REPUBLIC OF KENYA

MINISTRY OF TRANSPORT AND INFRASTRUCTURE

AIR ACCIDENT INVESTIGATION

ACCIDENT REPORT

HELICOPTER AS350B2 REGISTRATION 5Y-HLI

P.O. Box 52692- 00200 Nairobi

Telephone: 254-20-2729200

Fax: 254-20-2737320

SEAMLESS CONNECTIVITY
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ACCIDENT SUMMARY REPORT

OPERATOR:	Heliservices Ltd
AIRCRAFT TYPE:	Eurocopter AS 350 B2
MANUFACTURER:	Eurocopter
YEAR OF MANUFACTURE:	1998
AIRCRAFT REGISTRATION:	5Y-HLI
AIRCRAFT SERIAL NUMBER:	3160
DATE OF REGISTRATION:	5 August 2002
TYPE OF ENGINE:	Ariel 1D
DATE OF ACCIDENT:	17 December 2011
TIME OF ACCIDENT:	1048 Hrs
LOCATION OF ACCIDENT:	Kaptarkok School (Mokwo, Keiyo)
TYPE OF FLIGHT:	Charter
NUMBER OF PERSONS ON BOARD:	5 (Five)
INJURIES:	Nil
NATURE OF DAMAGE:	The Undercarriage Skid
PILOT'S FLYING EXPERIENCE:	over 1940 hrs

All times given in this report are Coordinated Universal Time (UTC). East African Local Time is UTC plus 3 hours.

INTRODUCTION

The AAID received notification of the helicopter accident that had occurred at Mokwo, Keiyo on the 17 December 2011 from the Kenya Civil Aviation Authority. Arrangements were then made for 2 investigators to travel to the site of the accident the following day to carry out the investigations.

The Helicopter, a Eurocopter AS 350B2 registration number 5Y-HLI, belonging to Heliservices Ltd made a hard landing during the take-off from an open school field in Mokwo, Keiyo District. The helicopter had a brief stop at the Kaptarkok school before attempting to take-off when the accident occurred.

The pilot and the four passengers exited the helicopter unhurt.

The helicopter suffered damaged on the left skid, front cross tube and the forward lower Canopy Cowling.

Investigations were carried out by the AAID which included the crash site visit, eye witness interviews, and the Operator maintenance and flight operation records, concluded that the helicopter was unable to sustain a continuous lift after take-off due to the loading and high altitude environment.

The investigations which were carried out in accordance with accident investigation regulations and the provisions of the ICAO annex 13, was not intended to apportion blame or liability purposes but with the sole objective of prevention of accidents and incidents.

The Cabinet Secretary, Ministry of Transport and Infrastructure, in accordance with regulation 18 of *The Civil Aviation (Aircraft Accident and Incident Investigation) Regulations, 2009* authorizes the release of this report.

30 June 2014

ABREVIATION

AGL :	Above Ground Level
AMSL :	Above Mean Sea Level
AOC :	Air Operator's Certificate
C of A :	Certificate of Airworthiness
C of R :	Certificate of Registration
CG:	Centre of Gravity
IAS:	indicated airspeed
ISA :	International Standard Atmosphere
Kg:	kilogram(s)
Kt:	knot(s)
lbs :	Pounds
ltr:	litre(s)
m:	metres
mb:	millibar(s)
Nm:	nautical mile(s)
Psi:	pounds per square inch
QNH :	Pressure setting to indicate height above aerodrome
Rpm:	revolutions per minute
TAS :	True Airspeed
TBO :	Time Between Overhaul
UTC:	Co-ordinated Universal Time (the contemporary equivalent of GMT)
V2:	Takeoff safety speed
VFR :	Visual Flight Rules

Table of Contents

1. FACTUAL INFORMATION

1.1 History of the flight

The Helicopter departed Eldoret International airport at 1012 Hrs for a flight to Elburgon when it had the accident. On board the Helicopter were the pilot and 4 passengers. The flight originated from Kitale then to Eldoret. From Eldoret the Helicopter was heading to Elburgon via Iten. The flight from Eldoret was uneventful upto the time the helicopter landed at an open Kaptarkok school field in Mokwo (Keiyo). After a brief stop on the ground the pilot and 4 passengers embarked onto the helicopter to continue the flight to Elburgon.

At 1150 Hrs the pilot did the preflight check procedures after which he attempted for the take-off. The helicopter which was stationed near the school structures lifted off from the ground slightly and moved slowly forward towards the southerly direction (180^{O}) as it gained the forward speed. The pilot realized that the lifting rate was insufficient to enable the helicopter to clear the visible obstacles (power lines and trees) ahead beyond the school compound and executed a turn to south westerly direction (210^{O}) before making a precautionary landing on a small gradient slope 30 meters after the school's perimeter fence. The helicopter hit the 5 feet perimeter fence then crash-landed approximately 150m from the point of take-off.

1.1.1 Location of the Accident

The accident occurred on a high altitude area, on a Kaptarkok school playing field on a small hill. The area coordinates are N 00^0 26.228 and E 035^o 33.899.

