MILITARY AIRCRAFT ACCIDENT SUMMARY
AIRCRAFT ACCIDENT TO ROYAL AIR FORCE

HARRIER T4 XW925

Date:	20 June 1989
Parent Airfield:	RAF Gutersloh
Place of Accident:	RAF Gutersloh
Crew:	2
Casualties:	1 Fatal, 1 Major

CIRCUMSTANCES

1. On the afternoon of 20 Jun 89, Harrier T4 XW925 took off from RAF Gutersloh on a familiarisation sortie with an Army Air Corps (AAC) captain, a Gazelle pilot, occupying the rear seat. The aircraft was flown by an experienced RAF Harrier pilot. The first part of the sortie, demonstrating the aircraft's characteristics at low and medium level, was uneventful and the aircraft returned to the airfield to carry out a variety of approaches. Subsequently, during an attempt to overshoot from a vertical landing (VL), control of the aircraft was lost and the 2 occupants ejected. The AAC passenger survived, but the RAF pilot was killed.

2. Before the flight, while the AAC passenger had been given the necessary briefings and fitted with flying equipment, the RAF pilot had planned and organised the sortie. The calculated Vertical/Short Take-Off and Landing (V/STOL) figures had shown that, with the prevailing outside air temperature (OAT) and airfield pressure (QFE), the aircraft could not hover, or land vertically, without the added thrust afforded by water injection of the engine.

3. Moreover, although XW925's engine had been found, on a recent airtest, to be 14.9°C 'hot', the pilot who had flown the aircraft on its previous sortie that day had considered the engine's Jet Pipe Temperature (JPT) to be about 25°C hotter than normal. The implication of the 'hot' engine was that, at full power, the engine's JPT had been 14.9°C higher than normal. Because of the JPT limiting system, the maximum thrust available would have been reduced by about 525lbs and by a proportionately greater amount had the engine been 25°C 'hot'.

4. The first part of the sortie proceeded uneventfully after which XW925 returned to Gutersloh for some circuit work. The pilot carried out a conventional (wingborne) approach and overshoot on Runway (R/W) 27 followed by a 65° nozzle approach and rolling vertical landing (RVL), also on R/W 27. The aircraft was then taxied to the Northern Strip for a short take-off (STO); this was completed successfully.

5. Subsequently, the aircraft was positioned for an approach to the Western Pad for a VL. (This concrete pad is situated at the extreme western end of the airfield and to the north of the R/W 27 overrun area; it offers no alternative landing sites from a westerly approach.) However, having achieved a hover at about 100 ft above the ground, the pilot elected to overshoot and accelerate away. The aircraft was then turned downwind for another attempt at a VL on the Western Pad. On this approach, the aircraft appeared to be travelling faster than normal during the deceleration and at a progressively lower height than the usual 100-150 ft.

6. The aircraft approached the pad at a height of 50-60 ft but, before coming to a complete halt, the pilot attempted to abort the approach and go around again. The aircraft appeared to accelerate slowly forward, but then started to sink. The nose rose and the right wing dropped followed by the aircraft yawing slightly and a single wing rock. At this point, the pilot ordered the AAC passenger to eject. He immediately did so, his seat leaving the aircraft at an angle of approximately 20° to the vertical. The RAF pilot ejected as the aircraft hit the ground; his seat trajectory was about 20° up from the horizontal because of the continued roll and pitch down of the aircraft.

7. The rear seat passenger landed safely, but suffered damage to his spine which was subsequently categorised as MAJOR. The RAF pilot was killed on impact with the ground, his ejection being beyond the seat's capabilities. At some stage during the final seconds of flight, the pilot had jettisoned the aircraft's drop tanks. The aircraft struck the ground slightly nose down, banked approximately 20-30° to starboard and at an estimated speed of 30-50 kts. Following the initial impact, the aircraft cartwheeled on to its back, stopping on the bank of the Ems canal, just outside the airfield perimeter, with its tailplane in the water and the cockpit on the canal bank.

