



Australian Government

Australian Transport Safety Bureau

Tail rotor malfunction involving a Robinson R22, registration VH-HPH

La Belle Downs Station, Northern Territory on 18 November 2014

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Addendum

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Tail rotor malfunction involving a Robinson R22, registration VH-HPH

What happened

On 18 November 2014, at about 1728 Central Standard Time (CST), a Robinson R22 helicopter, registered VH-HPH (HPH), departed from La Belle Downs Station, Northern Territory, for a local flight to check the progress of a bush fire, with the pilot and one passenger on board.

About two minutes into the flight, on climb and at about 300 ft above ground level, the pilot felt a vibration through the tail rotor pedals. The pilot decided to return to La Belle Downs station, turned the helicopter to the right and started a descent. The pilot was unable to stop the turn and the helicopter continued to descend and turn to the right. The helicopter started to spin in a tight circle and completed between five and six rotations before landing hard, bouncing once and then coming to a stop. The pilot performed the shutdown procedure and the pilot and passenger exited the helicopter. The pilot and passenger were uninjured. The helicopter was substantially damaged, including damage to the tail boom and both skids.

VH-HPH



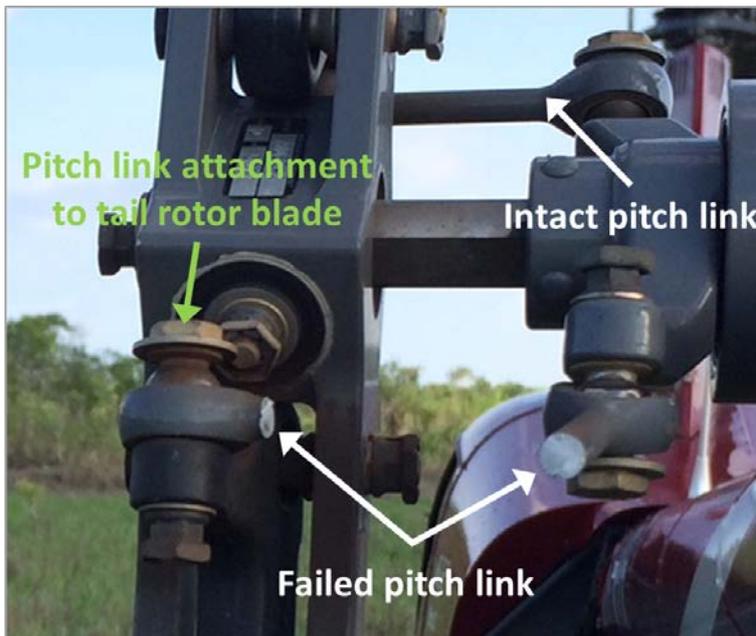
Source: Helicopter operator

Pilot comment

After landing, the pilot observed that the tail rotor pitch link¹ had failed (Figure 1).

Prior to the first flight of the day, the pilot reported carrying out a daily inspection without finding any defects. The pilot had then flown HPH for approximately 2 hours, prior to the accident flight.

Figure 1: Failed tail rotor pitch link



Source: Aircraft operator, annotated by the ATSB

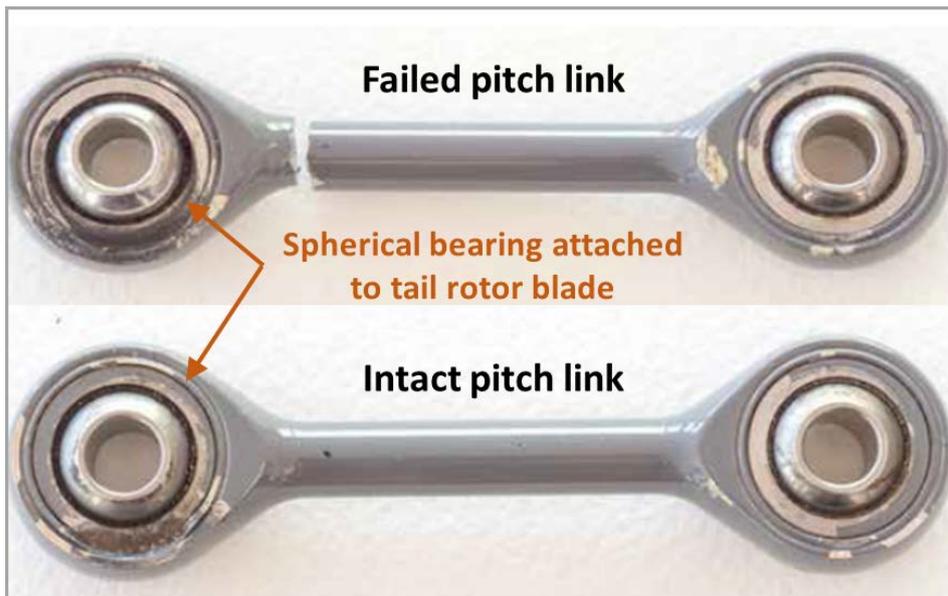
¹ There are two tail rotor pitch links, one for each tail rotor blade. The pitch link connects the blade to the tail rotor pitch control assembly. The tail rotor pitch control assembly is connected via push pull controls to the pedals in the cockpit, which the pilot moves for directional control.