The elevation of the accident site is 8,500 feet above the sea level (ASL).

1.2 Injuries to persons

Injuries	Crew	Passengers	Total in aircraft
Fatal	0	0	0
Serious	0	0	0
Minor	0	0	0
None	1	4	5
TOTAL	**1**	**4**	**5**

1.3 Damage to aircraft

The helicopter suffered damage on the left skid as a result of the hard sideward impact with uneven ground surface during the landing. The left front cross tube was bent inwards damaging the lower Canopy Cowling.

1.4 Other damage

There was no environmental damage associated with the accident.

1.5 Personnel information

1.5.1 Pilot

Male, aged 51 years at the time of the accident.

The pilot was medically examined and a medical certificate (class 1) was issued on 5 December 2011, with a validity period upto 14 June 2012.

The pilot had a valid commercial Helicopters pilot license which was issued on 1 July 1997. It was due to expire on 14 June 2012. He also had other helicopter ratings; Hughes 500MD and Bell 206 types at the time of the accident.

He had a total of 1940hrs and had flown more than 173hrs on AS 350 type during the preceding 6 months.

1.6 Aircraft information

The Helicopter Registration 5Y-HLI, Eurocopter AS 350B2, serial number 3160 was manufactured by Eurocopter in 1998 and was equipped with a Turbomeca Arriel 1D, turboshaft engine. The most recent inspection was performed on 2 December, 2011. At the time, the helicopter had accumulated approximately 3992 total flight hours, 5273 Landings and 5674 cycles.

The helicopter was imported into Kenya from South Africa under a South African CAA Export C of A issued on 12 July 2012. It was registered in Kenya on 5th August, 2002 to Heliservices Ltd and leased to ALS Ltd. The Helicopter had a valid certificate of Airworthiness for Public Transport category issued by the Kenya Civil Aviation Authority, which was due to expire on 22nd September, 2012.

The helicopter's maximum certified take-off weight was 2250 Kgs (4961 lbs) and a certified maximum landing weight 2250 Kgs (4961 lbs). It was certified to carry a maximum of 6 persons including the pilot.

1.7 Meteorological information

The weather reported as good with mostly cloudy sky. A mean temperature of 18^{O}C, Dew point of 12^{O}C and visibility of more than 1000m for the area.

1.8 Aids to navigation

Not applicable to this accident.

1.9 Communications

Not applicable to this accident.

1.10 Aerodrome information

Not applicable to this accident.

1.11 Flight recorders

The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR); neither was it required by regulation.

1.12 Wreckage and impact information

The helicopter first hit the school's 5 feet perimeter fence before landing heavily on the skids.

1.13 Medical and pathological information

Not applicable to this accident.

1.14 Fire

There was no fire outbreak before or after the hard landing.

1.15 Survival aspects

The accident was survivable.

1.16 Tests and research

Engine Ground Run

At the site of the accident the Helicopter was leveled up for the oil and fuel to flow internally for the quantity level checks. The engine was started and a dry run performed prior to the engine ground run. During the dry run no abnormal noise or indications was noted. There was no indication of turbine blades rubbing on the casing or the shroud. The engine ground run checks were then performed, all parameters indication on gauges revealed normal operation of the systems including oil pressure and temperature.

The Main and Tail Rotors were operating within normal range with the Gas Generator (Ng) RPM gauge indication at 83% and the Turbine Outlet temperature (T4) indication at 500^{O}C. at shut down, the Ng and Rotor were timed and found within allowable limits as per the AFM. There were no warning or caution alerts during the engine ground run. A final inspection of the engine after the engine ground run revealed no visible damage on the 5 engine modules. A slight oil leakage was noted from the number 3 engine module rea bearing scavenge duct.

The helicopter was later ferried to the Base where extensive examination and repairs were arranged by the operator.

Main Gearbox

The Helicopter Main Gearbox Assembly was dismantled for teardown at an approved test shop following the operator arrangement. The parts were examined for defect and wear beyond dimensional limits as per the applicable maintenance manual. Below are some of the parts from the Main Gearbox which were examined for defects and other damages.

Pinion and Gear Wheel

The Gearbox Reduction Gear was removed and examined as per the maintenance manual procedures due to over torque (defect) that had occurred. There were no sign or evidence of failure or defect that may have occurred prior to the accident.

Oil Jet

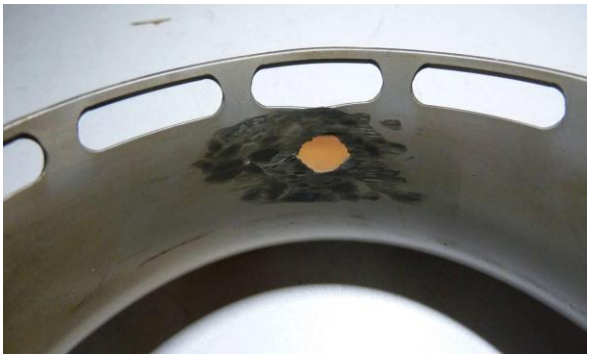
Upper Housing

The Oil jet was found worn out. The Upper Housing was found with enlarged bolt holes which exceeded the allowed dimensional limits.

