JUDICIARY OF
ENGLAND AND WALES

R (on the prosecution of Her Majesty's Inspectors of Health and Safety)

V

MARTIN BAKER AIRCRAFT LIMITED

SENTENCING REMARKS OF THE HONOURABLE MRS JUSTICE CARR DBE

Introduction

Martin Baker Aircraft Limited ("MBAL") now stands convicted on its guilty plea entered through one of its statutory directors, James Martin, on the first day of trial on a single offence of failing to ensure the safety of non-employees contrary to s. 3(1) and 33(1)(a) of the Health and Safety at Work Act 1974 ("the Act"). The particulars admitted are that MBAL, on and before 8th November 2011, failed to conduct its undertaking in such a way as to ensure, so far as was reasonably practicable, that persons not in its employment who may have been affected thereby, including Flt Lt Sean Cunningham, were not thereby exposed to risks to their health or safety, in particular by non-deployment of the main parachute attached to a Mark 10B ejection seat during low speed or zero-zero ejections.

On 8th November 2011 Flt Lt Sean Cunningham was a pilot in the Royal Air Force Aerobatic Team ("RAFAT"), known as "the Red Arrows", based at RAF Scampton, Lincoln, having passed through a highly competitive selection process. He flew as "Red 5". Whilst preparing to fly for routine training in his stationary aircraft, XX177, on the pan, his seat was inadvertently ejected, something that is a recognised risk. He was thrown some 200 feet in the air. His main parachute failed to deploy. He fell straight to the ground and died very swiftly. Flight Lt Cunningham was a fit and professional trained pilot, aged only 35 years, with a promising future ahead of him. This was, in the words of his father, an entirely preventable tragedy.

The Act and basis of plea

S. 3 of the Act imposes a duty on employers to conduct their business in such a way as to ensure, so far as is reasonably practicable, that non-employees are not thereby exposed to risks to their health or safety. Risk of injury is an ingredient of the offence, but resulting injury is not (though it can be (non-conclusive) evidence of risk). The risk must be a material risk to health and safety, which any reasonable person would appreciate and take steps to guard against, and not merely trivial or fanciful. Thus s. 3 creates absolute criminal liability subject only to the qualification of reasonable practicability.

MBAL's plea was entered on the following basis:

a) MBAL had good systems in place but they were not sufficiently adhered to in regard to dealings with the MoD/RAF in respect of the potential for pinching of the shackle to be caused through the over-tightening of the nut on the shackle in the Mk10B ejection seat;

b) This was an isolated failure (arising following the termination of its involvement in the training of RAF maintenance procedures for the Mk10B ejection seat);

c) The breach occurred in circumstances where there was nothing that put MBAL on notice of the potential for an interference fit (regarding a zero-zero ejection) to arise from an over-tightening of the nut;

d) This isolated failure was not identified and thus, nonetheless, persisted over a long period;

e) The breach was a substantial/significant cause of the tragic death of Flt Lt Cunningham.

The plea went on to state that it was entered on the basis that the following was agreed by the prosecution:

a) MBAL's culpability was "medium" (within the meaning of the Sentencing Council Guideline on Health and Safety Offences ("the Guideline"); and at least lower than the very top of medium culpability;

b) The "risk of harm created by the offence" was a low likelihood of death occurring only in the circumstances of an ejection in zero-zero or low speed conditions;

c) Bearing in mind the resultant death, the final harm category was "Harm Category 2";

d) There are no other aggravating features;

e) MBAL has a good health and safety record, having operated a very high hazard undertaking for very many years without similar previous breach or failure.

I am of course not bound by these matters, which are ultimately for the court.

MBAL's basis of plea is not accepted by the prosecution in all respects. Specifically, the prosecution contends that an aspect of MBAL's design of the ejection seat itself from inception, before and/or after re-design in 1991 exposed persons to a material risk, and that MBAL was on notice of this by virtue of queries raised by McDonnell Aircraft Co ("McDonnell Douglas") (a large US manufacturer) (in 1990) and British Aerospace plc ("BAe") (in 1991). Issues have also been raised in connection with the adequacy of the practices and training of the RAF/MoD after MBAL ceased training RAF/MoD engineers in 1983.

