



# EUROPEAN AVIATION SAFETY AGENCY

EXPERT DEPARTMENT / CERTIFICATION DIRECTORATE



## Operational Evaluation Board Report

Draft Report : 16 05 2014

**Manufacturer: Robinson Helicopter Company**

# R66

European Aviation Safety Agency  
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## R66



## Revision Record

Revision No.	Section	Pages No.	Date
Draft Report	All	All	16/05/2014

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## Operational Evaluation Board – OPS / FCL Subgroup

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<b>Stephen Turnour</b>	Certification Manager	Robinson Helicopter company	
<b>Tim Tucker</b>	Test Pilot/ Instructor	Robinson Helicopter company	

## Executive Summary

### Manufacturer Application

In August 2013, Robinson Helicopter Company made a formal application to EASA, Certification Directorate – for an OEB for the evaluation of the new R66 helicopter.

### Scope of the evaluations

The OEB report addresses mainly:

- Aircraft Type Designation and Pilot License Endorsement;
- Pilot Initial Type Rating Training “minimum syllabus” (ITR)
- Additional Type Rating Training “minimum syllabus” (ATR)

### Team Composition and Regulatory Framework

Both, Captain Roel Huysmans (EASA) and Captain Fred Cross (UK CAA) have conducted a Training Program evaluation - Test 5 (T5). This test consisted of the full type rating course with no credit for prior experience (new aircraft and new type rating).

Also EASA /OEB Section Rotorcraft Manager Jean-Marc Sacazes and Robinson Helicopter Company type expert Tim Tucker have participated actively to this Operational Evaluation Board (Refer to the list page 5).

EASA conducted this evaluation in accordance with EASA Air Operations and Air Crew requirements. This evaluation was based on (J) OEB Handbook and Common procedures Document (CPD) and the processes detailed in the JAA Administrative and Guidance Material, Section One, Part Two, Chapter 5.

#### Note on references and reference texts:

*Where references are made to requirements and where extracts of reference texts are provided, these are at the amendment state at the date of publication of the report. Readers should take note that it is impractical to update these references to take account of subsequent amendments to the source documents.*

## Abbreviations / Acronyms

AC	Alternating Current
AMC	Acceptable Means of Compliance
ATR	Additional Type Rating
CPD	Common Procedure Document
DAU	Data Acquisition Unit
DC	Direct Current (electrical)
EASA	European Aviation Safety Agency
EDU	Electronic Display Unit
FADEC	Full Authority Digital Engine Control
FFS	Full Flight Simulator
FSTD	Flight Simulation Training Device
FTO	Flight Training Organization
GA/TU	Go Around / Transition Up
IEM	Interpretative and Explanatory Material
IFR	Instrument Flight Rules
IR	Instrument Rating
ITR	Initial Type Rating
MDR	Master Difference Requirements
MET-H	Multi Engine Turbine (Helicopter)
MGT	Measured gas (turbine) temperature
MTOM	Maximum Take Off Mass
NAA	National Aviation Authority
N/A	Not Applicable
ODR	Operator Differences Requirements
OEI	One Engine Inoperative
OEB	Operational Evaluation Board
OPS	Flight Operations
OTD	Other Training Device
PFL	Practice forced landing
PIC	Pilot in Command
RFM	Rotorcraft Flight Manual
RPM	Revolution Per Minute
SET(H)	Single Engine Turbine (Helicopter)
TRI	Type Rating Instructor
TRTC	Type Rating Training Course
TRTO	Type Rating Training Organization
VFR	Visual Flight Rules
VNE	Velocity Never Exceed
VTOL	Vertical Take Off & Landing

- Part-ARA ....Annex VI to Commission Regulation (EU) No 290/2012 of 30 March 2012 amending Regulation (EU) No 1178/2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)
- Part-ARO ....Annex II to Commission Regulation (EU) No 965/2012 of 05 Oct 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)
- Part-CAT.....Annex IV to Commission Regulation (EU) No 965/2012 of 05 Oct 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)
- Part-FCL.....Annex I to Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)
- Part-ORA.....Annex VII to Commission Regulation (EU) No 290/2012 of 30 March 2012 amending Regulation (EU) No 1178/2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)
- Part-ORO.....Annex III to Commission Regulation (EU) No 965/2012 of 05 Oct 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)
- Part-SPA.....Annex V to Commission Regulation (EU) No 965/2012 of 05 Oct 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)



## I. Purpose and Applicability

Data has been submitted by Robinson Helicopter Company in support of the OEB process.