Engine;

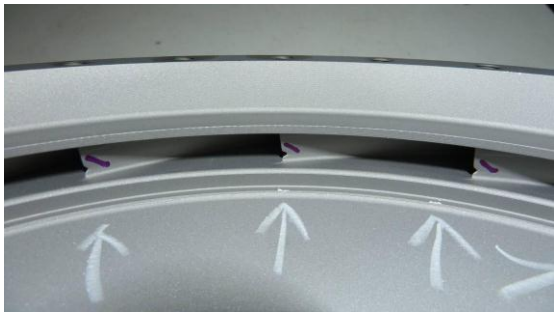
The Helicopter Engine was uninstalled and ferried for teardown at an approved test shop following the operator arrangement. Various components and parts were examined for defect and wear beyond dimensional limits as per the applicable maintenance manual.

Centrifugal Compressor



Centrifugal Compressor cover

There was evident rub beyond allowable limits on the Centrifugal Compressor blade tips. Through rub damage was evident on the Centrifugal Compressor cover.



Diffuser Assembly

1st Stage Nozzle Guide Vane

The engine Diffuser Assembly had evidence of erosion beyond allowable limits

The 1st Stage Nozzle Guide Vane had evident Crazing and cracks

The engine and Gearbox were inspected in accordance with Turbomeca Ariel 1 overhaul Manual X 292875002 revision 30 of October 2011. The inspections were called upon as a requirement following a suspected helicopter 'Heavy Landing' and engine 'Overtorque'. The inspections were carried out on engine Modules 1 to 5. There were defects noted on several parts some of which have been shown above.

1.17 Organizational and management information

This was not a factor in the accident

1.18 Additional information

The examination of parts following a teardown revealed several defects most of which are consistent with normal wear on engine usage. Some of the defects noted were probably caused by hard impact landing forces and subsequent engine over-torque effects.

1.19 Useful or effective investigation techniques

Nil for this accident

2 ANALYSIS

2.1. Airframe;

The helicopter was certified, equipped and maintained in accordance with existing regulations and approved procedures. It had a certificate of release to service issued on 2 December 2011 valid for 300 flight hours or 6 calendar months, whichever falls due earlier.

The mass and the center of gravity of the aircraft were within the prescribed limits.

There was no evidence of any defect or malfunction in the helicopter that could have contributed to the accident.

2.2. Engine;

The engine, model Ariel 1D and serial number 9607, was manufactured by Turbomeca, France on 16 September 1998. It had accumulated a total of 3698 hours since manufacture and had 783 hours after shop overhaul. It had a total of 4858 cycles.

Following the examination of the engine and Gearbox parts, it is considered that the defects and damages noted would probably contribute to the degrading of the engine power output at high altitude and subsequently affecting the helicopter's take-off performance.

2.3. Flight operations;

The accident area is a high altitude environment of 8,500 feet above sea level measured at QNH 1013 mill-bars of atmospheric pressure. The helicopter was able to land at an open school field with load of 5 occupants including the pilot and with 95% full capacity fuel tank. Take off from the same altitude and atmospheric pressure with the same weight became a bigger challenge for the same type

helicopter and would require a wider and open area with no obstacle to enable a safe take-off.

3 CONCLUSIONS

FINDINGS;

The pilot was licensed and qualified for the flight in accordance with existing Regulations.

The pilot was medically fit and adequately rested to operate the flight.

The pilot was in compliance with the flight and duty time regulations.

The pilot's actions and statements indicated that his knowledge and understanding of the aircraft systems was adequate.

The civil aviation authority's safety oversight of the operator's procedures and operations was adequate

4 PROBABLE CAUSE

The accident was probably caused by the pilot's inadequate preparation including loading and assessment of the helicopter's expected performance on take-off at the high altitude area.

4.1 CONTRIBUTING FACTORS

The helicopter's engine performance at high altitude may have degraded slightly as a result of the internal defects and wear noted during the engine strip.

APPENDICES

1. **APPENDIX (I)** CERTIFICATE OF REGISTRATION
2. **APPENDIX (II)** CERTIFICATE OF AIRWORTHINESS
3. **APPENDIX (III)** RADIO STATION LICENSE
4. **APPENDIX (IV)** AIR SERVICE LICENSE
5. **APPENDIX (V)** AIR OPERATOR CERTIFICATE
6. **APPENDIX (VI)** CERTIFICATE OF INSURANCE
7. **APPENDIX (VII)** AIRCRAFT MAINTENANCE MANUAL

APPENDIX (I)

Certificate of Registration

DCA (L) 25

Certificate Number
1902

State Issue: KENYA

Certificate of Registration of Aircraft.

1. Nationality and Registration Mark	2. Manufacturer and Manufacturer's Designation of Aircraft	3. Aircraft Serial Number
5Y-HLI	EUROCOPTER AS 350 B2	3160

4. Name of Owner : HELISERVICES LTD

FINANCIER: CREDIT BANK LTD

LESSEE: ALS LTD

5. Address of Owner : P.O. BOX 41937
NAIROBI

FINANCIER: P.O. BOX 61064
NAIROBI

LESSEE: P.O. BOX 41937, NAIROBI

6.

