MINISTRY OF DEFENCE

MILITARY AIRCRAFT ACCIDENT SUMMARY

AIRCRAFT ACCIDENT TO ROYAL AIR FORCE TORNADO GR4 ZA491

AIRCRAFT:	RAF Tornado GR4 ZA491
DATE:	22 July 2004
LOCATION:	North Sea off Newton Point
PARENT UNIT:	31 Squadron, RAF Marham
CREW:	Two – Pilot and Navigator
INJURIES:	Nil

Issued by: Directorate of Air Staff, Main Building, Ministry of Defence, Whitehall, London SW1A 2HB

March 2005

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SYNOPSIS

1. On the morning of 22 July 2004, Tornado GR4 ZA491 was flown on a training sortie designated as a squadron arrival check on the navigator. As planned, the aircraft conducted several simulated weaponry passes within the East Coast Ranges and air-to-air refuelling over the North Sea, prior to conducting an Operational Training Manoeuvre designed to counter the threat of surface-to-air missiles. During this manoeuvre the aircraft departed controlled flight and entered a left-hand spin. Unable to regain controlled flight, the crew ejected at 10,000 feet and the aircraft crashed into the North Sea near Newton Point. The aircrew were unhurt and were soon recovered by a search and rescue helicopter from RAF Boulmer. The Inquiry concluded that the cause of the accident was the loss of control of the aircraft and the subsequent irrecoverable spin.

BACKGROUND

2. On the morning of 22 July 2004 ZA491 was assessed as fully serviceable and was being flown on a training sortie designated as a squadron arrival check on the navigator. As planned, the aircraft conducted several simulated weaponry passes within the East Coast Ranges and air-to-air refuelling over the North Sea, prior to conducting an Operational Training Manoeuvre designed to counter the threat of surface-to-air missiles.

CIRCUMSTANCES

3. Prior to the commencement of air-to-air refuelling the aircrew noticed a failure of the manoeuvre flap/slat system, which improves aircraft handling characteristics. However, the crew elected to continue as planned since this failure did not automatically require a cessation of the sortie profile. On entering the Operational Training Manoeuvre at 20,000 feet the pilot initiated a slight climbing turn to the left at 60 degrees angle of bank, while selecting - via a throttle mounted switch - the manoeuvre flap/slat system; the wings were then swept fully forward to further improve aircraft manoeuvre. After approximately 60 degrees of turn, the pilot made control inputs intended to reverse the direction of the roll and place the aircraft in a planned 20 degrees nose down attitude. Simultaneously, and therefore masked to the pilot by his own actions, the aircraft performed an undemanded roll to the right; once recognised, the pilot was unable to arrest the undemanded rotation, although he did notice that the aircraft flaps had also incorrectly travelled to the fully extended position. After 3 divergent right-hand rotations, initial actions for the aircraft loss of control drill were completed by the pilot; however, at this stage the aircraft spin limiting system failed and the aircraft ‘flicked’ to the left, entering a left-hand, nose-low spin. Subsequent pilot actions failed to bring the flaps back to the UP position and, once the aircraft had completed 3 turns to the left, the pitch angle reduced and the spin became flat. At 12,000 feet the navigator transmitted a “Mayday” call and at 10,000 feet the pilot correctly called for ejection.

RESCUE AND SALAVAGE OPERATION

4. The ejection sequence was successful and both crew members landed in the sea and boarded their life rafts. During the descent, the pilot noted that his personnel locator beacon aerial had detached from his life survival jacket but he was able to re-attach it prior to entering the water. Approximately 25 minutes after ejection, the crew were recovered by search and rescue helicopter from RAF Boulmer. Due to the nature of the aircraft impact, the wreckage recovered by the salvage operation was in relatively large pieces and was mostly identifiable.

AIRCRAFT DAMAGE

5. The aircraft suffered Category 5 damage (beyond economic repair).

INVESTIGATION

6. The investigation concluded that a failure of the flap feedback mechanism, was caused by a locking pin that had dislodged during gearbox assembly, which had acted as a loose article and lodged itself within the High Lift Wing Sweep Control Unit flap feedback gearing; this in turn allowed an ungoverned extension of the flap to fully down during limit manoeuvring. This ungoverned flap extension, combined with the wing leading edge slats failing to extend – possibly caused by a mis-rigging of the slat screw jacks - resulted in a reduction in the specified angle of attack at which departure from controlled flight occurs, as manifested through aircraft stall or wing drop. During the Operational Training Manoeuvre, as the wings were swept forward, the failures within the flap and slat systems meant that the pilot unwittingly placed the aircraft into the now reduced angle of attack region which resulted in a stall, wing drop and the undemanded right-hand roll. These actions were initially masked by the pilot's own right-hand roll inputs. Additionally, the ungoverned extension of the flap to fully down position exacerbated rudder inputs from the aircraft Control and Stability Augmentation System which further increased the undemanded roll rate, resulting in yaw divergence and loss of stability in roll. Following the initial wing drop the aircraft completed 3 undemanded, divergent right-hand rolls, during which the increasing yaw and roll rate resulted in a pitch up. This

in turn led to a reduction in speed and an increase in aircraft angle of attack that resulted in the departure from controlled flight and spin of the aircraft. Had aircraft spin recovery in itself been effective it is unlikely that the increasing roll rate could have been reduced sufficiently to prevent the aircraft from pitching up and departing again. Thus, following the first undemanded roll, the aircraft was unrecoverable. The cause of the accident was determined as the loss of control of the aircraft and the subsequent fully developed, irrecoverable spin.

RECOMMENDATIONS

7. The Board of Inquiry recommended that:

a. The Tornado GR4/F3 Flight Crew Checklists should be amended to incorporate advice that states that if a flap/slat jam occurs when using the throttle manoeuvre flap/slat switch; the switch should be selected UP. Moreover, the advice should be extended to include guidance on general handling as opposed to just approach handling considerations.

b. All fast jet crews should be re-briefed on the importance of the timely application of correct recovery action, including the monitoring of angle of attack if appropriate, during loss of control/departure from controlled flight, and the importance of Crew Resource Management.

c. It should be highlighted to all Tornado crews that in-flight failures pertaining to wing sweep or high lift devices need to be treated with caution.

d. Current Tornado Maintenance Procedures pertaining to the High Lift Wing Sweep Control Unit gearbox should be amended to incorporate a method of securing the locking pins during assembly and the Tornado Integrated Project Team should undertake loose article checks of a sample of High Lift Wing Sweep Control Units in order to assess the risk to the fleet.

e. The RAF Centre of Aviation Medicine should investigate the security of the Personnel Locator Beacon aerial fitted to the aircrew life survival jacket.