



MINISTRY OF DEFENCE

Military Aircraft Accident Summary of a Royal Air Force Board of Inquiry

Aircraft:	Harrier GR7 ZG861
Date of accident:	3 June 1997
Place of accident:	Castle Douglas
Casualties:	None

Synopsis

1. Whilst departing from a simulated attack at low level, the pilot of Harrier GR7 ZG861 experienced a sudden and significant loss of power. He was unable to restore thrust and successfully ejected. The Inquiry found that the accident was caused by engine mechanical failure: The aluminium alloy spacer between the second and third stage Low Pressure (LP) compressor had failed and damaged the engine causing a power surge followed by a loss of thrust.

Background

2. Early in the Harrier GR7's service life it was found that the spacer in the LP compressor could fail from fatigue, due to resonance caused by excessive wear. The engine manufacturer therefore recommended that the spacers be inspected every 12 flying hours and proposed a modification to replace the aluminium alloy spacer with a titanium alloy version. This modification was approved in February 1995 and deliveries commenced in mid-1996. However, during mid-1995, two failures to unmodified engines were detected, within 10 hours of their previous inspection. This prompted the manufacturers to review their recommendation on the inspection interval and, after updating their failure analysis, they recommended that the interval be reduced to 6 flying hours. This policy was implemented although, in reality, the inspections

were carried out more frequently. In the case of ZG861 inspections had been carried out 6:36, 5:36 and 2:36 flying hours prior to the accident.

Circumstances

3. The aircraft was flying as lead of a 4 aircraft formation on an exercise sortie when the crash occurred approximately 50 minutes after take-off. The pilot was flying at low level when he heard a loud bang and felt the airframe vibrate, accompanied by a loss of thrust. He diagnosed an engine surge and carried out the appropriate drills but was unable to restore thrust. At a height of 600 feet and after checking that he was away from areas of habitation, he made a successful ejection and landed, without injury, amongst some trees. The pilot was later commended for his handling of the emergency.

Rescue Operation

4. Police and paramedics were quick to arrive at the scene. The pilot was given a brief medical examination before being transferred by Search and Rescue helicopter to hospital.

Aircraft Damage

5. The aircraft was destroyed in the crash.

Investigation

6. The engine was recovered relatively intact, allowing a detailed examination to take place. The LP compressor appeared undamaged but further investigation revealed a large crack in the aluminium alloy spacer between the second and third stage. Two fasteners located immediately either side of the crack had failed. The nuts, bolt shanks and washers were all missing and at least one nut and washer had been ingested by the High Pressure (HP) compressor. This caused damage which, in turn caused the engine surge and loss of thrust.

Safety Recommendations

7. The production of modified spacers was hastened and an aggressive embodiment campaign initiated. This programme was completed in November 1997. In the interim, risk reduction measures were introduced. These included removing from service those engines deemed most at risk due to age or wear and restricting to a minimum the time remaining engines spent operating at the level which caused resonance.

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