It is hereby certified that the above described aircraft has been duly entered on the register of the state in accordance with the Convention on International Civil Aviation dated 7th December, 1944, and with the Kenya Civil Aviation Act, 1977, and the Air Navigation Regulations issued thereunder, applicable in Kenya.

for and by authority of the Director of Civil Aviation

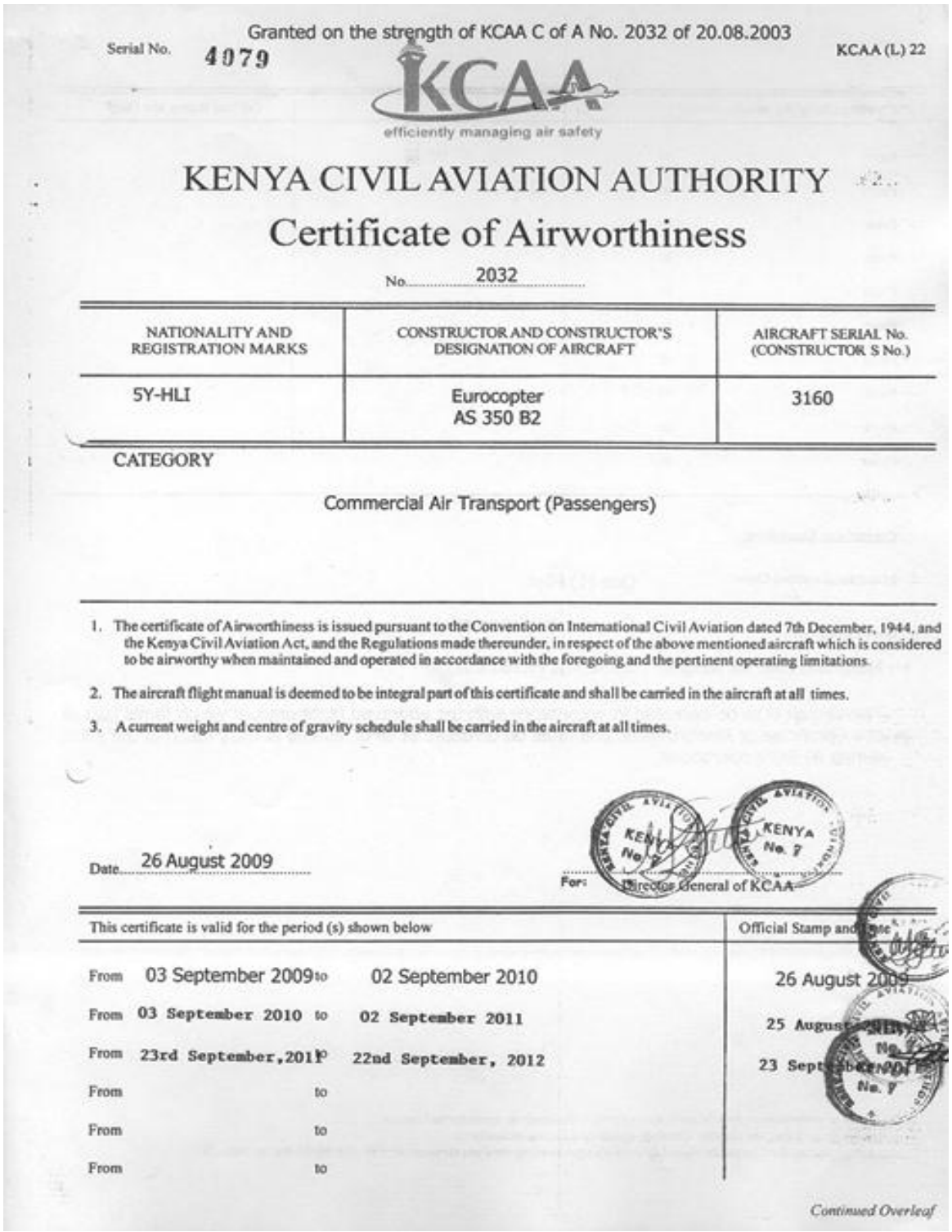
Date of issue 5th August, 2002

Date of Renewal.....
Date of Renewal.....
Date of Renewal.....
Date of Renewal.....
Date of Renewal.....
Date of Renewal.....

NOTE.—No entries or endorsements may be made in the foregoing certificate except in the manner and by the persons authorised for that purpose.

APPENDIX (II)

Certificate of Airworthiness



Granted on the strength of KCAA C of A No. 2032 of 20.08.2003

Serial No. 4079

KCAA (L) 22

efficiently managing air safety

KENYA CIVIL AVIATION AUTHORITY

Certificate of Airworthiness

No. 2032

NATIONALITY AND REGISTRATION MARKS	CONSTRUCTOR AND CONSTRUCTOR'S DESIGNATION OF AIRCRAFT	AIRCRAFT SERIAL No. (CONSTRUCTOR S No.)
5Y-HLI	Eurocopter AS 350 B2	3160

CATEGORY

Commercial Air Transport (Passengers)

1. The certificate of Airworthiness is issued pursuant to the Convention on International Civil Aviation dated 7th December, 1944, and the Kenya Civil Aviation Act, and the Regulations made thereunder, in respect of the above mentioned aircraft which is considered to be airworthy when maintained and operated in accordance with the foregoing and the pertinent operating limitations.
2. The aircraft flight manual is deemed to be integral part of this certificate and shall be carried in the aircraft at all times.
3. A current weight and centre of gravity schedule shall be carried in the aircraft at all times.

