PART 1.3 – NARRATIVE OF EVENTS

All times Zulu.

SYNOPSIS

1.3.1 On 8 Nov 11 Hawk T Mk 1 XX177 was assigned to be flown as part of a Royal Air Force Aerobatic Team (RAFAT) training sortie from RAF Scampton. The planned task was an authorized pre-display season work-up sortie involving a formation of 5 aircraft, followed by a transit to RAF Valley. Witness 8 Witness 21

1.3.2 At approximately 1057hrs the Pilot[1] of XX177, call sign Red 5, walked out to the aircraft and commenced aircraft external checks before boarding the aircraft front seat as the sole occupant. At 1106hrs, having completed his 'full and free'[2] after start control checks, with the engine running, canopy closed and all escape system safety pins in the correct position for solo flight, the front cockpit ejection seat firing sequence was initiated. Witness 2 Witness 8 Exhibit 1 Exhibit 2

1.3.3 The ejection sequence operated as expected up to and including the deployment of the 22 inch and 5 ft drogue parachutes. However, the main parachute did not deploy and the Pilot remained attached to the seat until impact with the ground. Witness 8 Witness 10 Witness 13

1.3.4 The Pilot was attended to by RAFAT personnel at the scene prior to the arrival of RAF Scampton emergency medical staff and subsequently civilian paramedics. The Pilot was later transferred by air ambulance to Lincoln General Hospital where he was pronounced dead; the post mortem showed that the Pilot had died at or shortly after impact. Witness 2 Exhibit 3

1.3.5 The accident resulted in Category 1 damage to XX177. Exhibit 4

BACKGROUND

1.3.6 **Aircraft History**. Hawk T Mk 1 XX177 was transferred to RAFAT from RAF Shawbury on 21 Apr 11. The aircraft was last flown on 4 Nov 11, four days prior to the accident, when four RAFAT training sorties were completed. Each sortie was captained by a different RAFAT pilot, the last flight of the day being flown solo by the accident Pilot. Following the last flight on 4 Nov 11 the aircraft was towed into the RAFAT hanger, After Flight Servicing (AFS) was carried out and the ejection seats were put into the safe for maintenance condition. Exhibit 5

1.3.7 **Ejection Seat History.** XX177 was fitted with a Martin-Baker (MB) Type 10B1 Mk 1 ejection seat in the front cockpit and a MB Type 10B2 Mk 1 ejection seat in the rear cockpit. The ejection seats are fully-automated, cartridge operated, rocket-assisted escape systems which are designed to provide safe escape from most altitude and speed combinations including a ground level stationary ejection referred to as 'zero, zero'. Both ejection seats were fitted to XX177 in Mar 11 following bay maintenance at RAF Valley. The last maintenance work carried out on the ejection seats was the conduct of RTI/Hawk/59D on 24 Oct 11, 9:40 flying hours prior to the accident. Exhibit 6 Exhibit 7

[1] Throughout the Report any reference to the 'Pilot' relates to the accident pilot; Flt Lt Cunningham (Red 5).

[2] Full and free checks – a set of control inputs of aileron, tail-plane and rudder to check freedom of movement and correct operation.

1.3.8 **Pilot Background.** The Pilot was in his second year with the RAFAT; he joined the unit in Aug 10 and completed his initial workup in May 11. He had flown a total of 1872 hours as a military pilot including 588 hours on the Hawk, of which 385 hours were as aircraft captain and 287 hours were with the RAFAT. Immediately prior to joining the RAFAT he had completed 12 months as a Hawk Qualified Pilot Navigation Instructor (QPNI) on 100 Squadron (Sqn) and six years on the Tornado GR4 as a Sqn pilot and Operational Conversion Unit (OCU) instructor. He had been assessed as above average at the end of his Tornado GR4 OCU tour and as high average at the end of his 100 Sqn Hawk tour. Exhibit 8 Exhibit 9

