

**INCIDENT**

<b>Aircraft Type and Registration:</b>	Sikorsky S-76C, G-XXEB	
<b>No &amp; Type of Engines:</b>	2 Turbomeca Arriel 2S2 turboshaft engines	
<b>Year of Manufacture:</b>	2009 (Serial no: 760753)	
<b>Date &amp; Time (UTC):</b>	23 May 2013 at 0930 hrs	
<b>Location:</b>	Denham Aerodrome, Buckinghamshire	
<b>Type of Flight:</b>	Private	
<b>Persons on Board:</b>	Crew - 2	Passengers - 6
<b>Injuries:</b>	Crew - None	Passengers - None
<b>Nature of Damage:</b>	None	
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence	
<b>Commander's Age:</b>	53 years	
<b>Commander's Flying Experience:</b>	7,262 hours (of which 2,850 were on type) Last 90 days - 44 hours Last 28 days - 28 hours	
<b>Information Source:</b>	Aircraft Accident Report Form submitted by the pilot and AAIB/NTSB enquiries	

**Synopsis**

During approach and descent to Denham Aerodrome, with autopilot disengaged, the pilot became aware of the aircraft yawing right. The pilot made a corrective pedal input and felt a restriction in the left pedal which also appeared to have an effect on the neutral yaw pedal position. The pilot declared a PAN and conducted an uneventful running landing. The yaw control system abnormality remained until the aircraft was shut down. The fault was later traced to the Pedal Damper Trim Actuator (PDTA). A detailed examination of the PDTA found that a small metal sealing ball had split within the solenoid valve. This caused an internal leakage of hydraulic pressure resulting in a PDTA trim runaway input and restriction within the helicopter yaw control system.

**History of the flight**

The aircraft was on approach to Denham Aerodrome with the autopilot disengaged. During the descent the pilot noticed the aircraft to be "out of balance, with the ball out to the left"; as the pilot made a corrective yaw input with the left pedal he felt a "heaviness" and restriction in the yaw control system. In addition to the restriction, the pilot detected that the range

of his yaw control to the left was now limited. He also noticed that the right pedal moved to almost its full forward travel, without pilot input, when pressure on the left pedal was relaxed. The co-pilot confirmed the problem was also apparent with his yaw pedals.

The crew conducted system checks and further diagnosis. Selection of the yaw trim switched to the IN and OUT positions had no effect. It was also confirmed that when the helicopter was flown into wind at 80 kt with full available left pedal applied, the right yaw remained. The pilot declared a PAN and decided to carry out a running landing and briefed the co-pilot to carry out an immediate engine torque reduction should directional control be lost. The passengers were also briefed on the situation and pilot's intention. The crew performed an uneventful running landing and ground-taxied to dispersal with the yaw control abnormality still apparent. The aircraft was shut down and the crew and passengers vacated the aircraft.

### **Pedal Damper Trim Actuator**

The PDTA is fitted within the helicopter mechanical yaw control system to provide yaw trim, a damping function and to respond to inputs from the Automatic Flight Control System (AFCS). Damping control uses hydraulic fluid restriction through an internal orifice and valve to retard excessively rapid pilot movement of the pedals. Trim and AFCS control is by the servo-controlled motion of a hydraulic piston to make yaw system inputs automatically or manually.

