

Report

Accident on **31 May 2010**
at "**Col des Bœufs**" (974)
to **the Robinson R22 helicopter**
registered **F-ORGB**

BEA

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

Ministère de l'Écologie, du Développement durable, des Transports et du Logement

Foreword

This report expresses the conclusions of the BEA on the circumstances and causes of this accident.

In accordance with Annex 13 to the Convention on International Civil Aviation and with European Regulation n° 996/2010, the investigation was not conducted so as to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this occurrence which may help to prevent future accidents.

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations.

SPECIAL FOREWORD TO ENGLISH EDITION

This report has been translated and published by the BEA to make its reading easier for English-speaking people. As accurate as the translation may be, the original text in French is the work of reference.

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Glossary

kt	Knot
hPa	Hectopascal
CPL(H)	Commercial Pilot's License (Helicopter)
UTC	Universal Time Coordinated

Synopsis

Date

Monday 31 May 2010 at 9 h 30⁽¹⁾

Site of accident

"Col des Boeufs"
Saint-Benoît Commune

Type of flight

Local flight

Aircraft

Robinson R22 helicopter
registered F-ORGB

Owner

Private

Operator

Private

Persons on board

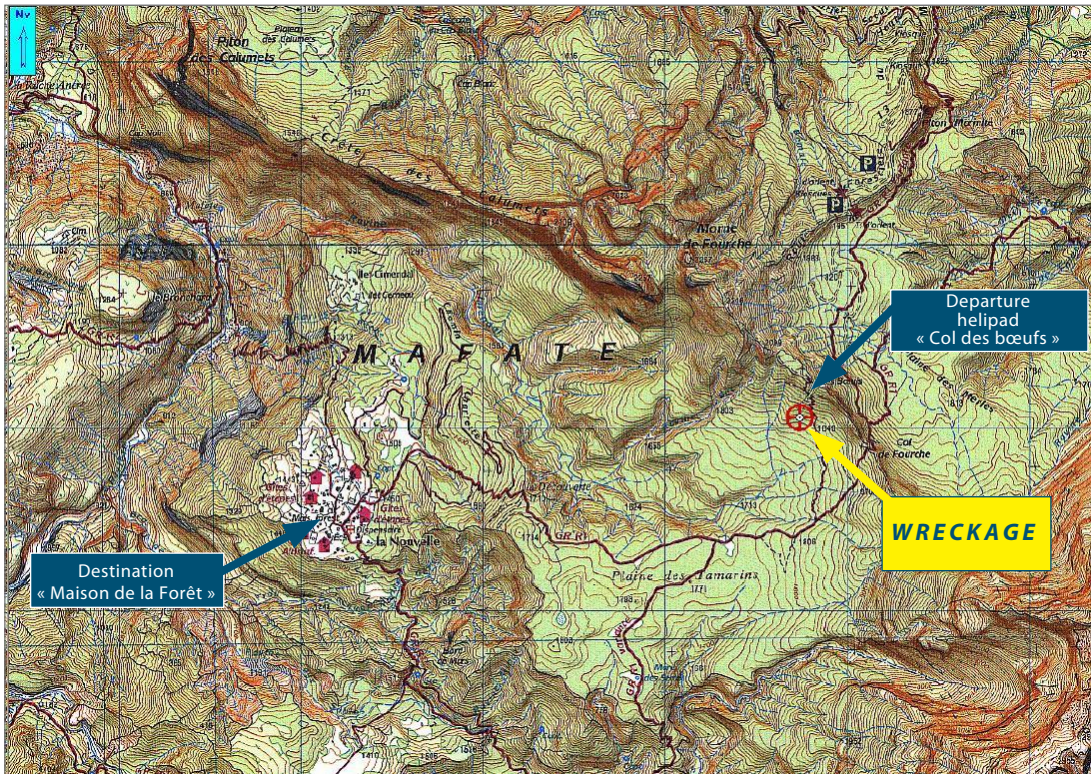
1 pilot and 1 passenger

⁽¹⁾All times in this report are UTC, except where otherwise specified. Two hours should be added to obtain the legal time applicable in mainland France and four hours added to obtain local time on the island of La Réunion (974) on the day of the accident.