This report is the result of an OEB evaluation on **Pilot Type Rating Training syllabus for the R66** provided by the Robinson Helicopter Company.

The OEB recommends for approval by NAAs:

- Aircraft Type Designation and Pilot License Endorsement;
- Pilot Initial Type Rating Training “minimum syllabus” (ITR)
- Additional Type rating Training “minimum syllabus” (ATR)

*Note:*

*Robinson R66 is listed in the Type Certificate Data Sheet delivered by EASA under Type Certificate Data Sheet EASA.IM.R.507.*

## 2. General Description of the R66

### General

The Robinson R66 is a five-place, single main rotor, single engine turbine helicopter aircraft constructed primarily of metal. The primary fuselage structure is composed of welded steel tubing and riveted aluminium sheet. The tail cone is a monocoque structure in which aluminium skins carry most primary loads. Fiberglass and thermoplastics are used in secondary cabin structure and in various ducts and fairings. The cabin doors are also constructed of fiberglass and thermoplastics.

### Landing Gear

The helicopter is equipped with a skid-type landing gear. A spring and yield skid type landing gear is used. Most hard landings will be absorbed elastically. However, in an extremely hard landing, the struts will hinge up and outward as the center crosstube yields to absorb the impact. Slight yielding of the aft crosstube is acceptable. However, yielding which allows the tail skid to be within 38 inches of the ground when the helicopter is sitting empty on level pavement requires crosstube replacement.

### Dynamic Systems

The dynamic systems of the R66 comprise two subsystems, the "Drive" and the "Rotor" system (main and tail).

- The drive system consists of a Main Gear Box (MGB) and a Tail Rotor Drive System.

#### Main Gearbox

The engine is mounted in a 37° nose-up attitude. A sprag-type overrunning clutch mates directly to the splined engine power take-off shaft. The clutch is connected to a shaft with flexible couplings at both ends to transmit power to the main gearbox.

#### Tail Rotor Drive System

The tail rotor drive line consists of an intermediate shaft running aft from the main gearbox and a long tail rotor driveshaft which runs the length of the tail cone.

- The rotor system consists of the main rotor system and the tail rotor system.

The main rotor has two all-metal blades mounted on the hub by coning hinges. The coning and teeter hinges use self-lubricated bearings. Each blade has a thick stainless steel spar at the leading edge which is resistant to corrosion and erosion. Aluminium skins are bonded to the spar approximately one inch aft of the leading edge.

The tail rotor has two all-metal blades and a teetering hub with a fixed coning angle. The tail rotor blades are constructed with wrap-around aluminium skins and forged aluminium root fittings.

## Flight controls

The flight control system controls the aircraft attitude and direction through main and tail rotor.

Dual controls are standard equipment and all primary controls are actuated through push-pull tubes and ball cranks. Bearings used throughout the control system either are sealed ball bearings which do not require lubrication or have self-lubricated liners.

Flight control operation is conventional. The cyclic is center mounted with the left and right control grips mounted to a cross tube which pivots on the center cyclic post. On later aircraft, the pilot's cyclic grip angle can be adjusted fore and aft relative to the cross tube by a mechanic to achieve the most comfortable hand position. The most forward position provides the most control clearance at aft cyclic for larger pilots.

Pilots should always verify the ability to apply full control travel prior to flight.

The collective stick has a twist grip to provide input to the engine fuel control. Raising or lowering collective provides power turbine governor inputs via an interconnecting linkage.

Pilot-side tail rotor pedals are adjustable to get an easy control the anti-torque flight control.

## Rotor brake

The rotor brake system is used to stop the rotation of the rotor. The rotor brake is mounted on the aft end of the main gearbox and actuated by a cable connected to a pull handle located on the cabin ceiling. The brake must be released before starting the engine. When the brake is engaged, the starter is disabled.

## Power Plant

One Rolls-Royce model 250-C300/A1 free-turbine turbo-shaft engine powers the helicopter. The engine is equipped with an ignition exciter, igniter, starter-generator, two tachometer senders, and additional power plant instrument senders.

