PRELIMINARY ACCIDENT REPORT

Accident and Incident Investigations Division

Accident
- Preliminary Report -
AIID Ref No: CA18/2/3/9939

Figure 1: ZS-OXK helicopter. (Source: FlightZone Aviation Photography)

Description:

On 2 January 2021 at approximately 0500Z, an AS350 B3 helicopter with registration ZS-OXK was destroyed during an accident which occurred while the pilot was on ground waiting for take-off clearance at Cape Town International Airport (FACT). The pilot momentarily removed his hand off the collective lever to lower the volume of the radio when the collective suddenly shot up; as a result, the pilot lost control of the helicopter. At the time of the accident, visual meteorological conditions (VMC) prevailed. The flight was conducted under the provisions of Part 127 of the Civil Aviation Regulations (CAR) 2011 as amended.

INTRODUCTION

Reference Number	**:** CA18/2/3/9939
Name of Owner/Operator	**:** South African National Parks
Manufacturer	**:** Eurocopter
Model	**:** AS350 B3
Nationality	**:** South African
Registration Marks	**:** ZS-OXK
Place	**:** Cape Town International Airport (FACT)
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 investigator went to Cape Town International Airport (FACT) on 21 January 2021 to conduct a follow up investigation. The investigator 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 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 have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer:

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ABBREVIATION	DESCRIPTION
AIID	Accident and Incident Investigations Division
AGL	Above Ground Level
AMO	Aircraft Maintenance Organisation
AOC	Air Operating Certificate
ATPL	Airline Transport Pilot Licence
C	Celsius
CAR	Civil Aviation Regulations
CVR	Cockpit Voice Recorder
CofA	Certificate of Airworthiness
CofR	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
kt	Knot
L	Litre
m	Metre
METAR	Meteorological Aeronautical Report
MPI	Mandatory Periodic Inspection
ml	Millilitre
n/a	Not Applicable
PAPI	Precision Approach Path Indicator
QNH	Query Nautical Height
SACAA	South African Civil Aviation Authority
UTC	Co-ordinated Universal Time
VFR	Visual Flight Rules
Z	Zulu

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 preparing to take-off on a patrolling and anti-crime flight from Cape Town International Airport (FACT) to the Cape Peninsula National Park in the Western Cape province. 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 lever down and locked. He then tested the hydraulic system by switching ON/DOWN the hydraulic accumulator HYD TEST switch and 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 smooth. He then switched the hydraulic accumulator HYD TEST switch to OFF/UP position, and then to ON/DOWN position again. He tested the range of the cyclic once more and, this time, there was full and free movement on all planes; he then put the switch to OFF/UP position. The pilot then tested the hydraulics by moving the master hydraulic switch on the collective pitch lever to OFF position, tested for movement and then moved the switch back to ON position.

1.1.3 The pilot further stated that he moved the throttle to flight position and carried out all the pre-take-off checks; and all was good. He then depressed the collective to release the mechanical lock and was ready for lift-off. While waiting for tower to grant take-off clearance, he 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 pilot did not hear any audible warning or see any warning light illuminating on the panel. The helicopter lifted off the ground to approximately 30 feet (ft) above ground level (AGL) 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 were ineffective. The helicopter continued to yaw through two full left turns while pitching forward with a slight roll to the right. The main rotor blades impacted the ground and the pilot lowered the collective fully down. The right-side skid impacted the ground and a dynamic rollover ensued with the helicopter coming to rest on its right side. A post-impact fire ensued in the engine compartment and the pilot shut down the engine and disembarked the helicopter unaided. The fire-fighters responded to the scene shortly thereafter and extinguished the fire.

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

1.1.5 The accident occurred during daylight on taxiway H3 (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 2: The 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 helicopter was destroyed by impact forces and a post-impact fire during the accident sequence.