1 - FACTUAL INFORMATION

1.1 History of Flight

The pilot of the Robinson R22 took off from the commune of La Nouvelle in the Mafate cirque bound for the "Col des Bœufs" situated at 1,940 metres altitude to collect some packages. Three people from an electric company were on the col and were supposed to reach a house in the forest to undertake some work. The pilot that they contacted by phone offered to take them by R22 to the site of the house in the forest from the "Col des boeufs" after a first flight that he was scheduled to make. The pilot landed on the helipad at the "Col des boeufs" and began embarking the first passenger with the engine running. The pilot took off from a hover at about one metre, then flew rearwards before turning right on the slope. During this manoeuvre, the tail touched the ground on the slope and then the right skid got caught under a boulder. The helicopter crashed and came to a stop further below.



1.2 Killed and Injured

Injuries	Crew members	Passengers	Others
Fatal	1	1	N/A
Serious	-	-	-
Light/None	-	-	-

1.3 Damage to Aircraft

The helicopter was destroyed.

1.4 Information on Flight Commander

Male, aged 44

- Private Helicopter Pilot's License PPL(H) issued in 1993 and valid
- Commercial helicopter pilot's licence CPL(H) issued in 1998 and valid
- Type ratings:
 - Robinson R22
 - SA316/319/315
- Experience:
 - total: 6,900 flying hours of which 6,800 as flight commander
 - in the previous six months: 146 hours on type
 - in the previous three months: 62 hours on type
 - in the previous thirty days: 53 hours of which 17 on type

1.5 Aircraft Information

1.5.1 Airframe

Manufacturer	Robinson
Type	R22 Beta II
Serial number	3919
Registration	F-ORGB
Entry into service	27/10/2005
Certificate of airworthiness	Valid until 19/04/2011
Utilisation up to the 31 May 2010	1,665 hours

1.5.2 Engine

Manufacturer	Lycoming
Type	O-360-J2A
Serial number	L-40137-36A
Installation date	26/10/2005
Total run time	1,665 hours
Run time since installation	1,665 hours

1.5.3 Weight, balance and performance

The helicopter is weight and balance sheet is in appendix 3.

Based on the elements gathered, the estimated weight was of the order of 580 kg.

The helicopter was within the authorized weight and balance limits.

At an altitude of 1,940 metres and a temperature of 17 °C, based on the "*in ground effect*" and "*out of ground effect*" takeoff performance graphs, the helicopter was within the limits of available power. However, during takeoff the pilot passed into "*out of ground effect*" and found himself at the limit of available power.

1.6 Meteorological Conditions

1.6.1 General situation

- Moderate east-north-east airflow over the island of La Réunion

1.6.2 Meteorological conditions at the site of the accident

- Slightly cloudy sky at 8 h 30 becoming overcast from about 9 h 45
- Wind from north-east 10 to 15 kt with gusts of up to 25 kt
- Turbulence possible, temperature about 16 °C

1.7 Flight Recorders

The applicable regulations do not require the carrying of flight recorders. The helicopter was not equipped with any.

1.8 Wreckage and Impact information

1.8.1 Examination of the site

The site of the accident was at 1,887 metres, below the "Col des boeufs" helipad, in very steep terrain in the Mafate cirque. This helipad was located at 1,940 metres on the west slope of the mountain. There were a variety of objects (containers) items deposited on the ground (Sand heaps, bigbag transport bags) which reduced the dimensions of the zone usable for helicopters to land.



Helipad at "Col des boeufs"- altitude 1,940 metres

Examination of the site showed 3 distinct zones:

- the zone where the tail boom and tail rotor touched, about 35 metres below the helipad;
- a second zone, where the forward part of the helicopter's right skid was found stuck under a rock and numerous pieces of the canopy were found nearby on the left. The instrument panel was detached and thrown to the left;
- the main zone around 53 metres below the helipad where the main wreckage of the helicopter was found.



