydraulic accumulator of the load compensator to be recharged before the hydraulic assistance is cut off using the switch on the collective stick in order to maintain hydraulic assistance on the tail rotor control channel. This assistance is necessary for controlling the helicopter on its yaw axis at low speed.

1.17 Organisational and Management Information

1.17.1 This was an aerial surveillance flight which was conducted under the provisions of Part 127 of the Civil Aviation Regulations 2011 as amended.

1.17.2 The operator was issued an Air Operating Certificate (AOC) number CAA/N270D with endorsement of Part 127 by the Regulator (SACAA) on 14 December 2020, with an expiry date of 31 December 2021. The operator of the helicopter had a Class G certificate in accordance with Civil Aviation Regulations.

1.17.3 The aircraft maintenance organisation (AMO) that certified the inspection was in possession of an AMO-approval certificate that was issued by the SACAA on 23 December 2020, with an expiry date of 31 December 2021.

1.18 Additional Information

1.18.1 AS350 B3 FM Section 7.10: Hydraulic System

2.1 HYDRAULIC SYSTEM COMPONENTS

The safety units allow for continued hydraulic assistance for a limited time in the event of a hydraulic pressure loss in the system. This limited time is sufficient to allow the pilot to reach a flight regime under which the control feedback forces are acceptable without hydraulic assistance.

- A single-body yaw servo,

- A load compensating system to reduce, in the event of a hydraulic pressure loss, the yaw pedal feedback loads for an indefinite period. The load compensator pressure can only be dumped by selecting the accumulator test switch to TEST position (down/on). This system consists of: A hydraulic accumulator, A non-return valve, A pressure relief valve, A pressure-drop solenoid electro valve on the accumulator, and, A load compensator actuator.

- Hydraulic system warnings:

If the pressure regulating unit pressure switch senses the hydraulic pressure dropping below 30 bars (435 psi) the following cockpit indications come on:

- *A red **HYDR** light on the Warning-Caution-Advisory panel, and*
- *A Gong sounds once (the Gong sounds when any red warning light comes on).*

2.2 SYSTEM CONTROLS AND MONITORING

The hydraulic system is controlled using two switches:

- *<u>The Hydraulic cut-off switch</u>: Guarded switch mounted on the collective grip with two positions, ON and OFF. Normally left in the ON position, allows the main-rotor servos to be powered when the hydraulic system is operating normally. Selected to OFF, during pre-flight checks, emergency procedures, and also when performing hydraulics-off training, the hydraulic system is then depressurised, the accumulators on the main rotor servos are depressurised simultaneously, the tail rotor load compensating system retains its assist function.*

- *<u>The accumulator test push-button</u>: [**HYD TEST**] or [**ACCU TST**] push-button switch mounted on the centre console with two positions: TEST (down) and OFF (up). It is normally left in the OFF position. Selected to the TEST position during pre-flight*

checks, emergency procedures and also, when performing hydraulics-off training, it will result in the solenoid valve opening on the regulator unit, which depressurises the hydraulic system. It will also open the tail rotor servo solenoid, depressurising the tail rotor load compensating servo but allowing the main rotor servos to be powered by the accumulators in their respective safety units.

Figure 8: Position of the “HYDR” warning light on the instrument panel.

Figure 9: Position of the “ACCU TST” switch on the systems control panel.