A direct drive, squirrel cage style cooling fan is mounted to the intermediate shaft and supplies cooling air to the engine and gearbox oil coolers.

The engine is fitted with an Engine Monitoring Unit (EMU), which is a digital recording device mounted behind the right rear seatback panel. The EMU continuously monitors N1, N2, engine torque, and MGT.

## Fuel system

A single bladder-type crash resistant fuel cell supplies fuel via gravity flow to the engine. The fuel cell incorporates left and right vent fittings, a filler port, a fuel gage sender, a low fuel sender, a sump drain and a finger strainer at the fuel outlet. The fuel cell is secured inside aluminium structure. The engine incorporates a fuel pump assembly with an inlet filter.

## Hydraulic system

Hydraulically-boosted main rotor flight controls eliminate cyclic and collective feedback forces. The hydraulic system consists of a pump, three servos, a reservoir and interconnecting lines. The pump is mounted on and driven by the main gearbox. A servo is connected to each of the three push pull tubes that support the main rotor swash-plate. The reservoir is mounted to the aft end of the main gearbox and includes a filter, pressure relief valve, and pilot-controlled pressure shut-off valve.

## Electrical Power

A 28-Volt DC electrical system is standard. The primary system components are a sealed lead-acid battery, a starter generator and a generator control unit. The battery is located beneath the left front seat or in a compartment in the left side of the baggage compartment.

## Cockpit Layout



### Instrument Panel

Standard primary instruments are a vertical speed indicator, airspeed indicator, engine ( $N_2$ ) and rotor dual tachometer, sensitive altimeter, torque meter and magnetic compass. Engines gauges include an  $N_1$  tachometer, measured gas (turbine) temperature, oil temperature and fuel quantity. Also standard are a clock, an ammeter, a digital outside air temperature gauge/voltmeter and an hour meter.

### Annunciator Panel

The annunciator panel consists of illuminated segments located at the top of the main instrument panel. If a caution or warning condition occurs, the appropriate segment illuminate indicating the nature of the problem.

### 3. Aircraft Main Characteristics:

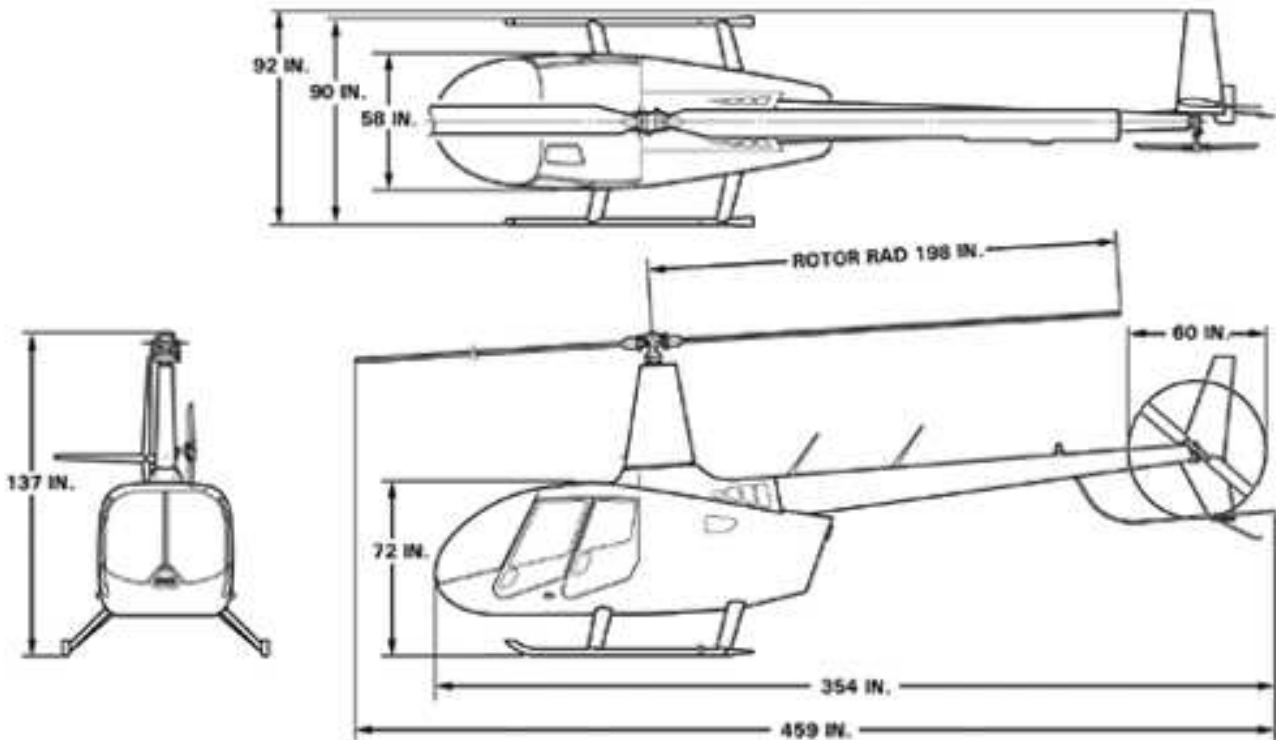
#### 3.1 Summary of main characteristics of the Robinson 66