1.8 2 Examination of the wreckage

Examination of the distortions on the rear empennage showed that the tail of the helicopter had struck the ground with a right vertical and lateral movement, with very high energy. The rear empennage had been dislocated. The tail gearbox (TGB) was not found. Both blades of the tail rotor had numerous impact marks on the leading edges and had been torn off about 10 centimetres from the blade shank.

Examination of the second impact zone showed that the right skid of the helicopter had got stuck under a rock leading to the airframe being thrown forward. The passenger was thrown out during this impact through the canopy. The instrument panel was torn out and thrown out of the cockpit. The right skid and the skid mounting failed in overload in several places. The airframe was projected, without touching the ground, for about 10 metres before crashing and slipping down the slope. The vegetation between the two impact points showed no signs of damage.

The main rotor blades, although twisted, bore few or no signs of damage on the leading edge, which indicates a lack of power and rotor rotation. The rotor sustained very little damage. The distortions and bends in the structure at the level of the tail boom confirm that the tail had struck the ground.

The end of the tail rotor drive shaft failed in torsion and showed that there was rotation during the first impact and contact between the tail rotor blades and the ground. The "Flex plate" that links the tail rotor drive shaft with the freewheel was distorted and squashed, which indicates that there was little power and low rotation speed.



Drive shaft on the TGB side



"Flex Plate" TGB-freewheel liaison

The engine and transmission block showed no signs of significant damage and no anomalies were observed. The air filter was destroyed, the carburettor was undamaged, and the lower section of the fuel filter was thrown out by the impact.

The helicopter cockpit was destroyed. A strong smell of petrol was coming from the wreckage.

The fuel cock was observed to be in an almost closed position.



Position of the fuel cock observed in the wreckage

The carburettor was disassembled and an absence of fuel noted. A sample was taken from the fuel pipe between the petrol filter and the carburettor and less than a millilitre of petrol was recovered.

1.9 Survival Aspects

The violence of the impact with the ground meant that there was little chance of survival for the two occupants.

The pilot and the passenger were thrown out of the helicopter. The passenger's three point seat belt was undone and showed no signs of failure or tearing. The harness on the pilot's side was torn out from the attachment points on the fuselage.

1.10 Tests and Research

Some tests were carried out on an R22 Beta II of the same type as that in the accident in order to evaluate the time it took for the engine to stop when the fuel cock is shut off in a situation when the engine is running and the rotor engaged.

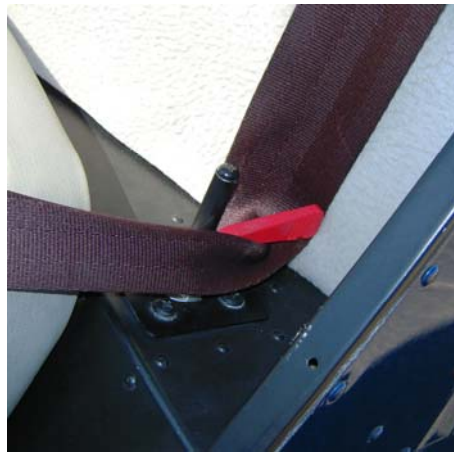
The first configuration tested was: rotor turning, collective pitch low, power idle. The engine stopped after 55 seconds, preceded by misfires.

The second configuration tested was: rotor turning, collective pitch low, maximum power. The engine stopped after 15 seconds.

The third configuration tested was: rotor turning, collective pitch and power adapted to allow a passenger to board with the fuel cock being closed during boarding, quick installation with seat belt attached (or attempted) and application of collective pitch and power to simulate a takeoff. The engine stopped dead after 13 seconds. The time taken by the passenger to attach the safety belt during this simulation was 7 seconds.

Several attempts were made by the passenger in the simulation to try to grasp the fuel cock while putting on the seat belt. None of these attempts was satisfactory.

A test simulating passing the passenger seat belt strap under the fuel cock made it possible to determine that when the passenger tried to put on the seat belt, it blocked and the traction exerted by the passenger did not make it possible to move the fuel cock.