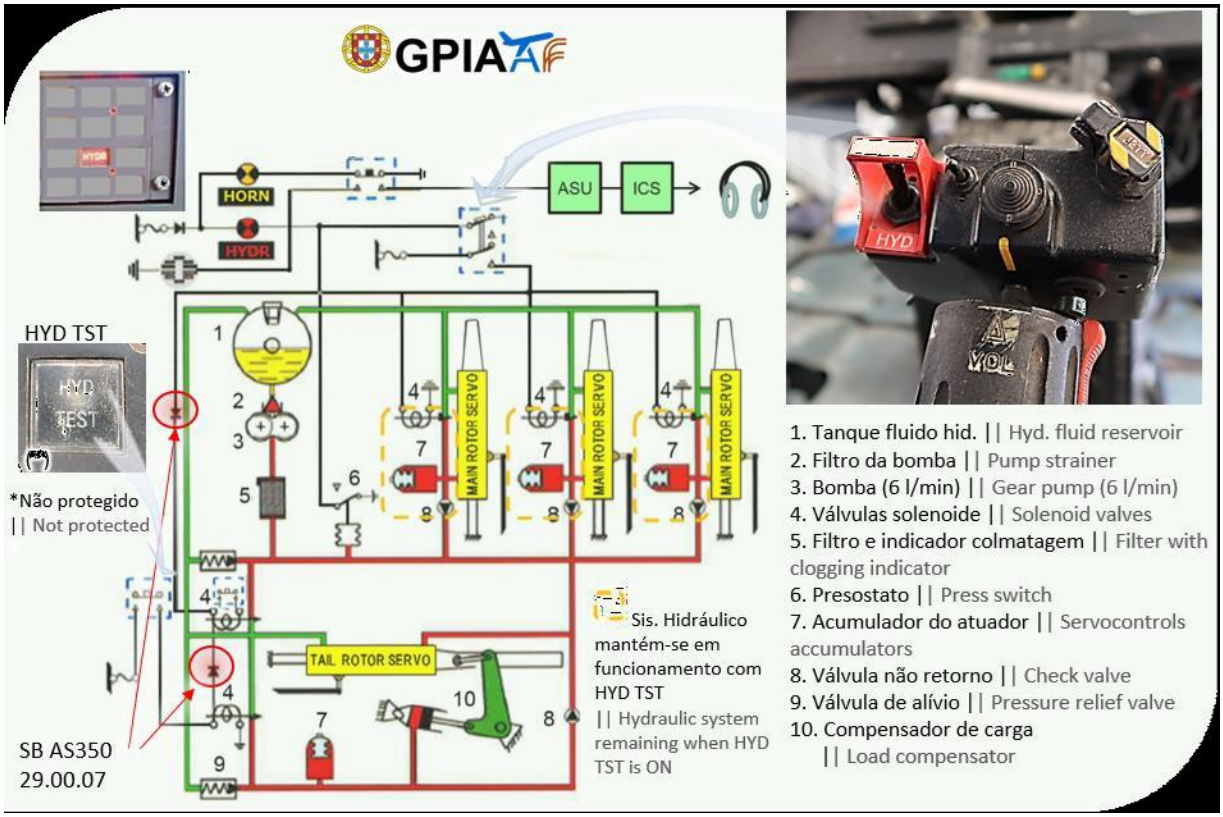
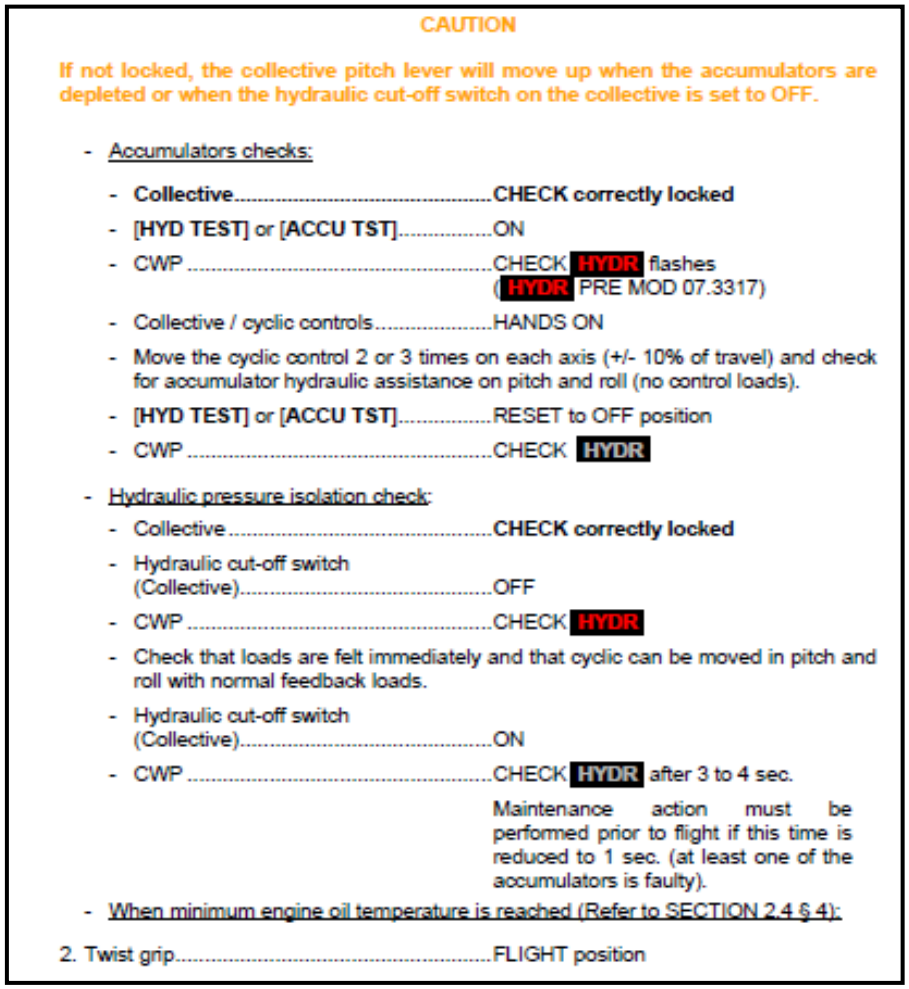