Figure 3: The helicopter at the scene 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	0270287691	Licence Type	ATPL (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 According to the pilot proficiency check form, he conducted his proficiency check ride with a Grade II instructor on 22 December 2020 for a total of 2.8 flying hours. The pilot flew a total of 19.4 hours from the check ride up to the accident flight. Prior to the check ride, the pilot last flew 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 Aérospatiale 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

Main Rotor Transmission & Blades:

Gearbox		Blades			
Serial Number	M2103	Part Number	355A11-0030-04		
Installation Date	7 July 2020	Serial Number	28336	28338	28339
Hours since New	6068.6	Hours since New	5606.7		
Hours since Overhaul	n/a				

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 kts	Visibility	9999m
Temperature	18°C	Cloud Cover	CAVOK	Cloud Base	CAVOK
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 navigational 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 navigation system unserviceable were recorded before the flight.

1.10. Aerodrome Information

1.10.1 The accident occurred during daylight on taxiway H3 (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:	Licensed	
Aerodrome Co-ordinates	S33°58'16.93" E018°36'15.45"	
Aerodrome Altitude	151 feet	
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	

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.

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 were ineffective. The pilot regained control of the collective to arrest the gain in height at approximately 30ft AGL. The helicopter continued to yaw through two full left turns while pitching forward with a slight roll to the right. 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 and the pilot shut down the engine and disembarked the helicopter unaided. The fire-fighters responded to the scene shortly thereafter and extinguished the fire.

1.12.2 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 rotor blades impact with the ground. All three frequency adapters had cracks on them due to impact forces.

Figure 4: The main rotor blades post-accident.

1.12.3 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 5: The engine compartment after fire damage.

1.12.4 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 due to most of the oil seeping out of the tank when the helicopter was resting on its right side.

Figure 6: Hydraulic reservoir and pump found intact post-accident.

1.12.5 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 bent upwards.

Figure 8: The left skid gear (left image) and the right skid gear (right image).

1.12.6 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 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 9: Damaged tail boom and tail rotor.

1.13 Medical and Pathological Information

1.13.1 To be discussed in the final report.

1.14 Fire

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

1.15 Survival Aspects

1.15.1 The accident was considered survivable due to the helicopter being at hover height and at a slow speed before impact. The pilot was also wearing a safety harness during the accident. The helicopter caught fire after impact, damaging only the engine section of the helicopter.

1.16 Tests and Research

1.16.1 To be discussed in the final report.

1.17 Organisational and Management Information

1.17.1 The operator was issued an Air Service Licence number N270D on 15 July 2009.

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, and with an expiry date of 31 December 2021. The operator of the helicopter held a Class G certificate in accordance with Civil Aviation Regulations.

1.17.3 The last maintenance inspection 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. 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

1 GENERAL

To reduce collective, cyclic and pedal control forces, the flight controls are hydraulically assisted. There are three main rotor servos, one longitudinal and two laterals and also a tail rotor servo for yaw control. The hydraulic fluid used must comply with the

approved specifications in SECTION 2 of the present flight manual. Total system fluid volume is 3 litres (0.79 US gal or 0.66 UK gal) up to the maximum level mark on the reservoir.

2 SYSTEM DESCRIPTION

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). 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,*
- *A Gong sounds once (the Gong sounds when any red warning light comes on).*