1.3.9 **Previous 24 hours.** On 7 Nov 11 After Flight (AF) and Before Flight (BF) servicing was conducted on XX177 in preparation for flight which included making the ejection seat 'safe for parking'[3]. Following the meteorological (met) brief at 0830hrs, the weather was judged by Officer Commanding (OC) RAFAT to be unsuitable for the planned local area flying events, therefore the day's sorties were cancelled. A Sqn lunch was organised in Lincoln to which the Pilot travelled at circa 1100hrs. On completion of lunch, the Pilot returned to RAF Scampton, arriving at 1330hrs and finished for the day at circa 1400hrs. Further AF servicing was conducted on XX177 including returning the ejection seat to a 'safe for maintenance' condition. The Pilot returned to the house that he shared with another RAFAT pilot near Lincoln and had dinner, spending the evening in the company of his house-mate and one other pilot from the team. His house-mate retired early and he heard the Pilot go to bed shortly after. On 8 Nov 11, the two house-mates left home in time to attend the 0830hrs met brief at RAF Scampton. The toxicology report conducted as part of the post-mortem indicated that at some point within the 12 hours prior to the accident the Pilot had consumed an un-prescribed over the counter cold remedy[4]. Witness 4 Witness 8 Exhibit 5 Exhibit 10

1.3.10 **Sortie Details and Preparation**. On the day of the accident XX177 was prepared for flight with the completion of BF servicing and the ejection seats were made 'safe for parking' whilst the Pilot attended the morning met brief. Shortly after the completion of the met brief, OC RAFAT[5] briefed the members of 'Enid[6]' formation, Red 10 (the RAFAT Flight Safety Officer (FSO)) and the Junior Engineering Officer (JEngO) on a change to the scheduled plan as a result of inclement weather at RAF Scampton. The revised sortie was planned to include a transit and landing at RAF Valley followed by a further sortie and overnight stay to take advantage of better weather to the west. An 1100hrs take off time was nominated. The Pilot drove the 16 mile round trip to his house to pick up an overnight bag, returning in time to complete pre-flight preparations and attend the sortie brief at 1015hrs. The Pilot then briefed the three new RAFAT pilots, Reds 2, 3 and 4, on how to re-programme the VHF radio with the necessary RAF Valley frequencies. Witness 2 Witness 4 Witness 6 Witness 7 Witness 8 Witness 21 Exhibit 5

1.3.11 At approximately 1045hrs the Pilot walked downstairs to don his flying clothing. The Pilot then waited near the line control with the other members of the formation due to a short delay whilst the engineering paperwork was prepared. During this period the Pilot engaged with other pilots and engineers in light hearted conversation and was reported to be in good spirits. The Pilot signed for XX177 at 1057hrs and, whilst walking to the aircraft, received a telephone call on his mobile phone at 1058hrs from an estate agent, lasting 49 seconds. Witness 2 Witness 5 Witness 8 Exhibit 5 Exhibit 11 Exhibit 12

[3] Safe for Parking – safety pins fitted to the Seat Firing Handle, Miniature Detonating Cord (MDC) firing unit and canopy MDC firing handle; Safe for Maintenance – in addition safety pin fitted to ejection seat main gun sear, rocket initiator sear and manual separation firing unit sear.

[4] Night Nurse.

[5] Officer Commanding RAFAT also known as 'Red 1' or 'Team Leader'.

[6] Within the RAFAT there are a number of different call signs; 'The Red Arrows' are the full 9 ship; 'ENID' are Reds 1 to 5; 'Gypo' are Reds 6 to 9; 'Synchro' are Reds 6 and 7.

1.3.12 **Sortie Pre-Accident Events**. After completing his external checks the Pilot climbed into XX177 and strapped-in. At 1103hrs 'Red 1' advised the formation over the Ultra High Frequency (UHF) radio that they would check-in at 1104hrs; the Pilot acknowledged this radio call, which was not normal for RAFAT operations[7]. Following the check-in at 1104hrs the engine start sequence was initiated with the Gas Turbine Starter (GTS), alerting the ground-crew of canopy closure prior to main engine start. The Pilot did not transfer his Miniature Detonating Cord (MDC) pin and Seat Firing Handle (SFH) pin at the expected time, immediately after canopy closure. He was seen to carry out his post start checks with his visor raised and mask lowered and during this time he also reprogrammed his radio with RAF Valley frequencies. Shortly before commencing his 'full and free' control checks the Pilot was prompted by ground-crew, and subsequently moved his MDC and SFH safety pins.