			R66
Dimensions	Fuselage	Length (maximum)	11659 mm (459 inches)
		Width	1473mm (58 inches)
		Height	3480 mm (137 inches)
	Main rotor	Diameter	10058 mm (396 inches or 33 feet)
	Tail rotor		60 inches
Number of Main Rotor Blades			2
Minimum Flight Crew	VFR		1
	IFR		N/A
Seating Capacity	Including Pilot Seats		5
Engine(s)			1 Rolls-Royce 250-C300/A1
Fuel tanks	Total usable		279 litres (73.6 US gallons)
Air Speed	Power ON	Absolute VNE	130 KIAS (140 KIAS below 998 kg (2200 lb))
	Power OFF		100 KIAS
Rotor Speed	Power ON	Maximum	412 RPM
	Power OFF	Minimum	359 RPM
Maximum Operating	Density Altitude		14000 ft.
Maximum gross weight			1225 kg (2700 lb)
			-

(Reading mode: column by column from the left to the right side →)

### 3.2 Exterior Dimension

## Robinson R66



## 4. Operator Difference Requirement (ODR) Tables

The R66 is a new helicopter with no variants, no Operator Difference Requirement tables have been produced

## 5. Optional Specific Equipment

No optional specific equipment requiring specific training has been evaluated.

## 6. Master Difference Requirement (MDR) Tables

The R66 is a new helicopter with no variants, no Master Difference Requirement tables have been produced.

## 7. Type Rating List and Licence Endorsement List

### 7.1 Type Rating List

The proposal of this OEB is to update the Class & Type Rating List as following:

- Table 9 / Type Rating List (Helicopters)

1 Manufacturer	2 Helicopter	3	4 Licence endorsement
<b><i>Robinson Helicopter Corporation</i></b>			
- SE Turbine -	<b>R66</b>		<b>R66</b>

This table 9 matrix contains only Helicopters that have been evaluated through a JOEB, an OEB or a Catch-Up process. Associated reports are published on the EASA –Expert Department / Certification Directorate Website and Pilot Training courses are available from the Manufacturers

## 8. Specification for Training

### 8.1 General

The Type Rating Training courses proposed by Robinson Manufacturer fulfilled the minimum requirements of EASA Air Crew Part-FCL. The assessment was based on the R66, Pilot Initial Type Rating Training syllabi.

The OEB recommends pilot type rating training courses are divided into the following phases for approval in Approved Training Organisations (ATO) and also for operator specific training, provided the operator specific documentation is used throughout the course.

- Prerequisites for entry onto the specific course,
- Theoretical knowledge instruction syllabus and test summary,
- Helicopter flight training courses,
- Skill test.

### 8.2 Course pre-entry requirements

All candidates must fulfil the requirements of Part-FCL.725 for the issue of class and type ratings

### 8.3 Licensing requirements

All students must fulfil the requirements of Part-FCL Appendix 9, Flight instruction and skill test. The AMC2 FCL.725 (a) of the Part –FCL requires.