The manoeuvring tests performed on the R22 in the tests and on the accident aircraft showed that rotation of the fuel cock was too hard, thus preventing any accidental movement during impact or through vibrations.

It was demonstrated that during boarding of a passenger via the side door, by grasping the side frame, it is possible to grab the fuel cock and turn it from the "ON" position towards a position close to "OFF".

The R22 is not equipped with an indicator light showing full or partial closure of the fuel cock. The only indication available to the pilot is the fuel pressure gage.



1.11 Additional Information

1.11.1 Testimony

During the investigation, several witness statements were taken.

Witness n°1

The main witness was part in a group of three people that were supposed to be transported by the pilot of the R22. This witness stated that when they arrived at the "Col des Bœufs", the pilot of the R22 was making the first rotation bound for "La Nouvelle". He made a sign to them to indicate that he was coming back to get them after having dropped off the packages. A few minutes later, the pilot came back, landed and boarded the first passenger with the engine running. The witness stated that the boarding was quick, and that he helped the passenger to close the door and that once the door was closed, the pilot took off, the passenger made a sign to him with his hand.

The pilot took off from a hover at about one metre, then flew rearwards and turned to the right. The witness said that he had seen the pilot perform takeoffs several times from this helipad and that the takeoff was similar to those he had already observed. However, he was concerned when he didn't see the helicopter reappear and head towards "La Nouvelle". He went to the edge and saw the helicopter that was crashing into the trees.

The witness did not remember seeing the passenger attach the seat belt, or the manner in which he climbed on board (position of the hands). The passenger had flown in a helicopter the week before during transportation to a site, but this was the first time that he had been on board an R22.

Witness n°2

This witness, who arrived at the site of the accident first, said that when he approached the wreckage, he noticed that the fuel cock was in the OFF position. He said that he did not touch the wreckage or the fuel cock.

1.11.2 History and modification of the fuel cock ergonomics

Three incidents or accidents that were caused by the closing of the fuel cock were identified. In all three cases, the passenger was seated on the side to be able to take photos.

Case n°1: the passenger moved the fuel cock with his elbow. The position of the fuel cock was modified.

Case n°2: the fuel cock had been installed the wrong way round and the passenger accidentally closed the fuel cock with his elbow.

Case n°3: the seat belt was caught in the handle of the fuel cock and when the passenger fastened his belt, he closed the fuel cock. A protective device to prevent the belt catching the fuel cock handle was installed.

The supplier of the fuel cock made a modification in its shape and use following these three events. This modification was to replace the handle by a selector with a safety notch to move from the ON position to the OFF position as well as a return towards the ON position.



Old type



New type

Note: Robinson took the decision from July 2007 to equip the new R22 with this new fuel selector. However, this modification was not the subject of a service bulletin, or of a mandatory replacement.

2 - ANALYSIS

2.1 Strategy for boarding with rotor turning

The decision to board a passenger with the rotor turning was likely motivated by:

- ❑ the fairly turbulent aerology at the helipad,
- ❑ the very short duration of the flight to be made (4 to 5 minutes),
- ❑ the fact that there were three people to transport and that the R22 could only take one at a time,
- ❑ the obstructions on the helipad that made the zone difficult to access,
- ❑ the pilot's knowledge of the spot and the fact that he was used to performing this type of flight.

This type of boarding is however marginal and is unusual in normal service.

2.2 Checks and takeoff strategy

As the boarding was performed with the rotor turning, the helicopter was ready for takeoff and in a configuration that did not require performing a specific check-list. Apart from the change in the weight and balance that the passenger may cause, the pilot probably did not think to check the fuel cock just before taking off. The helicopter is not equipped with an indicator showing the condition of the fuel cock and the fuel cock was of the old type.

The trajectory followed by the pilot was, according to the testimony, in accordance with what he usually did. The lift-off of the skids and the rearwards movement made it possible for him to get away from the mountain and the obstacles on the helipad. However, this manoeuvre meant that helicopter changed from the *"in ground effect"* configuration to *"out of ground effect"* which resulted in a requirement to increase power in ensure lift for the helicopter. The graphs in the flight manual show that, in the conditions on the day, the helicopter was at its performance limits. The turn (around 180°) to the right made by the pilot, made it possible to use the drop to gain speed and rapidly exit from the dangerous zone in the speed-height graphs and reach cruise speed while heading for his destination.