Witness 1
Witness 2
Witness 6
Witness 11
Exhibit 1
Exhibit 16

ACCIDENT SEQUENCE

1.3.13 **Accident Events**. The Pilot commenced the RAFAT Standard Operating Procedure (SOP) 'full and free' control checks; rapidly moving the control column fully forward then anti clockwise through 360° around the extremities of available movement. Simultaneously, full right and left rudder inputs were applied in opposition to full left and right control column inputs, finishing with the control column in a central position. Unusually, immediately following this, the Pilot carried out an additional rapid full aft stick movement before resetting it to the central position. At 1106hrs, some 0.766 seconds after completion of the control check, the XX177 front seat ejection sequence was initiated, see Figure 1.

Exhibit 1
Exhibit 2

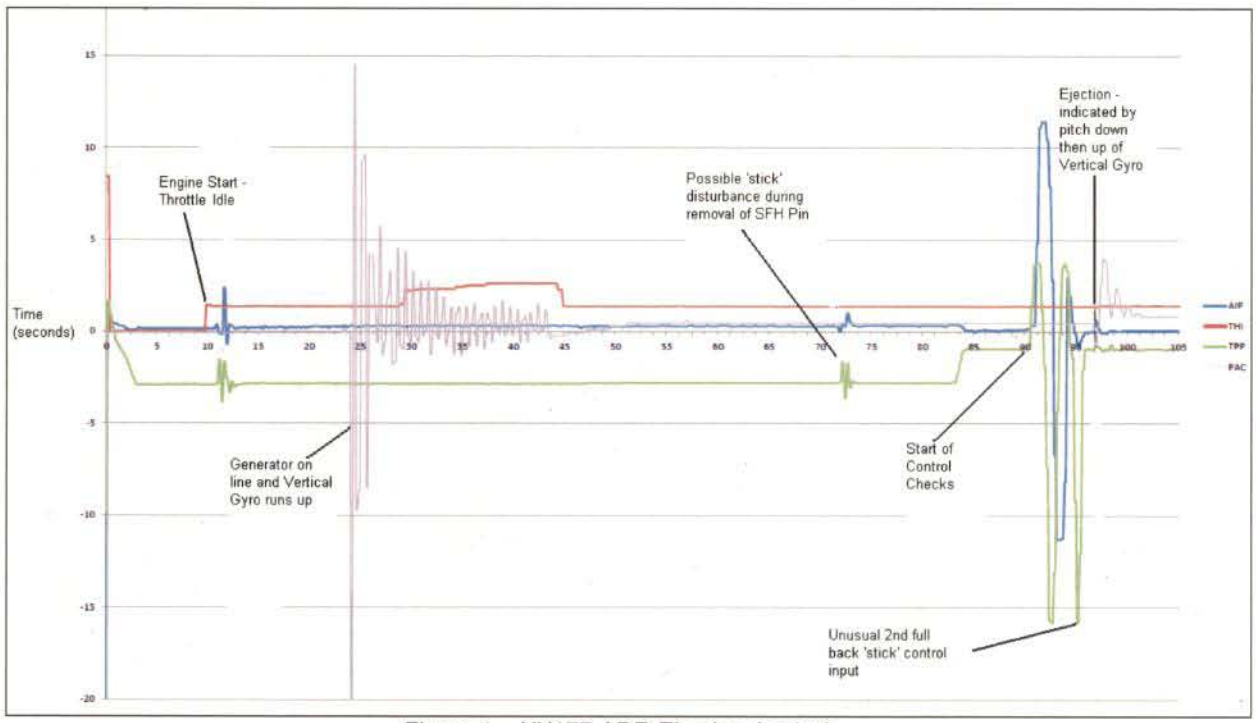

Figure 1 – XX177 ADR Ejection Analysis.