Figure 10: AS350 Hydraulic System Schematic. (Source: GPIAAF)



CAUTION

If not locked, the collective pitch lever will move up when the accumulators are depleted or when the hydraulic cut-off switch on the collective is set to OFF.

- Accumulators checks:
  - **Collective**.....**CHECK correctly locked**
  - **[HYD TEST]** or **[ACCU TST]**.....ON
  - CWP.....CHECK **HYDR** flashes (**HYDR** PRE MOD 07.3317)
  - Collective / cyclic controls.....HANDS ON
  - Move the cyclic control 2 or 3 times on each axis (+/- 10% of travel) and check for accumulator hydraulic assistance on pitch and roll (no control loads).
  - **[HYD TEST]** or **[ACCU TST]**.....RESET to OFF position
  - CWP.....CHECK **HYDR**
- Hydraulic pressure isolation check:
  - Collective.....**CHECK correctly locked**
  - Hydraulic cut-off switch (Collective).....OFF
  - CWP.....CHECK **HYDR**
  - Check that loads are felt immediately and that cyclic can be moved in pitch and roll with normal feedback loads.
  - Hydraulic cut-off switch (Collective).....ON
  - CWP.....CHECK **HYDR** after 3 to 4 sec.

    Maintenance action must be performed prior to flight if this time is reduced to 1 sec. (at least one of the accumulators is faulty).
- When minimum engine oil temperature is reached (Refer to SECTION 2.4 § 4):

2. Twist grip.....FLIGHT position

Figure 11: AS350 B3 FM Section 4.3: Start Up Hydraulic Checks.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

2.1.1 Man

The pilot was issued an Airline Transport Pilot Licence (ATPL) Helicopter (H) on 11 August 2020 with an expiry date of 31 August 2021. He was issued a Class 1 aviation medical certificate on 10 June 2020 with an expiry date of 30 June 2021 with no restrictions. The helicopter type was endorsed on his licence. The pilot completed his proficiency check flight on 22 December 2020 and signed it off in his logbook as an anti-poaching and crime patrol flight. Prior to the check flight, the pilot had last flown the helicopter type in January 2007.

2.1.2 Aircraft

The last MPI was conducted on 29 October 2020 at 6068.6 airframe hours and the helicopter had a total of 6152.3 airframe hours at the time of the accident.

A test on the hydraulics revealed that all components of the hydraulic system were serviceable prior to the accident. The hydraulic fluid leaked out of the reservoir after the helicopter impacted the ground. The readout of both the VEMD and DECU system indicated that the engine had failed after the helicopter impacted the ground and also that the main rotor stoppage was consistent with an engine delivering power when the main rotor blades impacted the ground. Records indicate that the aircraft was airworthy and there were no recorded defects prior to the flight.