This takeoff strategy did not make it possible to land again in case of a failure during the takeoff or in the first moments of the flight.

2.3 Fuel cock ergonomics

The tests undertaken on an R22 of the same type equipped with the same model of fuel cock showed that it was possible for a passenger to grasp the handle on the cock to turn it during loading. There is no protective guard on this fuel cock to prevent the passenger being able to grasp it.

The fuel cock can be in any of the intermediate positions between the OFF position and the ON position. An intermediate position for this fuel cock can lead to a significant decrease in the fuel flow which can lead to a loss of power.

There is no indicator showing a partial or total closure of this fuel cock on the instrument panel.

The new model of the fuel cock installed on the R22 since July 2007 prevents, according to the manufacturer, any accidental manoeuvring of, as well as partial closing of, the fuel cock.

3 - CONCLUSION

3.1 Findings

- The helicopter possessed a valid certificate of airworthiness.
- The pilot held the requisite licences and qualifications.
- The examination of the wreckage that was performed did not bring to light any technical malfunctions that may have contributed to accident.
- At the time of the impact, the engine was not producing power.
- The carburettor was undamaged and contained no fuel.
- The fuel cock was found in an almost closed position.
- The fuel cock installed was of the old type (with handle).
- Boarding the passenger was performed with the engine turning.

3.2 Causes of the Accident

The accident was caused by the engine stopping during the takeoff phase. This shut down was caused by the accidental closing of the fuel cock by the passenger, unnoticed by the pilot, during boarding with the rotor turning, followed by a rapid takeoff.

Other contributory factors included:

- the fuel cock installed that was of an old type (with a handle);
- The decision to undertake boarding and a takeoff with the rotor turning without previous checks;
- decision to use a helipad whose topographical situation provided no safeguards in case of a failure during takeoff;

4 - SAFETY RECOMMENDATIONS

Note: In accordance with Article 17.3 of European Regulation (EU) 996/2010 of the European Parliament and Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation shall in no case create a presumption of blame or liability for an accident, a serious incident or an incident. The addressee of a safety recommendation shall inform the safety investigation authority which issued the recommendation of the actions taken or under consideration, under the conditions described in Article 18 of the aforementioned Regulation.

It was shown during the tests performed on an R22 of the same type, equipped with the same type of fuel cock with a handle, that it was possible for a passenger to grasp the handle and to move it inadvertently, which causes the fuel circuit to close. Following 3 other events of the same type, the fuel cock manufacturer proposed a new model of selector. This was installed from July 2007 on new R22 helicopters.

Consequently, the BEA recommends that:

- **EASA and the FAA make mandatory the installation of a fuel cock with a selector as modified since July 2007 on R22 type helicopters in order to avoid any accidental manoeuvres.**