1.3.14 **Ejection**. Following the ejection seat initiation, the ejection seat main gun fired, the MDC shattered and the front seat was ejected from XX177, see Figure 2. The rocket pack fired as the seat cleared the aircraft and the seat started to rotate forwards whilst travelling in a forward and left trajectory from the aircraft. The Barostatic Time Release Unit (BTRU) then fired which deployed the drogue assembly (22 inch and 5 ft drogues), stabilizing the seat, prior to it apexing after 3.2 seconds of flight at approximately 220 ft agl. Having operated as expected for a zero/zero ejection until that point, the drogue shackle then failed to separate

Witness 1
Witness 12
Witness 13
Witness 10
Witness 4
Exhibit 1
Exhibit 2

[7] Information calls to the formation such as this were normally only acknowledged by Red 2.

from the scissor shackle and this prevented main parachute deployment. The Pilot remained attached to the seat as it descended to the ground underneath the drogue assembly. The ejection seat impacted the ground eight seconds after initiation, 30° left of the aircraft having travelled a lateral distance of 66 metres, as shown in Figure 3. Exhibit 14 Exhibit 15

Figure 2 – XX177 post ejection with shattered canopy.

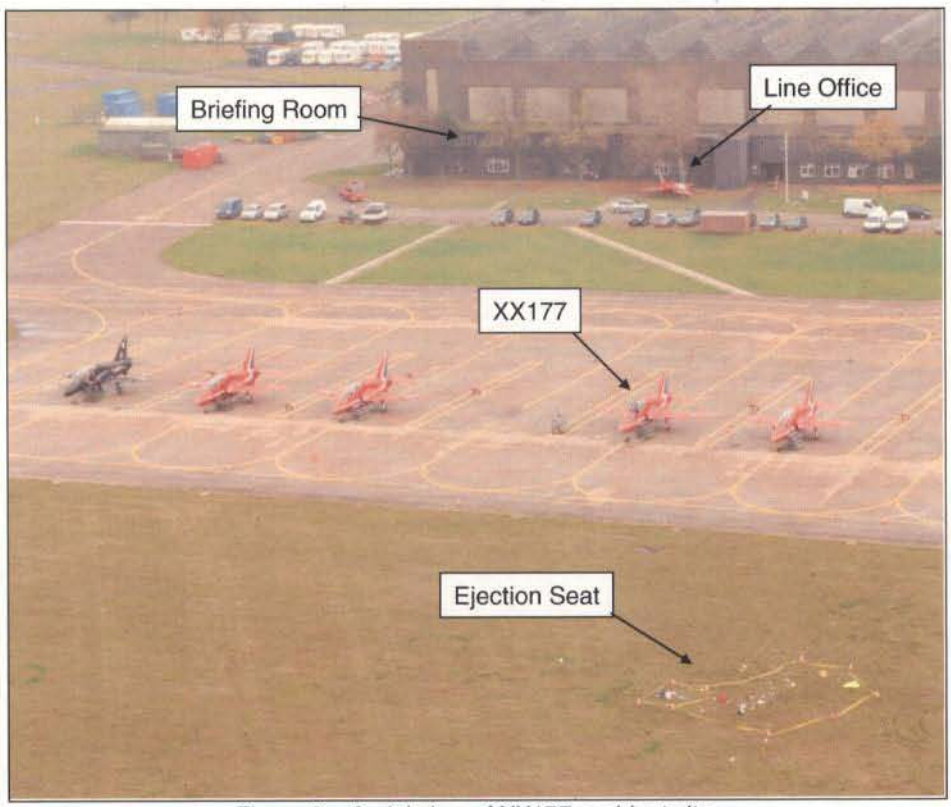

Figure 3 – Aerial view of XX177 accident site.