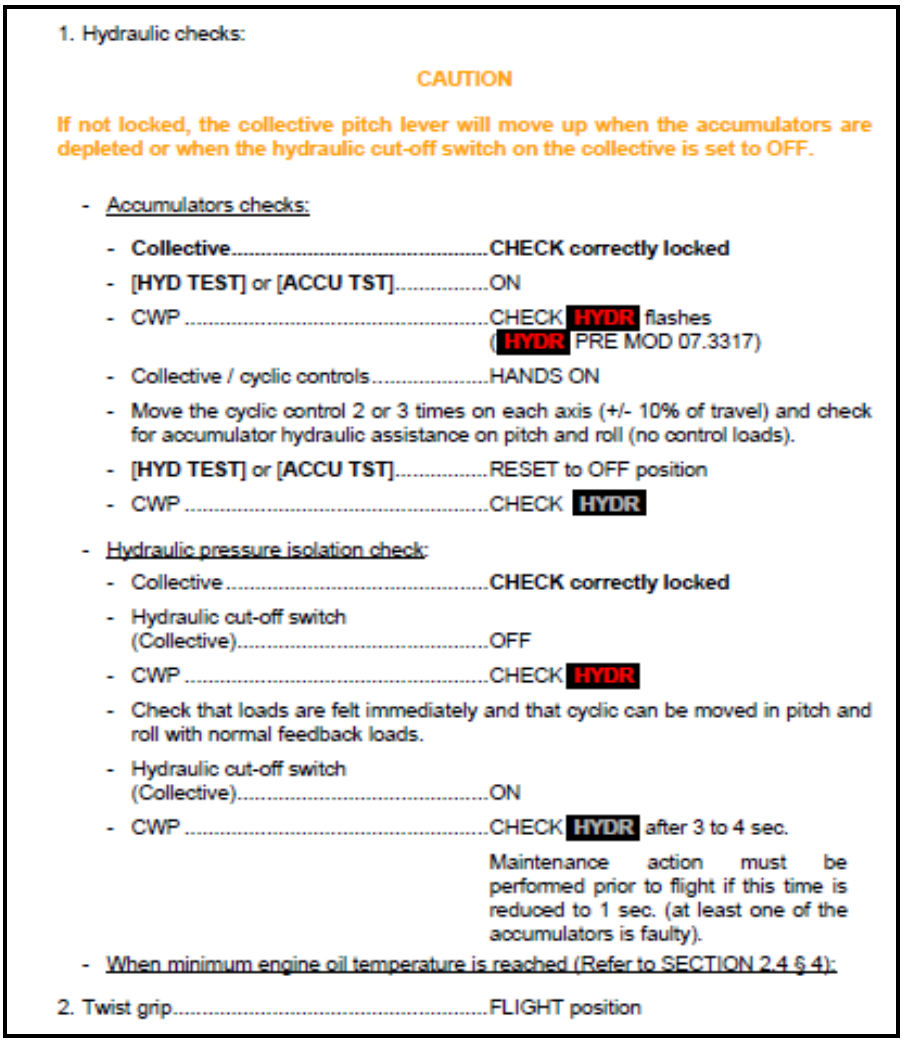
2.2 SYSTEM CONTROLS AND MONITORING

The hydraulic system is controlled using two switches:

- *The Hydraulic cut-off switch: 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 depressurized, the accumulators on the main rotor servos are depressurized simultaneously, the tail rotor load compensating system retains its assist function.*
- *The accumulator test pushbutton: [**HYD TEST**] or [**ACCU TST**] pushbutton 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 depressurizes the hydraulic system. It will also open the tail rotor servo solenoid, depressurizing the tail*

rotor load compensating servo but allowing the main rotor servos to be powered by the accumulators in their respective safety units.

1.18.2 AS 350 B3 FM Section 4.3: Start Up Hydraulic Checks



1. Hydraulic checks:

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

1.19 Useful or Effective Investigation Techniques

1.19.1 To be discussed in the final report.

2. Findings

2.1 General

From the available evidence, the following preliminary findings 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 conclusions 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.

2.1.1 The pilot was issued an Airline Transport Pilot Licence (Helicopter) 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.

2.1.2 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.

2.1.3 The weather at the time of the accident was recorded as follows: Wind, 200° at 7 knots (kts); Visibility, 9999m; Cloud Base, ceiling and visibility OK (CAVOK); Temperature, 18°C; Dew Point 8°C; and Query Nautical Height (QNH) 1017hPa.

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

2.1.5 The last mandatory periodic inspection (MPI) was conducted on 29 October 2020 at 6068.6 airframe hours and the aircraft had flown a total of 83.7 hours since its last MPI. The helicopter was issued a CRS on 29 October 2020 with an expiry date of 29 October 2021 or at 6168.6 hours, whichever occurs first.

2.1.6 The pilot momentarily took his hand off the collective lever to lower the volume of the radio; the collective shot up, resulting in the loss of control and a crash.

3. On-going Investigation

3.1 The AIID investigation is on-going and the investigator will be looking into other aspects of this occurrence which may or may not have safety implications.

This report is issued by:

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