Date 26 August 2009

For: Director General of KCAA

This certificate is valid for the period (s) shown below		Official Stamp and Date
From 03 September 2009	to 02 September 2010	26 August 2009
From 03 September 2010	to 02 September 2011	25 August
From 23rd September, 2011	to 22nd September, 2012	23 September
From	to	
From	to	
From	to	

Continued Overleaf

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Continuation of the validity period		Official Stamp and Date
From	to	
From	to	
From	to	
From	to	
From	to	
From	to	
From	to	
From	to	
From	to	
From	to	

Compulsory Conditions:-

Minimum Required Crew: One (1) Pilot.

Number of Seats: Six (6) - (including pilot).

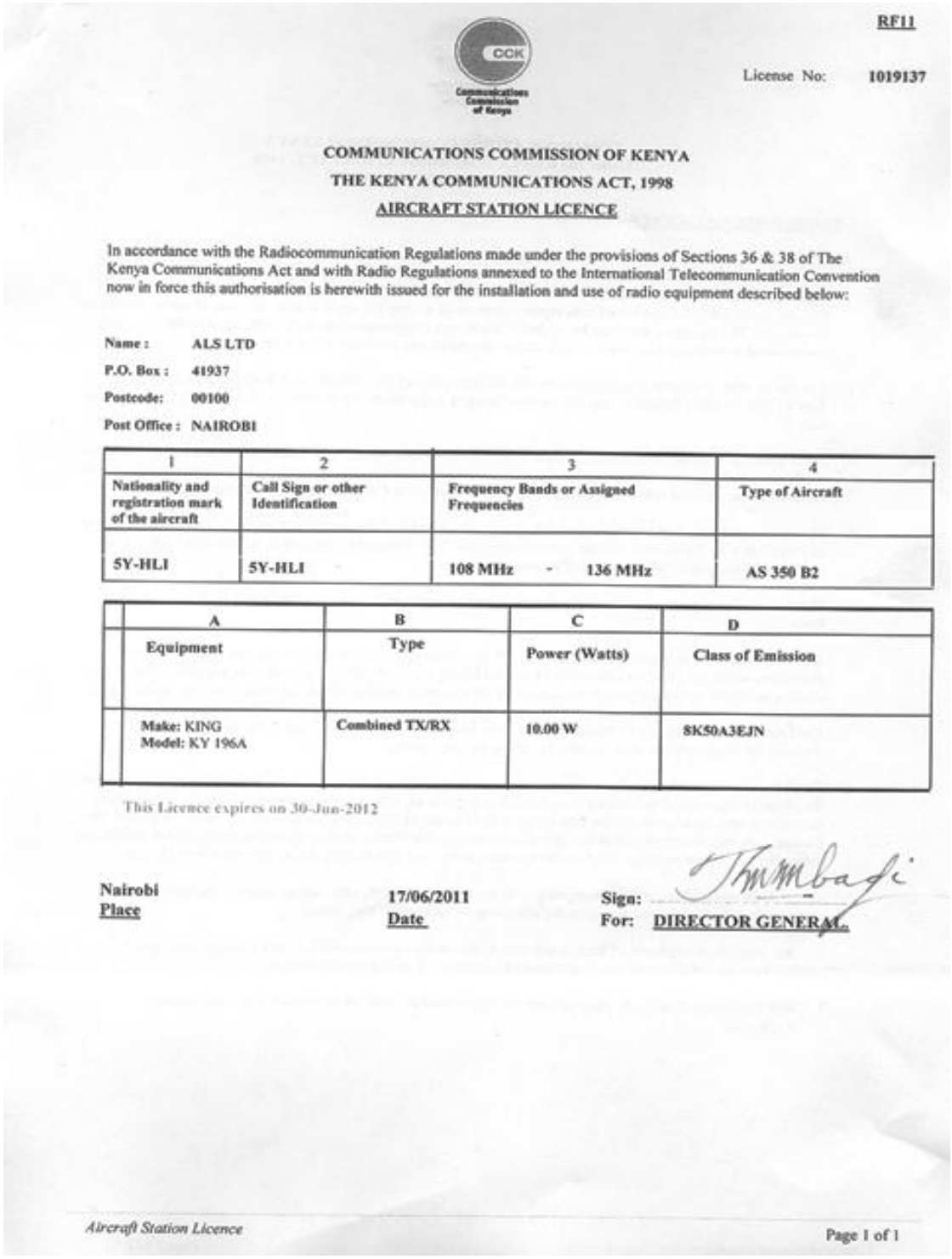
Maximum take-off weight: 2,250 Kgs (4,961 Lbs)

The aircraft is to be operated in accordance with the approved flight manual which forms part of this Certificate of Airworthiness and must be on board at all times and at easy reach of the pilots during all flight operations.