List of appendices

Appendix 1

Takeoff performance "in ground effect" graph

Appendix 2

Takeoff performance "out of ground effect" graph

Appendix 3

Weight and balance sheet

Appendix 4

"Speed-height" graph

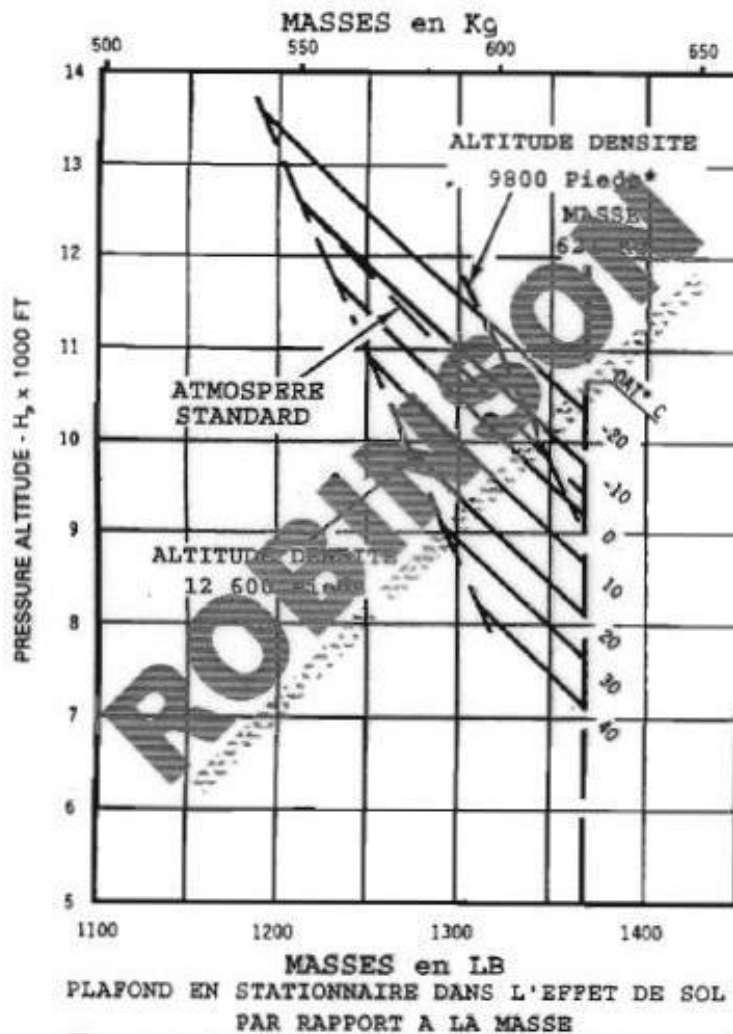
Appendix 1
Takeoff performance "in ground effect" graph

MANUEL DE VOL HELICOPTERE
ROBINSON R 22

EDITION N° 3

PERFORMANCES

DANS L'EFFET DE SOL. PATINS A 2 Pieds
PLEIN GAZ ET REGIME A 103-104%
VENT NUL



R22 BETA II
MOTEUR O-360-J2A

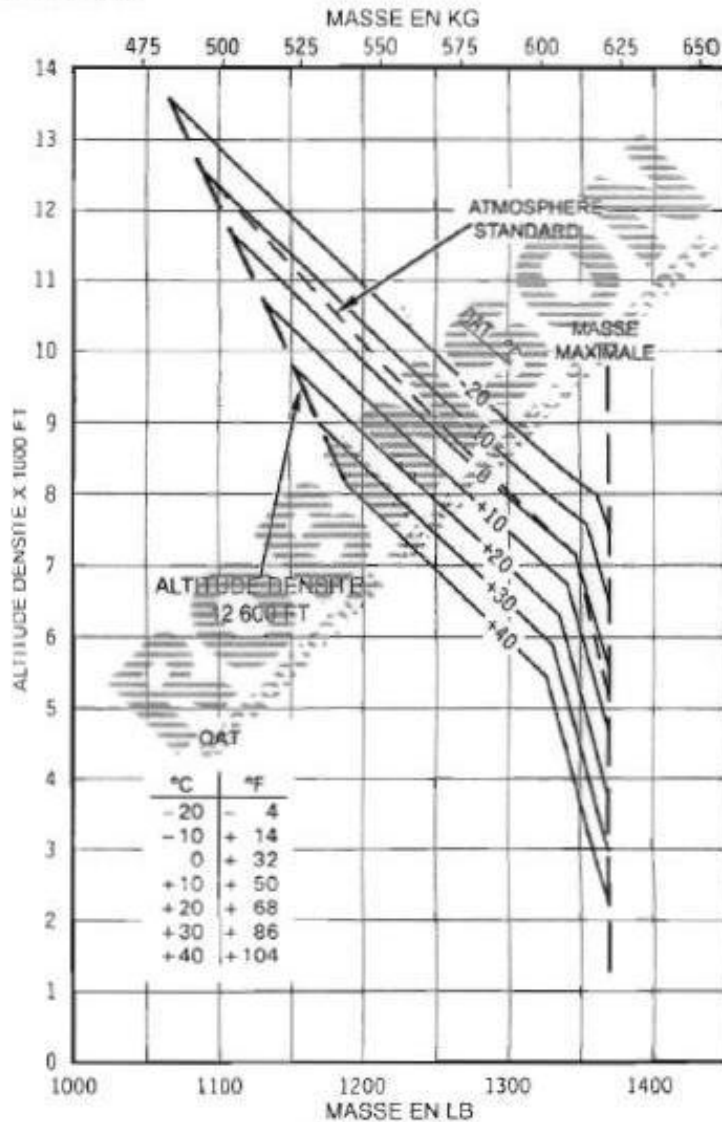
* La contrôlabilité de l'appareil en vol stationnaire a été démontrée jusqu'à l'altitude densité de 9800 pieds et par vents de 17 Kt.