CAUSE

8. It was clear that the pilot had been unable to hover and land from his second attempt at a VL and had elected to go around again while critically low on fuel.

9. Careful examination of the wreckage revealed no malfunctions in either the engine or the water injection system; a birdstrike was similarly ruled out. Considering the operating environment on the day of the accident, the high ambient air temperature would have resulted in higher JPTs to produce a given thrust, while XW925's engine/airframe combination was such that operating JPTs had been noted to be about 25°C above normal on the aircraft's previous sortie. Taken together, these factors represented a significant loss of maximum thrust with the JPT limiting system in operation. This is designed to limit the JPT to a maximum of 745°C by cutting back the available engine RPM.

10. The pre-flight calculations, which took account of the OAT and at least some of the excess engine operating temperature, had shown, the aircraft required water injection to be able to hover, even at low fuel weights. Post-crash examination revealed a water level below which the further selections of water injection are inhibited. However, whether water flows or not, a selection to "on" resets the engine temperature datums to a higher level in anticipation of the cooling effect of water injection.

11. The events leading to the accident were reconstructed from the available information, especially the recollections of the AAC passenger. It was estimated that, the RVL on R/W 27, a STO on the Northern Strip and the first attempt at a VL would have consumed all the available water supply.

12. The second attempt at a VL was therefore carried out without the benefit of water injection. Clearly, a rolling landing on R/W would have been a wiser course of action in these circumstances. However, if the pilot thought that the light fuel weight would offer some hover capability as long as he kept the water injection system switched on, this would have the effect, in the absence of any water, of allowing the engine to operate at a higher temperature and thus produce more thrust, although at the cost of reducing the engine's overall life significantly.

13. The final approach to the Western Pad was made with the reported wind from 340°-350° at 5-7 kts. This was unfavourable in that any sideslip would have to be corrected, as the aircraft approached the hover, by use of the yaw puffer ducts and a further bleeding of thrust from the engine. The pilot flew a fast approach to the pad, necessitating the use of the nozzles in the braking position to reduce speed. (The braking stop vectors the thrust from the nozzles slightly forwards to provide a braking component). As this takes away some of the vertical thrust component, and with overall thrust being limited by the JPT limiting system, the pilot had to choose either to lose height while braking to a halt over the pad or to restore the vertical thrust by returning to the hover stop and so control height at the expense of braking. As it was, the pilot ended up very low and overshot the pad.

14. With fuel now critically low and without the performance necessary to manoeuvre back overhead the pad and VL, the pilot elected to abort the attempt from a fast walking pace. With no more thrust available, the aircraft descended further during the early stages of the attempted acceleration. This may have caused the engine to re-ingest its own exhaust gases inducing further height loss. Without even a suitable grass area ahead of the aircraft to land on, any attempt to turn away from the canal would have increased the rate of descent and possibly caused the wing rock seen from the ground. At a very late stage, the pilot over-rode the JPT limiting system in an attempt to gain more thrust, but was forced to order abandonment of the aircraft in the face of the impending crash.

15. It was concluded that the primary cause of the accident was that the pilot attempted an accelerating transition from conditions in which the aircraft had insufficient thrust margin to enable this manoeuvre to be successful. The main contributory cause was the pilot's decision to attempt a VL, without water, in conditions which placed the aircraft on the extreme margins of the normal operating envelope. These margins were then further eroded by:

a. The hot engine.

b. An adverse wind.

c. Yaw Autostab action associated with b.

d. The high ambient temperature.

e. A rushed approach because of a low fuel state.

f. The confines of the Western Pad.

SUBSEQUENT ACTIONS

16. In future, the Harrier squadrons at RAF Gutersloh will have briefings before the summer to re-emphasise the implications of operations in hot weather and the use of water injection.

CLAIMS

18. Claims have so far been settled totalling some DM 2,710 in respect of damage caused by this accident.