### **PDTA technical investigation**

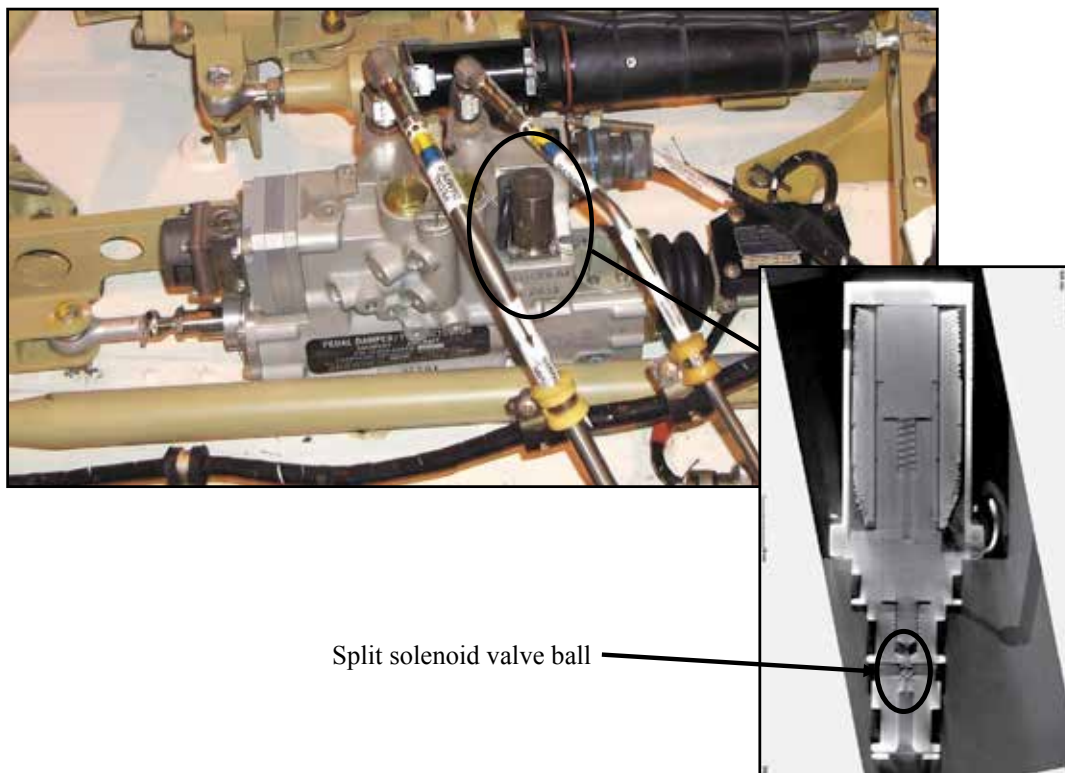
Initial fault diagnosis found that the cause of the yaw control system anomalies was the PDTA. This was replaced and the helicopter flown without further incident. The faulty PDTA had been overhauled and issued by the manufacturer on 27 February 2013 and was fitted in G-XXEB having accrued approximately 73 flying hours since installation. The faulty PDTA was returned to the manufacturer in the United States in order to determine the nature of the fault. The National Transportation Safety Board (NTSB) assisted the AAIB to co-ordinate the component examination.

A Computerised Tomography (CT) scan was carried out on the PDTA and it was found that a small steel ball, part of the trim solenoid valve, had split in half. PDTA functional checks by the manufacturer on a hydraulic test bench demonstrated that the broken ball produced identical symptoms to those experienced by the pilot. Figure 1 shows the PDTA in position and the CT scan of the servo valve ball.

Analysis and testing of the PDTA indicated that the split ball was allowing hydraulic pressure to leak internally past the solenoid valve to act on the trim-on control valve, thus placing the PDTA in trim mode continuously. In addition, the leakage acted within the PDTA against the damping circuit, which, with the actuator moving constantly, needed a significant force to overcome.

The new steel ball had been fitted at overhaul prior to the PDTA release to service and is most likely to have fractured during the flight from London to Denham. A detailed metallurgical

analysis of the ball by the NTSB on behalf of the AAIB is continuing. However, the most likely cause of the ball fracture was an anomaly in its heat treatment process during manufacture.



**Figure 1**

PDTA and servo valve CT scan

#### **Safety action**

The helicopter manufacturer is in the process of issuing a Sikorsky Safety Advisory, and a Rotorcraft Flight Manual revision, to inform operators of the symptoms of a PDTA fault and actions to be taken by the crew.