AIR ACCIDENTS INVESTIGATION INSTITUTE
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CZ - 14 - 098

FINAL REPORT

Investigation of causes of an incident of the R 22 Beta II helicopter, registration mark OK-OBA at the Podhořany aerodrome, on 2 April 2014

Prague
October 2014

This investigation was carried pursuant to Regulation (EU) of the European Parliament and of the Council No. 996/2010, Act No. 49/1997 Coll. on civil aviation, and Annex 13 to the Convention on International Civil Aviation. The sole and only objective of this report is the prevention of potential future accidents and incidents free of determining the guilt and responsibility. The final report, findings and conclusions stated therein pertaining to aircraft accidents and incidents, or possible system deficiencies endangering operational safety shall be solely of informative nature and cannot be used in any other form than advisory material for bringing about steps that would prevent further aircraft accidents and incidents with similar causes. The author of the present Final Report states explicitly that the said Final Report cannot be used as grounds for holding anybody liable or responsible as regards the causes of the air accident or incident or for filing insurance claims.

Glossary of Abbreviations Used in this Report

°C	Temperature in degrees Celsius
°F	Temperature in degrees Fahrenheit
AGL	Above ground level
AMSL	Above mean sea level
BASE	Cloud base
BKN	Broken
CAVOK	Visibility, cloud and present weather better than prescribed values or conditions
CTR	Control zone
CHMI	Czech Hydrometeorogical Institute
E	East
FEW	Few of cloud amount
ft	Foot (unit of length = 0.3048 m)
h	Hour
FRS CR	Fire Rescue Service of the Czech Republic
km	Kilometre
kt	Knot (unit of speed = 1.852 $km.h^{-1}$)
LKBE	Public domestic aerodrome Benešov
LKCV	Private military international aerodrome Čáslav
LKPD	Public international aerodrome Pardubice
LKPN	Public domestic aerodrome Podhořany
m	Metre
MCTR	Military control zone
METAR	Aviation routine meteorological report
min	Minute
MTWR	Military aerodrome control tower
N	North
NIL	None
PCR	Police of the Czech Republic
PPL (A)	Private Airplane Pilot Licence
PPL (H)	Private Helicopter Pilot Licence
RWY	Runway
SCT	Scattered
TCU	Towering cumulus
TOP	Cloud top
TWR	Aerodrome control tower
UTC	Co-ordinated Universal Time
AAII	Air Accidents Investigation Institute
VRB	Variable

A) Introduction

Operator:	Legal entity
Aircraft Manufacturer and Type:	ROBINSON HELICOPTER COMPANY, R 22 Beta II
Registration mark:	OK-OBA
Place:	LKPN
Date and Time	2 April 2014, at 12:20 (all times are UTC)

B) Synopsis

On 2 April 2014, AAII received a notice of a R22 helicopter incident at LKPN from the aircraft operator. The pilot intended to take a flight to LKBE. Shortly after the take-off, a failure of an engine cooling fan occurred. The pilot interrupted the climb immediately and decided to take a precautionary landing at the take-off aerodrome. During the descent he noticed that the engine temperatures reached the maximum value. He made a safe landing.

The pilot reported the incident to PCR and other authorities in compliance with the operational handbook of the aviation activities operator.

The cause of events was established by the inspector responsible Ing. Zdeněk FORMÁNEK based on the data from the pilot and repair organisation.

The Final Report was issued by:

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on xxx October 2014.

C) This Final Report consists of the following main parts:

1) Factual Information
2) Analysis
3) Conclusions
4) Safety Recommendations
5) Appendices

1. Factual information

History of the Flight

The pilot provided the following information regarding the history of the flight and the incident.

On 2 April 2014, he intended to make a private flight to LKBE. He arrived at the Podhořany aerodrome at 11:30 and made a preflight preparation and helicopter inspection. At 12:00 he started the helicopter and performed the engine heating-up for approx. 5 minutes. He established a radio connection with MTWR LKCV and received an instruction to make a fly around of MCTR LKCV. After that he called in TWR LKPD and asked for a passage over their CTR.

After the helicopter take-off he started the climb to 300 metres above ground. After approx. 5 minutes of the flight there was a bang and the whole helicopter shuddered. The pilot assumed there was a collision with a larger bird or that the "engine shot from the exhaust pipe", that is why he asked TWR LKPD for the return to the take-off aerodrome. During the descent he found out that the engine temperatures "were at full stretch". After the touchdown on the grass area in front of the hangar, he shut the helicopter engine down. There was a smell of burnt oil inside the cockpit, therefore he left the cockpit immediately. Smoke was rising from the engine compartment. The pilot used a hand extinguisher from the helicopter to cool the engine compartment down. The smoke intensity decreased only very little and the air was seen to shimmer intensively above the engine. The pilot was afraid that the helicopter might explode, so he asked the FRS CR for help.

He further provided in his statement that approx. 15 minutes later a former flight manager from LKPN arrived. The two of them performed the inspection of the helicopter and found out that there was no fire hazard. They waited for the arrival of PCR and FRS CR. After the arrival at the place of incident, the Police of the Czech Republic subjected the pilot to a preliminary breath test with the negative result.