Operator investigation

An examination of the tail rotor pitch links was conducted on behalf of the helicopter operator by a consultant in engineered-system failure analysis and the following was found (Figure 2):

- Alternating stress in the failed pitch link resulted in the initiation and propagation of a fatigue crack.
- The alternating stress in the pitch link resulted from failure of the spherical bearing to provide a low friction connection between the end of the tail rotor blade and the pitch link.
- The failed pitch link spherical bearing attached to the tail rotor had extensive wear. Axial wear of the spherical bearing was measured to be about 0.108 inch (2.743 mm).
- The intact pitch link spherical bearing attached to the tail rotor also showed signs of extensive wear. Axial wear of the spherical bearing was measured to be about 0.041 inch (1.041 mm).
- The factors that influence the rate of wear in the spherical bearing that attaches the tail rotor blade to the pitch link would not be expected to vary from helicopter to helicopter.
- No physical explanation was found as to why the specified inspection procedures (*R22 Maintenance Manual*, Chapter 2 Inspection, section 2.410) failed to detect bearing wear. Possible explanations beyond what could be ascertained by the examination were that the helicopter was operated in an exceptionally abrasive environment or the Teflon bearing lining was affected by some cleaning action.

Figure 2: HPH tail rotor pitch links



Source: Aircraft operator, annotated by the ATSB

HPH maintenance documentation

About 443 hours prior to the accident, at a 50 hourly inspection, the tail rotor pitch links (part number B345-3) were found to be unserviceable. Two new pitch links, with the same part number, were installed. The pitch link had failed about 2 hours prior to the next scheduled 100 hourly inspection. The maintenance release indicated that all the required daily inspections had been carried out and that there were no outstanding maintenance issues.

Manufacturer comment

The helicopter manufacturer was only aware of one other similar failure that occurred about 10 years ago. The manufacturer believed that the failure was as a result of the axial wear (about five times more than permitted) allowed binding to occur, with resultant fatigue failure to the pitch link.

Pilot operating handbook

Robinson Model R22 Pilot's Handbook, Section 4 Normal Procedures Daily or Preflight checks, dated 20 April 2007 page 4-3, included an item to check the tail rotor pitch links for "No looseness".