No entries or endorsements may be made on this certificate except by an authorised person.
If this certificate is lost, the Director General, should be informed immediately.
Any person finding this Certificate should forward if immediately to the Director General, P.O. Box 30163-00100, Nairobi.

APPENDIX (III)

Radio Station Licence



RF11

License No: 1019137

COMMUNICATIONS COMMISSION OF KENYA

THE KENYA COMMUNICATIONS ACT, 1998

AIRCRAFT STATION LICENCE

In accordance with the Radiocommunication Regulations made under the provisions of Sections 36 & 38 of The Kenya Communications Act and with Radio Regulations annexed to the International Telecommunication Convention now in force this authorisation is herewith issued for the installation and use of radio equipment described below:

Name : ALS LTD

P.O. Box : 41937

Postcode: 00100

Post Office : NAIROBI

1	2	3	4
Nationality and registration mark of the aircraft	Call Sign or other Identification	Frequency Bands or Assigned Frequencies	Type of Aircraft
5Y-HLI	5Y-HLI	108 MHz - 136 MHz	AS 350 B2

	A	B	C	D
	Equipment	Type	Power (Watts)	Class of Emission
	Make: KING Model: KY 196A	Combined TX/RX	10.00 W	8K50A3EJN

This Licence expires on 30-Jun-2012

Nairobi
Place

17/06/2011
Date

Sign:
For: DIRECTOR GENERAL

Aircraft Station Licence

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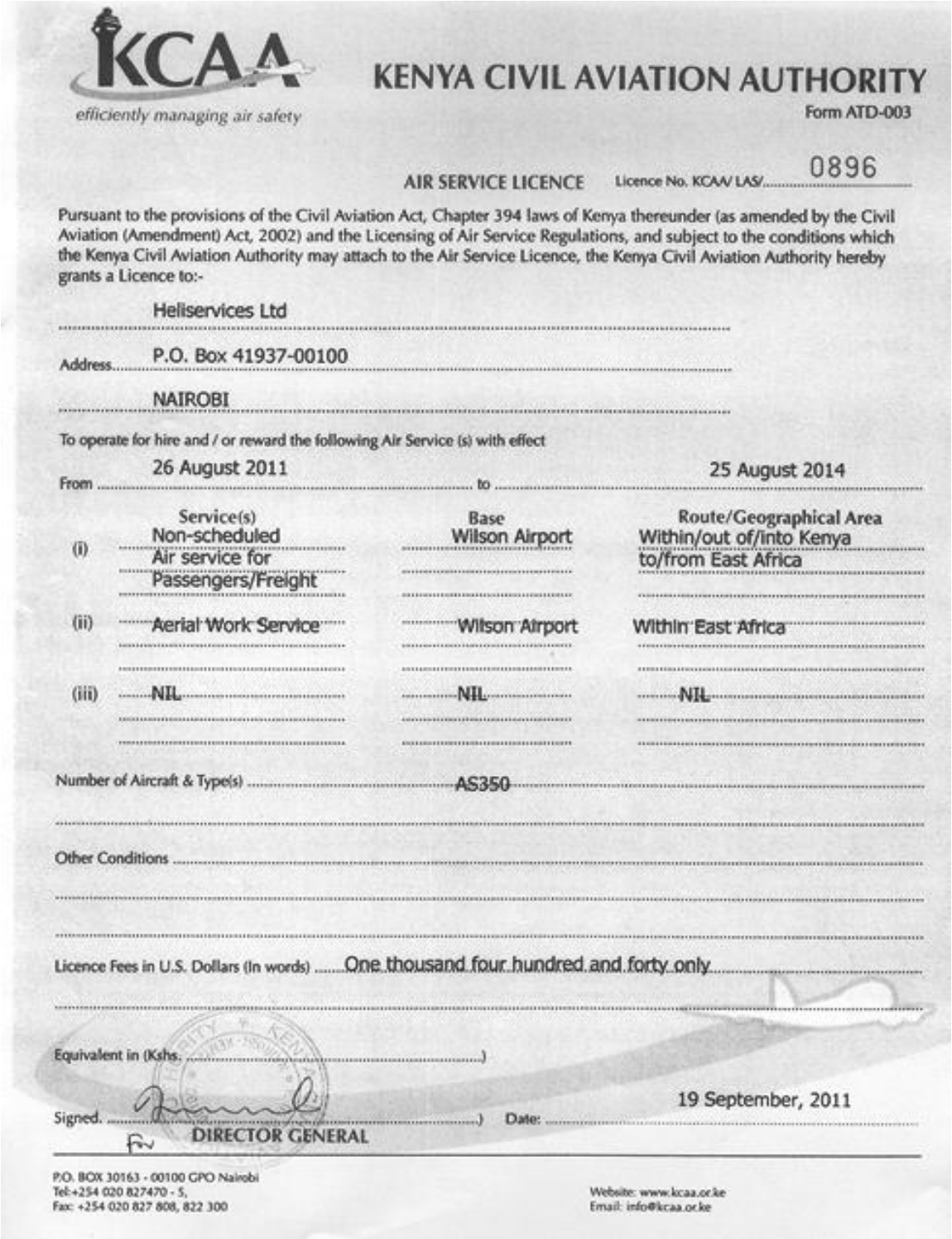
APPENDIX (IV)