Fig. 1 Helicopter after the incident with the engine cooling fan removed

Helicopter Pilot

The helicopter was flown by a male, aged 60, holder of a valid Private Helicopter Pilot Licence PPL (H). He had a valid class 2 medical certificate. According to the data in the pilot logbook he flew the total of 1267 hours on all types of aircraft by 2 April 2014. On the R 22 helicopter he flew 167 hours. He was also the holder of a valid pilot licence PPL (A) and the UL aircraft pilot licence.

Helicopter

The Robinson R 22 Beta II helicopter, registration mark OK-OBA, is a light single-engine, two-seat, all-metal helicopter with a traditional structure and fixed skid landing gear. The helicopter is driven by a piston engine type Lycoming 0-360-J2A.

Type:	R 22 Beta II
Registration mark:	OK-OBA
Manufactured by:	Robinson Helicopter Company, USA
Year of manufacture:	2008
Serial number:	4327
Certificate of airworthiness inspection:	valid
Total hours flown:	902 h
Total hours flown since the last inspection:	69 h
Liability insurance:	valid

Power plant:	
Engine/Type:	Lycoming O-360-J2A
Manufactured by:	Textron Lycoming, USA
Serial number:	L-41126-36E
Year of manufacture:	4 January 2008
Total hours flown:	902 h
Total hours flown since the last inspection:	69 h

Helicopter operation

The helicopter was recorded in the aeronautical register on 12 July 2011. Since 2011 it was been operated by TRAFFIC a.s. from LKPN.

No notation regarding the defects in the helicopter operation were recorded in the board logbook or aircraft logbook. The last 100-hour inspection was performed on 24 April 2013 with the conclusion “Aircraft considered capable to be released into service”. Since then the helicopter flew 69 h. On the day of incident 1 flight of 8 mins was taken with the helicopter.

During the flight, a failure occurred – an engine cooling fan separated due to a break up of a cone in the assembly of the fan shaft and lower bearing of the expanding mechanism. As a result of that the engine temperature increased above the permitted upper limit. No logger, the record of which might be used in the flight analysis, was installed on the helicopter board.

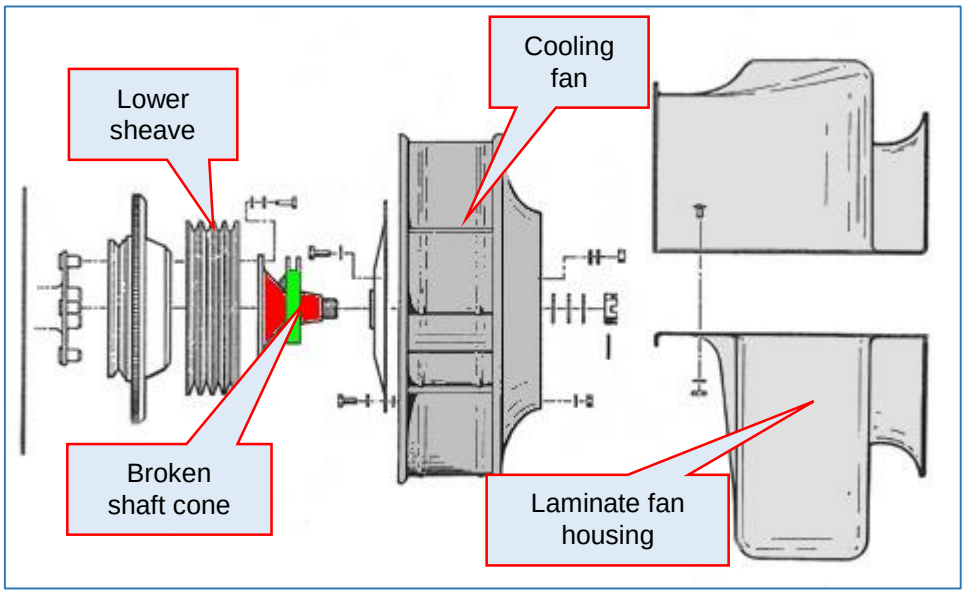

Fig. 2 Installation of the radial cooling fan

Fig. 3 Broken fan shaft cone of the R22 helicopter

Additional Information

After the inspection of the helicopter at the place of hangarage, the decision was made to transport it to the service centre.

In cooperation with the helicopter manufacturer, Robinson Helicopter Company, using the procedures from Robinson R22 Maintenance Manual RTR 060 and Lycoming Operator's Manual 60 297-12 the course of work to remove the defect was specified.

- inspection and check of sparking plug function,
- inspection and check of the ignition harness cables,
- inspection and check of ignition magnetos,
- inspection and check of oil filters with an emphasis on the content of metal dust in filters,

- construction of Lycoming SB388C (AD 2005-0023R3) – check of exhaust valve clearances,
- replacement of all damaged parts of the engine cooling fan assembly and air conduits, engine test and dynamic balancing of the new fan.

After the above-specified work and a 100-hour annual inspection were performed, the helicopter was released into service.