- for an Initial issue of a SET(H) under 3175 Kg MTOM , an approved flight instruction of at least:

Helicopter types	In Helicopter	In Helicopter and FSTD associated training Credits
SET(H) under 3175 Kg MTOM	5 hrs	Using FFS level C/D: At least 2 hrs helicopter and at least 6 hrs total Using FTD level 2/3: At least 4 hrs helicopter and at least 6 hrs total

- for an additional issue of a SPH, SET (H) CS 27 and 29 , an approved flight instruction of at least:

Helicopter types	In Helicopter	In Helicopter and FSTD associated training Credits
SET(H) to SET(H)	2 hrs	Using FFS level C/D: At least 1 hr helicopter and at least 3 hrs total Using FTD level 2/3: At least 2 hrs helicopter and at least 4 hrs total

Note:

These requirements have to be considered as the bare minimum, additional training could be necessary depending on:

- complexity of the aircraft type, handling characteristics, level of technology;
- Category of helicopter (SEP or SET helicopter, multi-engine turbine and multi Pilot helicopter);
- Previous experience of the applicant.

### 8.4 Initial, Additional Single Engine Turbine (SET) Type Rating

#### 8.4.1 Initial SET Type Rating (ITR)

Candidates for the Initial R66 Type Rating who do not hold a SET type rating must:

- Hold a valid Helicopter Pilot licence,
- Hold a SEP type rating
- Comply with the requirements set out in Part –FCL Subpart H – Section 1 & 3

#### 8.4.2 Additional SET Type Rating (ATR)

Candidates for an R66 Type Rating who already hold a SET rating must:

- Hold a valid Helicopter Pilot licence,
- Hold a SET Type Rating
- Comply with the requirements set out in Part FCL Subpart H – Section 1 & 3.



## 8.5 Theoretical knowledge syllabus and test summary

### 8.5.1 Initial and Additional Type Rating

Theoretical instruction should be provided in accordance with Part FCL Subpart H – Section 1 – FCL.725

The following sections present a summary of the material that an Initial and Additional Type Rating training program should consider. Whilst based on the Robinson Manufacturer programs, training providers should ensure their type specific courses cover the pertinent material.

Initial and Additional Type Rating theoretical knowledge syllabus	ITR	ATR
Turbine Engine Theory(*)	2.0	
Helicopter structure, engine, transmissions, electrical, fuel, rotors and equipment, normal and abnormal operation of the systems	8.0	8.0
Limitations (**)	1.0	1.0
Performance, flight planning and monitoring (**)	1.0	1.0
Weight and balance	1.0	1.0
Emergency procedures (**)	1.30	1.30
Pilots pre-flight walk around, ground handling, equipment installation removal, pilots servicing (****)	1.0	1.0
Optional equipment	In addition	In addition
<b>TOTAL THEORETICAL KNOWLEDGE SYLLABUS</b>	15.30	13.30
Theoretical examination session (***)	1.30	1.30
<b>TOTAL (HOURS)</b>	17.0	15.0

Note:

(\*) If an initial type rating for a turbine powered aircraft is required, the candidate must first undergo a turbine engine theoretical course.

(\*\*) Theoretical instruction elements that can be covered during the ground training course and/or during flight training briefing phase.

(\*\*\*) The theoretical knowledge examination shall be written and consist of at least 50 multiple-choice questions distributed appropriately across the main subjects of the syllabus.

(\*\*\*\*) Instruction elements that can be covered during ground training course and/or during flight training briefing phase

## 8.6 Flight training course summary

### 8.6.1 Initial and Additional SET Type Rating

The following table indicates the minimum flight training required determined by the OEB for different combinations with/without regards to previous Robinson R22 or R44 experience. Each helicopter flight session could be extended or reduced at the discretion of the instructor, but the total minimum flight time is unchanged. Additional flight could be necessary at the discretion of the instructor if the trainee has not successfully demonstrated the ability to perform all maneuvers with a high degree of proficiency.

Type Rating Flight Training Syllabus	SET ITR	ATR*	ATR**
Helicopter exterior visual inspection, cockpit inspection, starting procedures <sup>(1)</sup> , pre-take off /landing procedures, taxiing, Air taxiing, general handling, climbing/descending / turns, circuits	1.15	1.0	0.8
Take off / landing various profiles including simulated maximum take-off mass, sloping ground / crosswind take off and landings.	1.15	1.0	0.7
Basic and advanced autorotation's, practice forced landings, steep turns	1.15	1.0	0.7
Abnormal & Emergency Procedures, Autorotative landings, Simulated IF	1.15	1.0	0.8
Total Flight Time	5.0	4.0	3.0
Skill Test	As required	As required	As required

\* ATR for holders of a SET **without** a R22 or R44 type rating

\*\* ATR for holders of a SET **who additionally hold** a R22 or R44 type rating

(1) During training the candidate should have experience of at least 4 engine starts, ideally 1 of which should be with ground power.