Air Service License



KCAA
efficiently managing air safety

KENYA CIVIL AVIATION AUTHORITY
Form ATD-003

AIR SERVICE LICENCE Licence No. KCAA/ LAS/ 0896

Pursuant to the provisions of the Civil Aviation Act, Chapter 394 laws of Kenya thereunder (as amended by the Civil Aviation (Amendment) Act, 2002) and the Licensing of Air Service Regulations, and subject to the conditions which the Kenya Civil Aviation Authority may attach to the Air Service Licence, the Kenya Civil Aviation Authority hereby grants a Licence to:-

Heliservices Ltd

Address P.O. Box 41937-00100

NAIROBI

To operate for hire and / or reward the following Air Service (s) with effect

From 26 August 2011 to 25 August 2014

	Service(s)	Base	Route/Geographical Area
(i)	Non-scheduled Air service for Passengers/Freight	Wilson Airport	Within/out of/into Kenya to/from East Africa
(ii)	Aerial Work Service	Wilson Airport	Within East Africa
(iii)	NIL	NIL	NIL

Number of Aircraft & Type(s) AS350

Other Conditions

Licence Fees in U.S. Dollars (In words) One thousand four hundred and forty only

Equivalent in (Kshs.)

Signed.) Date: 19 September, 2011

DIRECTOR GENERAL

P.O. BOX 30163 - 00100 GPO Nairobi
Tel:+254 020 827470 - 5,
Fax: +254 020 827 808, 822 300

Website: www.kcaa.or.ke
Email: info@kcaa.or.ke

APPENDIX (V)

Air Operator Certificate

KCAA FORM: OPS 001C

AIR OPERATOR CERTIFICATE

1 3

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KENYA [1]

KENYA CIVIL AVIATION AUTHORITY [2]

Serial No.:[3] 0024

KCAA Ref.:
FPOS / 3010 / 230

4 8

AOC #[4]: 230

Operator's Name[6]
HELISERVICES LIMITED

Dba Trading Name[7]
HELISERVICES LIMITED

Operator Address[9]
P. O. BOX 41937- 00100
NAIROBI

Telephone:[10]
+254 02 6008362/6005510

Fax:
+254 02 6007185

E-mail: www.ats.co.ke

Operational Points of Contact:[8]
WILSON AIRPORT

Expiry Date[5] (dd.mmm.yyyy):
30TH NOVEMBER 2012

11

This certificate certifies that[11] **HELISERVICES LIMITED** is authorized to perform commercial air operations, as defined in the attached Operations Specifications, in accordance with the Operations Manual and the Civil Aviation (Air Operator Certification and Administration) Regulations, 2007.[12]