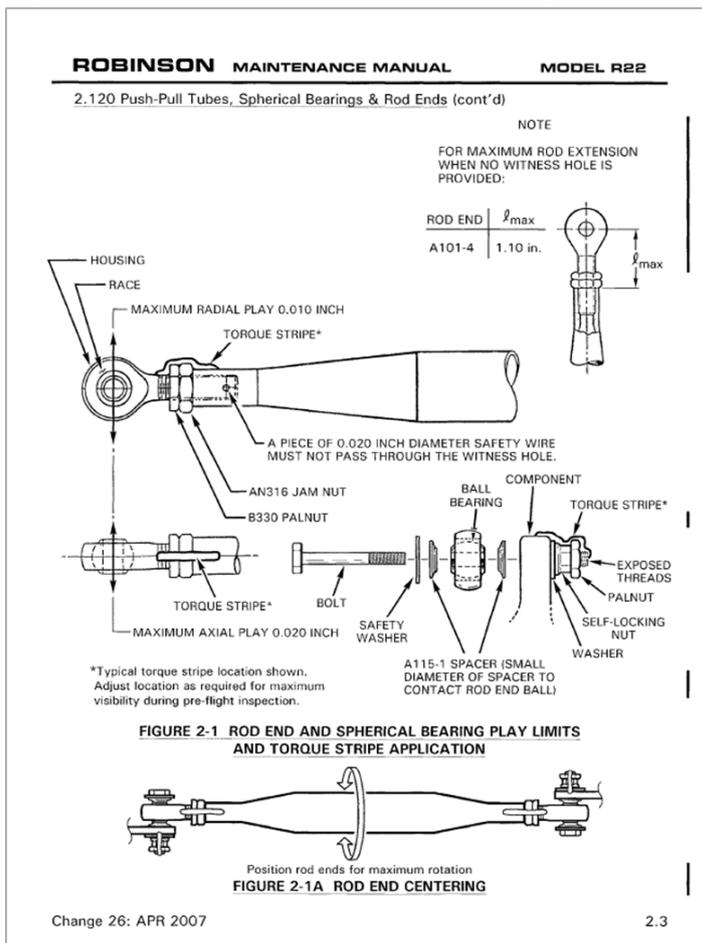
Robinson maintenance manual

The Robinson Maintenance Manual Model R22 contains inspection requirements to be conducted at the 100-hour or annual inspection. Section 2.410 Inspection procedures and checklist item 12. Rotor Hub Hinge Bolts, dated October 2014, required the condition of the pitch links and rod ends to be inspected. This inspection was to be in accordance with section 2.120 Push-Pull Tubes, Rod Ends, and Spherical Bearings (dated October 2014), with reference to Figure 2-1 (reproduced below in Figure 3). The inspection needed to meet the following conditions:

- the maximum allowed axial play of 0.020 inch (0.508 mm). The axial play of HPH's failed pitch link was about 0.108 inch (2.743 mm) and the intact pitch link was about 0.041 inch (1.041 mm)
- the maximum radial play of 0.010 inch (0.254 mm) for the rod end spherical bearings
- with no looseness between the bearing outer race and the rod end housing.

The maintenance manual also contained a caution that the Teflon-lined bearings must not be lubricated or cleaned with solvent.

Figure 3: Robinson maintenance manual spherical bearing limits



Source: Robinson

ATSB comment

CASA SDR database search

The operator reported to the ATSB that the R22 helicopter tail rotor pitch links had been failing regularly in mustering operations. CASA provided information from their Service Difficulty Report (SDR) database from 1983 to 2014. The database showed three previously reported defects with the same part number tail rotor pitch link as HPH where the pitch link had failed (Table 1). Two of the failures had occurred in flight.

Table 1: CASA SDR database - Tail rotor pitch link failures

month/year of SDR	Failure	Time since new (hours)	Part number pitch link	Operation
09/2009	Tail rotor pitch link failed in flight.	434	B345-3	Mustering
11/2009	Tail rotor pitch link failed in flight. Spherical bearing attached to the tail rotor blade was found worn to limits.	562	B345-3	Mustering
04/2014	During the scheduled 100 hourly inspection the tail rotor pitch link fractured near the spherical bearing attached to the tail rotor blade.	289	B345-3	Unknown

CASA reported two important points in relation to the CASA SDR system:

in the case of the Robinson R22, there is no legislation requiring the manufacturer to be notified of the tail rotor pitch link failures in Australia that have been reported to CASA. While there is no requirement to provide this information, CASA usually provides data dumps of defect reports on an annual basis to North American NAAs [National Airworthiness Authorities including the US Federal Aviation Administration and Transport Canada].

CASA encourages the industry to pass the defect information to the approval holder [manufacturer] and, as part of any follow up action CASA is likely to send the information to the approval holder [manufacturer], foreign or domestic.

Safety message

Continuing airworthiness relies on inspections identifying damage so that parts can be repaired or replaced prior to failure. Therefore, scheduled maintenance inspections and the pilot's daily inspection are a central element of the continuing airworthiness of the aircraft.

Regulators and aircraft manufacturers depend on accurate data to ensure the ongoing continued airworthiness of the aircraft. It is important that defects are reported to CASA through the Service Difficulty Reports (SDR) system, and to the manufacturer, so issues can be identified and rectified.

General details

Occurrence details

Date and time:	18 November 2014 – 1730 CST	
Occurrence category:	Accident	
Primary occurrence type:	Technical – rotor malfunction	
Location:	La Belle Downs Station, Northern Territory	
	Latitude: 13° 06.78' S	Longitude: 130° 29.93' E

Helicopter details

Manufacturer and model:	Robinson Helicopter Co R22	
Registration:	VH-HPH	
Serial number:	3988	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.