The permitted temperature range values specified in R22 Pilot's Operation Handbook.

OIL TEMPERATURE	
Green arc	75 to 245°F (24 to 118°C)
Red line	245°F (118°C)
CYLINDER HEAD TEMPERATURE	
Green arc	200 to 500°F (93 to 260°C)
Red line	500°F (260°C)

Meteorological Conditions

According to the CHMI Aviation Weather Service report, a shallow trough of depression proceeded from the west. According to expert estimate the meteorological situation at the place of air accident was as follows:

Surface wind:	VRB up to 4 kt, occasionally 080° 170° / 3 - 7 kt
Upper wind:	1000 ft AGL 150°/10-12 kt
Weather:	scattered clouds to cloudy
Visibility:	over 10 km, sporadically 6-10 km
Cloudiness:	FEW / SCT sporadically up to BKN, BASE 055-070, TOP 080- 100, TCU-140
Turbulence:	NIL
Zero isotherm level:	7000 - 7700 ft AMSL
Ice:	NIL

Abstract from METAR reports

From MET stations Pardubice and Čáslav of 11:00 and 12:00 UTC

2 April 2014, 11:00 UTC
METAR LKPD 021100Z 08004KT 360V160 CAVOK 17/02 Q1012 NOSIG
METAR LKCV 021100Z 14005KT 090V180 CAVOK 18/04 Q1011 NOSIG

2 April 2014, 12:00 UTC
METAR LKPD 021200Z 12005KT 060V200 CAVOK 17/05 Q1011 NOSIG
METAR LKCV 021200Z 10005KT 040V180 CAVOK 18/06 Q1011 NOSIG

No atmospheric precipitation occurred at the meteorological stations analysed.

Aerodrome Information

The Podhořany aerodrome is a public domestic aerodrome. At LKPN grass RWY 07/25 and RWY 13/31 are used for the aircraft operations. The helicopter took off from

the grass manoeuvring area in front of the hangar. The elevation at the landing place is 1250 ft (381 m).

The pilot landed on the grass manoeuvring area of the aerodrome in front of the hangar. Location coordinates were N 49° 56‘ 32“, E 15°33‘ 03“.

LKPN was clear of traffic at the time of the incident.

Fig. 4 Helicopter landing place.

2. Analysis

The pilot was fit to fly and performed all actions before and during the flight in compliance with the flight manual. No facts that would indicate the cooling fan failure before the incident followed from the pilot’s information, after the technical inspection and subsequent repair at the service organisation. In his statement the pilot specified that the helicopter was free and clear before the flight. After the take-off it did not show any unusual activity, the flight proceeded in a standard way; also after the defect the helicopter flew normally.

The helicopter documentation did not registered any rough landings or any number of autorotations with rough landings that might have an effect on the smooth engine operation, possibly result in the wear of mechanical parts of the helicopter cooling fan.

As a result of the broken cone in the shaft bearing housing the fan separated from the lower bearing of the expansion mechanism, damaged and deformed the laminate fan housing. The fan stopped performing its function, the engine was not cooled down during the flight, as a result of which the permissible engine temperatures were exceeded.

The pilot reacted to the fact by interrupting his flight to LKBE and returning from the flight to LKPN, where he landed safely. If he continued the flight, it is highly probable that the fire would break out in the helicopter.

The helicopter was operated and serviced in compliance with the documentation specified by the manufacturer. During the take-off until the time the incident occurred, the pilot did not notice any abnormality in the helicopter control or engine operation and its performance. The technical inspection of the helicopter confirmed that a mechanical failure of a part of the helicopter cooling system occurred, probably due to a fatigue fracture or material defect on the fan shaft cone.

The proximity of the hangar had a positive effect on pilot's behaviour in handling the critical situation. The pilot touched down on the grass area in front of the hangar, extinguished the engine compartment that the smoke was rising from. However, it was not a fire, but evaporating products of lubricants (oil, lubes), which came into a contact with the engine where temperatures exceeded 260 °C.

Meteorological conditions did not affect the flight.

3. Conclusions

The investigation resulted in the following conclusions:

The pilot

- was fit for fly,
- had a valid licence of the aeronautical mobile service radio operator,
- used a possibility of fast return to the take-off aerodrome which prevented a large-scale damage of the helicopter,
- was medically fit.

The helicopter

- had a valid certificate of airworthiness inspection and was airworthy
- had a valid liability insurance,
- the engine worked perfectly normally during the whole flight and all control elements were fully functional,
- the mechanical damage of the cooling fan shaft cone arose probably due to a fatigue fracture or material defect,
- the helicopter manufacturer does not require monitoring of the operation wear state of critically stressed components in the fan shaft assembly.

Causes

The incident was caused by a failure of the engine cooling fan due to a break up of a cone in the assembly of the fan shaft and lower bearing of the expanding mechanism.

4. Safety Recommendations

In carrying out the pre-flight preparations, post flight inspections and prescribed work according the R22 Maintenance Manual pay increased attention to the state of operational wear critically stressed parts in the assembly of the fan shaft.

5. Appendices

NIL