Appendix 2
Takeoff performance "out of ground effect" graph

MANUEL DE VOL HELICOPTERE
ROBINSON R 22

EDITION N° 3
REV 1
PERFORMANCES

HORS L'EFFET DE SOL, VENT NUL
PUISSANCE DE DECCOLLAGE OU PLEIN GAZ
REGIME À 104 %



BETA II
Moteur O-360-J2A
PLAFOND EN STATIONNAIRE HORS L'EFFET DE SOL
EN FONCTION DE LA MASSE

Appendix 3
Weight and balance sheet



CORAIL HELICOPTERES

Fiche de Pesée R 22 BETA II

Type d'appareil :	R22 Béta II	N° de série :	3919
Immatriculation :	F-ORGB	Lieu :	PIERREFONDS

Nom : CIMETIERE Date : 16/04/2009 <i>correction pesée</i> Visa	PESEE INITIALE Date : 11/07/05 Masse : 387,64 kg Centrage : 2.65 m	Masse max. et limite decentrage Masse MAX : 622 kg Masse Mini : 417 kg Centrage AV : 2,426 AR : 2,2590													
	<table border="1"> <thead> <tr> <th>Points de levage</th> <th>Masse nette (kg)</th> <th>Bras de levier (m)</th> <th>Moment (m.kg)</th> </tr> </thead> <tbody> <tr> <td>Total pesée :</td> <td>387.6479</td> <td>2.640</td> <td>1 023.3905</td> </tr> </tbody> </table>	Points de levage	Masse nette (kg)	Bras de levier (m)	Moment (m.kg)	Total pesée :	387.6479	2.640	1 023.3905	<table border="1"> <thead> <tr> <th>Masse à vide</th> <th>Centrage X</th> <th>Moment X</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">↑</td> <td style="text-align: center;">↑</td> <td style="text-align: center;">↑</td> </tr> </tbody> </table>	Masse à vide	Centrage X	Moment X	↑	↑
Points de levage	Masse nette (kg)	Bras de levier (m)	Moment (m.kg)												
Total pesée :	387.6479	2.640	1 023.3905												
Masse à vide	Centrage X	Moment X													
↑	↑	↑													

Correction de Pesée longitudinale

Equipements ou modifications	Masse (+ ou -) (kg)	Bras de levier (m)	Moment (m.kg)
Masse à vide :	387.6479	2.640	1 023.3905
o RDBA: KANNAD ELT	1.19	2.946	3.51
e RDBA: POINTER 3000-10	-1.22	-3.090	3.770
□			
	0.000	387.62	2.659
	↑	↑	↑
	Centrage latéral	Masse corrigée	Centrage longitudinal
			Moment

