FINAL REPORT

AAIU Synoptic Report No: 2005-024
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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Accidents, on 2 November 2004 appointed John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this occurrence and prepare a Synoptic Report.

Aircraft Type and Registration:	Robinson R44 Raven 2, G-IVEN
No. and Type of Engines:	1 x Lycoming IO-540-AE1A5
Aircraft Serial Number:	10442
Year of Manufacture:	2004
Date and Time (UTC):	2 November 2004 @ 14.30hrs
Location:	One mile east of Cork Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - none
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Nil
Commander's Licence:	UK PPL (H)
Commander's Details:	Male, aged 31 years
Commander's Flying Experience:	106 hours, of which 25 were on type
Information Source:	Pilot contacted AAIU

1. FACTUAL INFORMATION

1.1 History of the Flight

The Pilot said he departed Cork Airport about 14.25 hrs in a southerly direction on a VFR flight to Weston. He then turned east on track for Dunkettle. At about 1,100 feet above mean sea level (AMSL) or 700 feet above ground level (AGL) he started to get violent vibrations in the cyclic control. At first he thought it was a problem with the main rotor head and he decided to land immediately.

During the descent he contacted Cork Tower and advised them he was making a forced landing due to hydraulic problems. During the descent the controls were stiff and heavy with large vibrations. He verified that control frictions were off and hydraulics switched on. He turned the aircraft right 90º to avoid some trees and wires and set down in a field 2 miles east of Cork Airport.

The pilot unfastened his lap and diagonal harness and exited the helicopter in the normal way. He examined the area underneath the auxiliary fuel tank and noticed a spray of oil on the lower and back firewall. EI-EHC, Robinson R22 helicopter routing from the South West went to the assistance of G-IVEN, located the helicopter and landed beside it. Emergency services from Cork Airport went to the scene. There were no injuries reported and no fire. EI-EHC reported that G-IVEN had a hydraulic leak. An engineer then proceeded to the scene to investigate the problem.

1.2 Aircraft Information

The engineer confirmed by using a hydraulic ground rig that the forced landing was caused by loss of hydraulic fluid in the flight control system, which in turn resulted in the flying controls functioning without hydraulic servo assistance. The pilot's experience of vibration coming through the cyclic control would have been caused by hydraulic pump cavitation.

The engineer detected that the leak was coming from a tee-piece union on the output side of the hydraulic pump. He removed the union (see drawing of pump in **Appendix A**) and noted that the O-ring retainer (Part No. MS 28773-04) had a ring mark around it, indicating that the associated union nut (Part No. D452-6) was tightened too far up the union and distorted the retainer. The O-ring was not damaged but had a distortion in the same location as the retainer. Replacing the retainer rectified the defect.

The helicopter was first registered in July 2004 and has a current Certificate of Airworthiness in the Transport Category. At the time of the incident, it had a total of 24 hours flight time since new.

1.3 Manufacturers Comment

The helicopter manufacturer advised that the retainer (which seats the O-ring seal) had not been installed properly at helicopter manufacture. The manufacturer could not visually inspect the retainer when installing the tee fitting in the pump, as after installation the retainer is hidden. The manufacturer depended solely on a leak check with normal system pressure after assembly to verify that the installation was correct.

The manufacturer revised procedures to visually inspect the retainers and O-ring seals to verify that the assembly is correct at sub-assembly stage before the fittings are installed in the final assembly.

This is the first occurrence of this nature in the manufacture of 1300 R44 helicopters with hydraulic systems. The manufacturer has no plan to issue a Service Bulletin although there are several places in the hydraulic system where retainers and O-rings are used.

2. ANALYSIS

If this incident had occurred a further mile ahead the pilot may have had to put the helicopter down in estuary water. As it was, another helicopter was quickly on the scene and an engineer with a hydraulic rig was able to identify the problem. A video of the leak taken by this engineer was helpful to the Investigation.

The incident shows that an improperly installed retainer may not cause a leak for several flying hours. The manufacturer indicates that their procedures are being revised and the Maintenance Manual will be changed. As a similar method is used throughout the hydraulic system, the Investigation feels that, in the meantime, the manufacturer should issue a general Servicing Instruction to cover the correct method of assembly.

3. CONCLUSIONS

(a) Findings

Vibration in the helicopters controls was due to a loss of hydraulic system pressure.

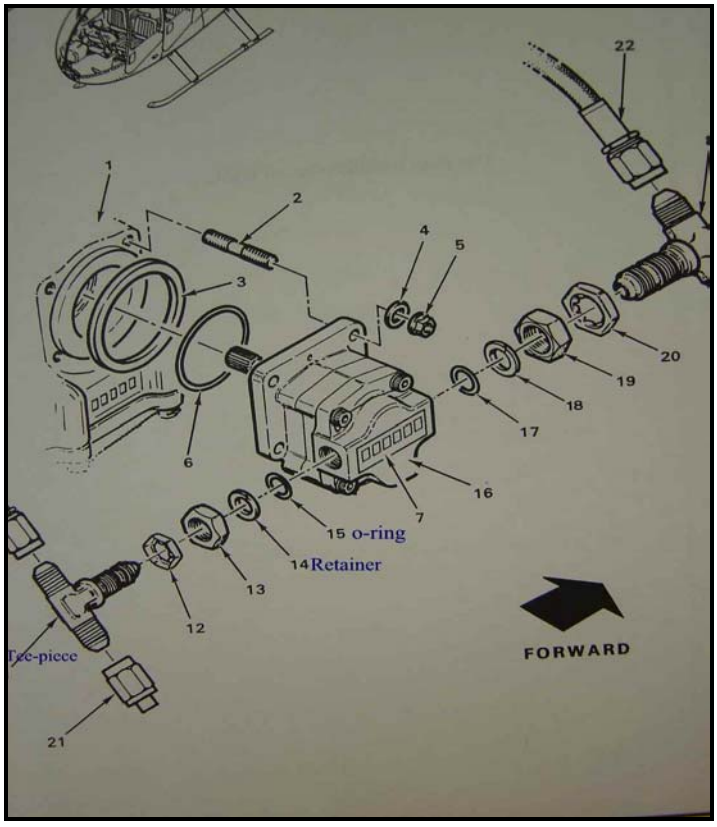
(b) Causes

The hydraulic system pressure loss was due to faulty installation of a retainer ring at the output of the hydraulic pump during manufacture.

4. SAFETY RECOMMENDATIONS

It is recommended that the manufacturer should issue a Servicing Instruction detailing the correct installation procedure for the hydraulic system retainer and O-ring seal assemblies. **(SR 23 of 2005)**

APPENDIX A



A drawing of the engine driven hydraulic pump showing the Tee-piece, Retainer and O-ring seal.