POST CRASH MANAGEMENT

1.3.15 **Pilot medical care**. First aid was initially administered to the Pilot by RAFAT personnel prior to the arrival of fire rescue and on-base medical staff. The Pilot was separated from the seat by first responders to aid access to the pilot and to remove him and the first aiders from any potential ejection seat ordinance hazards. Civilian paramedics arrived at 1129hrs and the Lincolnshire Air Ambulance was scrambled at 1124hrs, arriving at 1134hrs. The Pilot was transferred to Lincoln General Hospital at 1145hrs, arriving at 1150hrs. Witness 2 Witness 7 Witness 8 Witness 31 Exhibit 16

1.3.16 **Post Incident Drug and Alcohol Testing (PIDAT).** There was no consideration given by either Comdt CFS or the acting RAF Scampton Stn Cdr, as to whether there was a need to conduct PIDAT on any personnel. Witness 21 Witness 27 Exhibit 17

1.3.17 **Control of the accident site**. The initial accident site cordon and Incident Control Point (ICP) were designated by RAF Scampton personnel. RAF Cranwell, who held Aircraft Post Crash Management (APCM) responsibilities, was informed at 1144hrs resulting in a Post Crash Management Incident Officer (PCMIO) being nominated at 1200hrs. He assumed responsibility for the site at 1330hrs before passing control to Lincolnshire Police at 1658hrs. The crash site was cleared and returned to RAFAT at 1528hrs on 11 Nov 11. Witness 21 Witness 27 Exhibit 17 Annex A

1.3.18 **Aircraft and ejection seat**. XX177 was shut down by one of the RAFAT pilots and then remained untouched until it was secured as evidence by Lincolnshire Police within an RAF Scampton hangar on 10 Nov 11. The ejection seat was recovered to Lincolnshire Police HQ on 9 Nov 11. Witness 3 Annex A

DEGREE OF INJURY

1.3.19 The Pilot was pronounced dead at 1210hrs on 8 Nov 11 having sustained multiple injuries that were beyond the range of human tolerance. Two RAFAT engineering personnel suffered minor injuries due to canopy fragmentation, and their proximity to the efflux from the ejection seat rocket pack, with an unspecified number also believed to have taken Trauma Risk Management (TRiM)[8] counselling having witnessed the accident. Witness 10 Witness 26 Witness 48 Exhibit 3 Exhibit 10

AIRCRAFT ESCAPE AND SURVIVAL FACILITIES

1.3.20 The Pilot ejected within the safe ejection envelope of the Martin Baker Type 10B1 Mk 1 ejection seat. The ejection sequence worked correctly up to the point where the drogue shackle assembly should have separated from the scissor shackle allowing main parachute deployment. All other components of the ejection seat and associated systems were found to be serviceable. Annex B Annex C

DAMAGE TO AIRCRAFT, PUBLIC AND CIVILIAN PROPERTY

1.3.21 **Aircraft**. XX177 was assessed as having suffered Category 1 damage as a result of the ejection, with the value of rectification, including engine refurbishment and replacement of the ejection seat, canopy and pilot AEA provisionally estimated at £448,324. Exhibit 4

1.3.22 **Public property**. There was no damage to public property.

1.3.23 **Civilian property**. There was no damage to civilian property.

[8] TRiM is a peer-delivered support system, which is designed to identify various risk factors in service personnel after traumatic incidents.

GLOSSARY

Acronym/ Abbreviation	Explanation
1 Gp	Air Command, 1 Group
2 Gp	Air Command, 2 Group
22(Trg) Gp	Air Command, 22 (Training) Group
AAIB	Air Accident Investigation Branch
AAES	Aircraft Assisted Escape System
ADR	Air Data Recorder
AEA	Aircrew Equipment Assemblies
AES PT	Aircraft Escape Systems Project Team
AESO	Aircraft Engineering Standing Orders
AF Servicing	After Flight Servicing
AGL	Above Ground Level
Air Cdre	Air Commodore
ALARP	As Low As Reasonably Practicable
AOA	Aircraft operating Authority
AOC	Air Officer Commanding
AoR	Area of Responsibility
ASIMS	Air Safety Information Management System
ASMP	Air Safety Management Plan
ASMS	Air Safety Management System
ATC	Air Traffic Control
AVM	Air Vice Marshall
BBMF	Battle of Britain Memorial Flight
BF Servicing	Before Flight Servicing
Break	Break to land manoeuvre
CAE	Chief Air Engineer
CAM	Continuing Airworthiness Manager
CAMO	Continuing Airworthiness Management Organisation
CAR	Corrective Action Requirement
Cat	Category
CBRN	Chemical, Biological, Radiological and Nuclear
Cdr	Commander
CFS	Central Flying School
Crew in	Process of pilot arriving at aircraft including the in cockpit pre-start checks
CT	Continuation Training
CVR	Cockpit Voice Recorder
DAEMS	Defence Aviation Error Management System
DE&S	Defence Equipment and Support
DD	Display Directive
DDH	Delivery Duty Holder
DIO	Defence Infrastructure Organisation
DLoD	Defence Lines of Development
DSAT	Defence Systems Approach to Training
EA	Environmental Agency
EMS	Engineering Management System
ENID	Consists of Red 1 to Red 5
F700	The engineering record for a specific aircraft tail number.
FLO	Family Liaison Officer
Flt Lt	Flight Lieutenant
FRC	Flight Reference Cards
FSCC	Flight Servicing Competency Check
GH	General Handling