Correction de Pesée

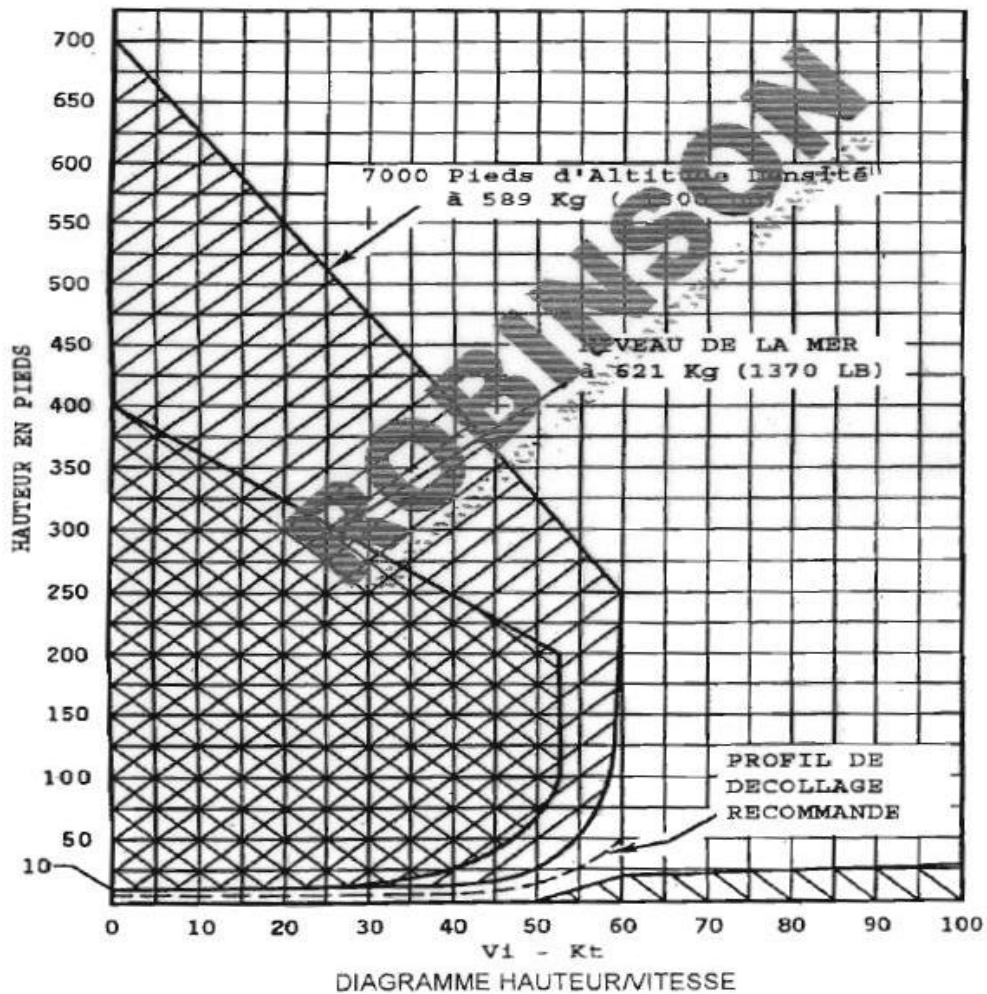
Equipements ou modifications	Masse (+ ou -) (kg)	Bras de levier (m)	Moment (m.kg)
Masse à vide :	387.62	2.659	1 030.67
o Equipe	77.00	1.980	152.46
e Passagers	77.00	1.980	152.46
□ Carburant principal max.53 kg	47.00	2.758	129.63
□ Combustible auxiliaire max.29 kg	23.00	2.636	60.63
	611.62	2.495	1 525.84
	↑	↑	↑
	Centrage latéral	Masse corrigée	Centrage latéral
			Moment

Appendix 4
"Speed-height" graph

MANUEL DE VOL HELICOPTERE
ROBINSON R 22

EDITION N° 3
REV 1
PERFORMANCES

CONDITIONS DÉMONTREES: SURFACE PLANE ET DURE
VENT CALME.
REGIME 103 à 104%.
EVITER LE VOL DANS LES ZONES HACHUREES



Traduction autorisée DGAC

Manuel déposé SGDL

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F-ORGB N° 3919

BEA

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

Zone Sud - Bâtiment 153
200 rue de Paris
Aéroport du Bourget
93352 Le Bourget Cedex - France
T : +33 1 49 92 72 00 - F : +33 1 49 92 72 03
www.bea.aero

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