2.1.3 Environment

The accident occurred during daylight on taxiway Hotel at FACT at GPS co-ordinates determined to be: 33°58'38.32" South, 018°35'51.88" East, at an elevation of 140ft. Taxiway Hotel is situated between hangars with other aircraft parked nearby. The weather at the time of the accident did not contribute to the accident.

2.1.4 Mission

This was a Part 127 flight with an intention of anti-crime patrol at the Cape Peninsula National Park during daylight. While waiting for take-off clearance from ATC at FACT, the pilot momentarily removed his hand from the collective pitch lever to adjust the volume on the radio. The collective pitch lever then moved up to its maximum position and the cyclic became very stiff and difficult to control, rendering the tail rotor uncontrollable. Post-accident test of the hydraulic system concluded that the system was serviceable prior to the accident. It is probable that the pilot did not release the HYD TEST push-button after testing this system. It is noted that the pilot repeated this process (HYD TEST) twice during the pre-take-off checks and could have, therefore, omitted to return the push-button to the OFF position. As stated in the Safety Information Notice No. 2630-S-29, hydraulic assistance on the tail rotor will not be maintained during take-off/flight should the HYD TEST push-button be left in the ON position. The pilot stated that he lost control of the yaw pedals which further confirm that he had no hydraulic assistance on his pedals. It is also probable that the “gong” sound and warning light illuminated during the accident sequence. During this time, the pilot may have been focused on “handling” the helicopter which was out of control and could have not been aware of the warning light and sound.

2.1.5 The investigation revealed that it is probable that the pilot did not return the HYD TEST button on the console to the “OFF” position before cutting off the hydraulic assistance using the “CUTOFF” switch on the collective stick. This resulted in the hydraulic pressure not being supplied to the servos. Thus, when the pilot momentarily took his hand off the collective pitch lever, it was forcefully pushed up due to natural and centrifugal forces on the main rotor. This would render the helicopter uncontrollable.

3. CONCLUSION

3.1. General

From the evidence available, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2. Findings

3.2.1 The pilot was issued an ATPL (H) on 11 August 2020 with an expiry date of 31 August 2021. The pilot's Class 1 aviation medical certificate was issued on 10 June 2020 with an expiry date of 30 June 2021, with no restrictions.

3.2.2 The aerial surveillance flight was conducted under the provisions of Part 127 of the CAR 2011 as amended and in visual flight rules (VFR) by day.

3.2.3 The prevailing wind at the time of the accident was from the south-east (200°) at 7 knots (kts); there was good visibility and the temperature was 18°C. The weather was not a factor in this accident.

3.2.4 The helicopter was issued a Certificate of Airworthiness on 22 December 2020 with an expiry date of 30 December 2021.

3.2.5 The last mandatory periodic inspection (MPI) was conducted on 29 October 2020 at 6068.6 airframe hours and the helicopter had flown a total of 83.7 hours since its last MPI. The helicopter was issued a Certificate of Release to Service (CRS) on 29 October 2020 with an expiry date of 29 October 2021 or at 6 168.6 hours, whichever occurs first.

3.2.6 Post-accident read-out of the VEMD system concluded that the actual flight lasted 4 minutes and all damage to the engine and rotor was due to impact when the helicopter hit the ground.

3.2.7 Post-accident test of the hydraulic system was found to be satisfactory as none of the components showed any signs of failure. The loss of hydraulic fluid in the reservoir was due to impact.

3.2.8 The accumulator test push-button (HYD TEST) mounted on the centre console, when left in the TEST/DOWN position during pre-flight checks, will result in the solenoid valve opening on the regulator unit, which depressurises the hydraulic system. It will also open the tail rotor servo solenoid, depressurising the tail rotor load compensator, but allowing the main rotor servos to be powered by the accumulators in their respective safety units.

3.2.9 The investigation revealed that it is probable that the pilot did not return the HYD TEST button on the console to the “OFF” position before cutting off the hydraulic assistance using the “CUTOFF” switch on the collective stick. This resulted in hydraulic pressure not being supplied to the servos. Thus, when the pilot momentarily took his hand off the collective pitch lever, it was forcefully pushed up due to natural and centrifugal forces on the main rotor. This would render the helicopter uncontrollable.