~~RESTRICTED – SERVICE INQUIRY~~

Gp	Group
Gp Capt	Group Captain
GPS	Global Positioning System
GYPO	Consists of Red 6 to Red 9
HF	Human Factors
HP	High Pressure
Hrs	Hours
IAM	Institute of Aviation Medicine (now named RAF CAM)
IBA	Internal Business Agreement
IMC	Instrument Meteorological Conditions
IRE	Instrument Rating Examiner
IRT	Instrument Rating Test
JARTS	Joint Aircraft Recovery and Transportation Squadron
JBA	Joint Business Agreement
JEngO	Junior Engineering Officer
JSP	Joint Service Publication
Km	Kilometres
MAA	Military Aviation Authority
Maj	Major
MAOS	Maintenance Approved Organization Scheme
MAP	Maintenance and Airworthiness Processes
Minor Star Servicing	Hawk Servicing conducted every 1200 Flying Hours/6 years
MDC	Miniature Detonating Cord
MilAAIB	Military Air Accident Investigation Branch
MITL	Man In The Loop
Mk	Mark
MOU	Memorandum of Understanding
MPCM	Manual of Post Crash Management
MRP	Military Aviation Authority Regulatory Publications
MOD	Ministry of Defence
NDT	Non-Destructive Testing
OC	Officer Commanding
OCU	Operational Conversion Unit
ODH	Operational Duty Holder
OJT	On The Job Training
OJTIT	On The Job Training Instructor Training
PCM	Post Crash Management
PDA	Public Display Authority
PEC	Personal Equipment Connector
POL	Petrol, Oil, Lubricants
PT	Project Team
QUEST	Quality Engineering Standards and Training
QFI	Qualified Flying Instructor
QPNI	Qualified Pilot Navigation Instructor
QTI	Qualified Tactics Instructor
RA	Regulatory Article
RAF	Royal Air Force
RAFAT	Royal Air Force Aerobatics Team
RAF CAM	Royal Air Force Centre of Aviation Medicine
RR	Risk Register
RTI	Routine Technical Instruction
RtL	Risk to Life
RTS	Release to Service
SAR	Search and Rescue
SEngO	Senior Engineering Officer

SEP	Safety and Environmental Panel
SFH	Seat Firing Handle
SFHP	Seat Firing Handle Pin
SI	Service Inquiry
SME	Subject Matter Expert
SNOW	Serial Number Of Work
SO	Senior Operator
SOP	Standard Operating Procedure
SQEP	Suitably Qualified and Experienced Person
Sqn Ldr	Squadron Leader
STANAG	Standardization Agreement
SUTTO	Start Up Taxi and Take Off
UTI	Urgent Technical Instruction
TOLERABLE	The risk boundaries for Risk of Death per annum must be assessed by the Operational Duty Holder (ODH) and Senior Duty Holder (SDH) to judge the relative RtL from the routine operation of aircraft within their AoR. To be defined as tolerable the risk of death per annum per population at risk must be for 1st and 2nd party ≤ 1 in 1000 and for 3rd party ≤ 1 in 10,000. (RA1210)
TR	Turn Around Servicing
VMC	Visual Meteorological Conditions.
Wg Cdr	Wing Commander