13

Date of Issue[13] (dd.mmm.yyyy):
24TH NOVEMBER 2011

R. KING'ORI

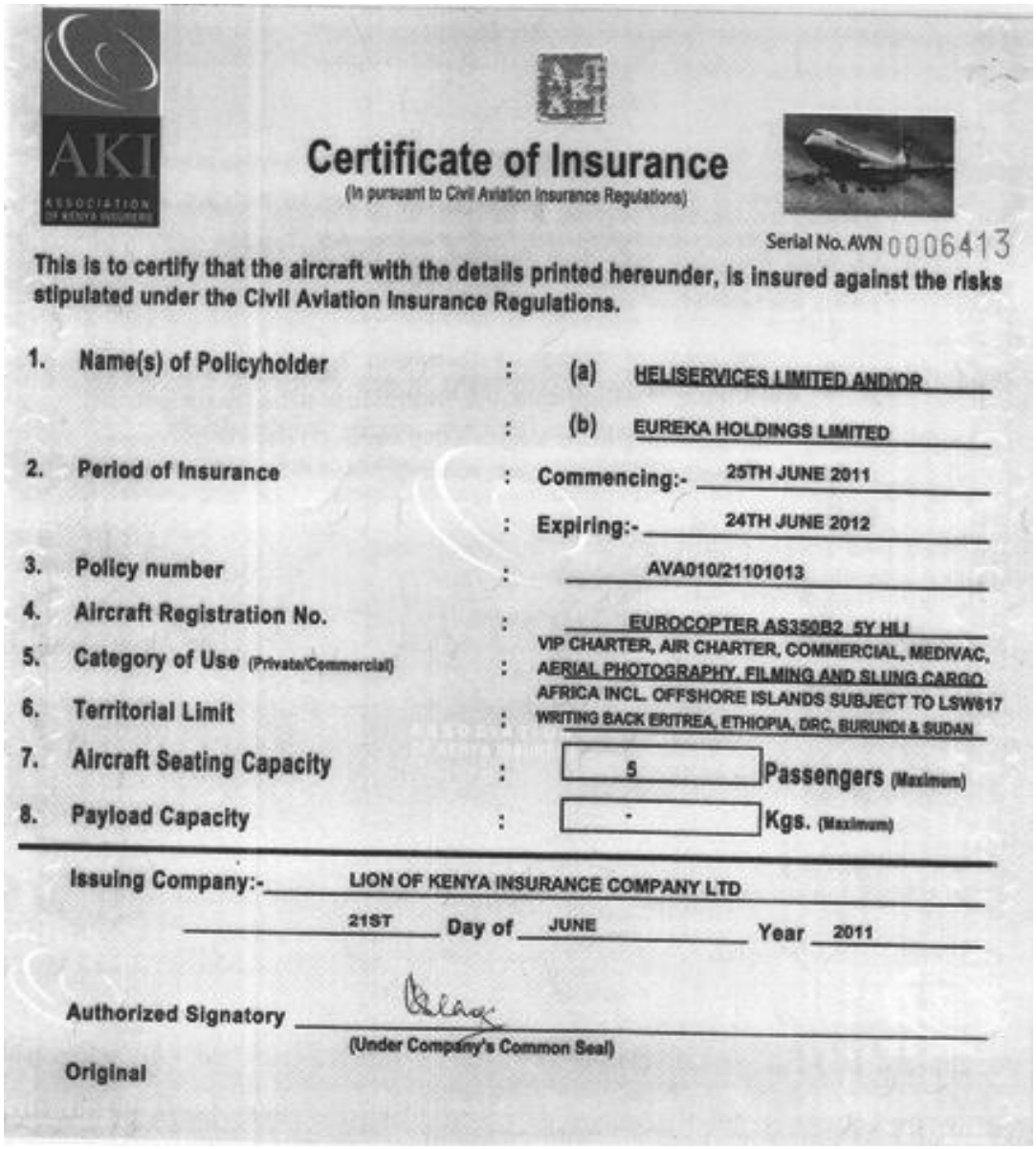
By authority of the Director General[14]

14

INSTRUCTIONS (See reverse)

APPENDIX (VI)

Certificate of Insurance



AKI
ASSOCIATION OF KENYA INSURERS

Certificate of Insurance

(In pursuant to Civil Aviation Insurance Regulations)

Serial No. AVN 0006413

This is to certify that the aircraft with the details printed hereunder, is insured against the risks stipulated under the Civil Aviation Insurance Regulations.

1.	Name(s) of Policyholder	: (a)	HELISERVICES LIMITED AND/OR
		: (b)	EUREKA HOLDINGS LIMITED
2.	Period of Insurance	: Commencing:-	25TH JUNE 2011
		: Expiring:-	24TH JUNE 2012
3.	Policy number	:	AVA010/21101013
4.	Aircraft Registration No.	:	EUROCOPTER AS350B2 5Y HLJ
5.	Category of Use (Private/Commercial)	:	VIP CHARTER, AIR CHARTER, COMMERCIAL, MEDIVAC, AERIAL PHOTOGRAPHY, FILMING AND SLUNG CARGO.
6.	Territorial Limit	:	AFRICA INCL. OFFSHORE ISLANDS SUBJECT TO LSW617 WRITING BACK ERITREA, ETHIOPIA, DRC, BURUNDI & SUDAN
7.	Aircraft Seating Capacity	:	5 Passengers (Maximum)
8.	Payload Capacity	:	- Kgs. (Maximum)

Issuing Company:- LION OF KENYA INSURANCE COMPANY LTD

21ST Day of JUNE Year 2011

Authorized Signatory

(Under Company's Common Seal)

Original

APPENDIX (VII)

E. Procedure

1. Definitions and limitations

   a. The case of overtorque is defined for any incident during which the engine torque (read on the indicator exceeded the defined values:

   – in maximum continuous rating: 94%,
   – during take-off with IAS < 40Kts (red line): 100% max.,
   – transient for maneuver close to hover (red triangle): 107% max. with a max. time of 10 seconds.

2. MGB damage rate (accumulation law):

   a. Overtorque time:

   – t1 = running time between 94 and 100%,
   – t2 = running time between 100 and 110%,
   – t3 = running time between 110 and 117%.

3. Steps to be taken in case of overtorque:

   a. During forward flight

   1. Calculation of the MGB damage rate

   Ifi $(t1/40 + t2/14 + t3/10) \geq 1$

   – Carry out the major overhaul of the MGB.
   – Scrap the planet gears of the fixed ring gear and of the sun gear.

NOTE:

To make damage follow-up simpler, it is possible to replace the cumulated times "t (cumulated)" with:

– *"t (cumulated)" between 94 and 100%, replace with 8 min between 2 overhauls*
– *"t (cumulated)" between 100 and 110%, replace with 3 min between 2 overhauls*
– *"t (cumulated)" between 110 and 117%, replace with 2 min between 2 overhauls.*

NOTE:

– *If an anomaly is found on one component, replace all similar parts.*
– *There are no particular steps to be taken for a torque value < 94%.*