3.2.10 The pilot had last flown the helicopter type in January 2007.

3.3 Probable Cause

3.3.1 It is probable that the pilot lost control following a loss of hydraulic pressure as he omitted to release the “HYD TEST” push-button on the front centre console before cutting off the hydraulic assistance (using the “CUTOFF” switch) on the collective stick.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report; the AIID expects that all safety issues identified by the Investigation are addressed by the receiving States and organisations.

4.2. Safety Recommendation/s

4.2.1 Safety message: Pilots are advised to always use the checklist provided by the manufacturers in the flight manual to ensure that they do not omit/skip any of the checklist items required for the safe operation of the helicopter/aircraft.

5. APPENDICES

5.1 Annexure A (Airbus Helicopter Safety Information Notice No. 2630-S-29)

This report is issued by:

Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa

ANNEXURE A

AIRBUS HELICOPTERS

No. 2630-S-29

SAFETY INFORMATION NOTICE

SUBJECT: HYDRAULIC POWER

HELICOPTER WITH SINGLE HYDRAULIC SYSTEM - Hydraulic failure training
ATA: 67

For the attention of

AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
AS350	B, BA, BB, B1, B2, B3, D	L1
AS550		A2, C2, C3, U2
AS355	E	

Recent events (incidents and accidents), which occurred during hydraulic failure training, have led Airbus Helicopters to remind you of the procedures and precautions specified in the Flight Manual concerning this type of training.

The analysis of these events revealed two essential causes:

- Non-release of the "HYD TEST" push-button located on the front center console before cutting off the hydraulic assistance using the "CUTOFF" switch on the collective stick. This phase described in the hydraulic failure training procedure of the Flight Manual supplement is essential for helicopters equipped with a load compensator on the yaw channel**. This operation enables the hydraulic accumulator of the load compensator to be recharged before the hydraulic assistance is cut off using the switch on the collective stick, in order to maintain hydraulic assistance on the tail rotor control channel. This assistance is necessary for controlling the helicopter on its yaw axis at low speed. This operation also enables the training phase to be stopped at any time, and the hydraulics to be restored by simply actuating the "CUTOFF" switch.

- Non-compliance with the "CAUTION" indicated in the Flight Manual emergency procedures for the loss of hydraulic pressure or in the Flight Manual supplement for hydraulic failure training. This "CAUTION" requires that no hover flight or maneuvers at low speed be performed in this configuration. In these flight phases, the intensity and direction of the load return from the main rotor through the controls may rapidly change and generate a significant workload for the pilot, thus causing a risk of loss of control of the helicopter.

** The helicopter versions equipped with a load compensator on the yaw channel are: AS350 B1, B2, B3 and L1 and AS550 A2, C2, C3 and U2.
The helicopter versions not equipped with a load compensator on the yaw channel are: AS350 B, BA, BB, D and AS355 E.

AIRBUS HELICOPTERS

No. 2630-S-29

The Flight Manual supplement describes all the steps associated with hydraulic failure training and gives all the details and explanations on the operation of the system in this configuration, as well as the task definition for the persons involved (trainee and instructor).

Airbus Helicopters also reminds you that, in compliance with the Flight Manual, it is not permitted to take off without hydraulic assistance (take-off with the red "HYD" warning light lit on the warning panel) and that the training procedure for hydraulic failure/loss of hydraulic assistance must be performed when the helicopter is in a stabilized flight phase (cruise flight).

Compliance with the Flight Manual procedures ensures safe landing in all situations, regardless of whether it is in a training phase or you encounter a real failure.

NOTE: In addition, Airbus Helicopters informs you that TELEX INFORMATION Nos. TI 00000142 (AS350 B1, B2 and L1/AS550 A2, C2, U2), TI 00000152 (AS350 BA and BB), TI 00000153 (AS350 B3 and AS550 C3) and TI 00000154 (AS350 B and D) issued on December 09, 2003 are available on TIPI and give complementary information on the hydraulic system operation and the associated procedures.