#### Note

**No credit is given for a reduction of flight training from the R66 towards the R22 or R44**

## 8.8 Training Areas of special emphasis (TASE)

The following procedures for training should receive special attention. Therefore the OEB supports the manufacturer recommendations and training providers should consider the following elements:

## 8.8.1 TASE / Training Methodology for Pilots and Instructors

- **Autorotation / Autorotative landings**

- Autorotation training as detailed in Section 4 of the FM shall be conducted within gliding distance of a suitable landing area.
- Autorotation training shall be performed with a trainee and an Instructor only
- An N<sub>1</sub> Deceleration Check shall be conducted prior to the conduct of an autorotation .
- Cabin heat must be selected off before commencing autorotation.
- Practice autorotation entry
  - To initiate the autorotation the throttle should be closed before lowering the collective.
  - Recommended airspeed of 60-70kts should be maintained with the RRPM in the green.
- **Power recovery procedure**
  - At approximately 40ft AGL a cyclic flare should be commenced to reduce forward speed and rate of descent, and smoothly roll throttle full on to recover engine power
  - Pilots need to be aware of the lag in response of a turbine engine during the recovery phase.
  - At 8 feet AGL the aircraft should be levelled and collective applied to control descent.
- **Autorotative landing**
  - When practicing an autorotation landing to the ground it should be performed in the same manner as power recovery autorotations except the throttle should be kept closed throughout the manoeuvre. Always contact the ground pointing straight ahead with skids level...

- **Simulated Hydraulic failure**

- A switch located on the top of the pilot's cyclic grip is used to simulate a loss of hydraulic system pressure. Use care not to switch hydraulics off inadvertently.
- If switched off, hydraulics should always be re-engaged with a relaxed grip on the controls to prevent over-control. Avoid re-engaging hydraulics between hover and 100 ft AGL
- Hydraulics-off hovering can be challenging. A landing site where a run-on landing can be made should be available.

- **Low "G" Mast Bumping**

- Excessive rotor flapping can be caused by Low G Conditions and teetering of rotor.
- Due to light weight and high power of the R66, it can be susceptible to Low-G Mast Bumping in turbulent conditions.
- Example: low tank fuel, single pilot - light and fast.
- If significant turbulence is encountered, reduce airspeed to 60-70kts.
- Avoid abrupt forward cyclic movements and initiate descent with collective.
- Recover thrust by aft cyclic (to reload the disks) rather than lateral cyclic roll, then correct laterally.
- Ensure smooth input on controls; not abrupt, full range, un-coordinated input.

- **Engine Start**

- Engine starting can be critical in a turbine engine. Extensive damage can result if excessive measured gas temperatures (MGT) are allowed to occur during the start process (hot start). Pilots need to be very familiar and focused on the proper starting procedure. Factors such as battery voltage, fuel introduction, MGT limitations and time between starts must be well understood.
- If student has previous experience in R44, note difference in operation of fuel cutoff control in R66 and mixture control on R44 and R44 II.
- Instructors are recommended to be in a position to be able to terminate the start sequence if the student is slow to react.

### Notes

**The OEB recommends an in depth reading, analysis and study of all the safety tips and notices listed in the Robinson Helicopter Company's Pilot Operating handbook of the R66.**

## **9. Specification for Testing, Checking, Currency & Recent Experience**

### **9.1 Skill test**

As required by Part-FCL.725 (c)

### **9.2 Proficiency Checks**

As required per FCL 740 H

### **9.3 Specification for Recent Experience**

As required by Part FCL.060

## **10. Specification for Flight Simulation Training Devices**

No FSTD's exists at the moment of this report.

## **11. Application of OEB Report**

This OEB report applies to commercial operations. However, the OEB also recommends private or corporate operations to follow the findings of this report.

## **12. Appendices**

Appendix 1: EASA TCDS. EASA.IM.R.507.