Despite their differences, neither the prosecution nor the defence has invited me to hear factual or expert oral evidence and both have invited me to proceed on the papers alone, alongside submissions. (It is convenient to record here that, due to the passage of time, not all of the relevant papers are now available.) I required the position that the parties did not seek a *Newton* hearing to be confirmed in writing, if that was their position, and after exchange of sentencing submissions. The parties did so. I indicated to them at the outset that in such circumstances there would necessarily be limits to the scope of any findings that I could make (which would have to be on the criminal standard of proof). My focus is to assess questions of culpability, on which there is broad agreement on range, and harm in the round for the purpose of sentencing by reference to MBAL's admitted breach. Issues of design and training might in broad terms inform that assessment but

could not form a hard and fast basis for the ultimate sentence. The RAF/MoD is neither a party nor represented in these proceedings.

The validity of such an approach was accepted by both parties, although the prosecution submits that I can nevertheless be sure (on the papers) to the necessary standard that in 1990/1991 MBAL was on notice of material flaws in its design, and I have proceeded accordingly.

The submissions before me have nevertheless descended into considerable detail, perhaps the consequence of the matter having proceeded effectively to the first day of trial with the parties fully prepared for a 6 week hearing. I received over 100 pages of written submissions and 2 full bundles of dense, often technical, documentation. But I emphasise again that my function is not to conduct a trial of the merits. I could not in any event do so without areas of disagreement being explored fully on the evidence. I expressed concerns during the sentencing hearing about the appropriateness of being taken to only excerpts from statements or reports, without understanding their full context or being told the extent to which their contents were agreed or not agreed.

Finally, by way of introduction, I should record that I have received, either directly or through my clerk, a considerable amount of unsolicited correspondence and material from third parties in relation to this matter. In order to ensure the integrity of the process, I have not read this material but rather passed it on to the parties for them to consider what, if any of it, is necessary or appropriate for me to consider. I have not in fact been invited by them to include any of the material in my deliberations. I also record that, in answer to my enquiry, I was told that there have not been any past, nor are there any ongoing, related civil proceedings.

The facts

MBAL

MBAL's business was and remains the design, manufacture, supply and product support of ejection seats in the main for military jet aircraft. MBAL is a family-owned company founded by Sir James Martin in 1934 originally as an aircraft manufacturer. In 1944 Sir James Martin was invited to devise a means of assisted escape for pilots, resulting in the design of the first Martin-Baker ejection seat, first deployed in 1949. The Martin-Baker ejection seat has been an important and valuable air safety development, designed for use in an emergency, and which has undoubtedly saved many lives over the years. So much is clear from the testimonials and letters that I have read from pilots who have ejected successfully in the past.

MBAL's trade is international, supplying governments and their military air forces. It supplies 92 air forces around the world with ejection seats. MBAL has supplied ejection seats to the Royal Air Force ("RAF")/the Ministry of Defence ("MoD") for many years, including those fitted to all Hawk aircraft in the RAF's fleet.

The Hawk ejection seat

The Hawk is a two-seater "fast jet" used by the RAF mainly to train pilots to fly high-speed military fighter aircraft and in the Red Arrows, who adopted the Hawk in 1979. With its speed and manoeuvrability it is a very good aerobatic aircraft. Each seat in a Hawk is an ejection seat supplied by MBAL ("the Hawk ejection seat"). Between 1976 and 1982 175 Hawks were supplied to the MoD and the RAF currently operates a fleet of 54, the Royal Navy 13.

The two seats are positioned in tandem, with the pilot in front and any passenger behind. The pilot sits on the seat, held in by straps. If it is necessary to abandon the jet, the pilot pulls a handle

situated between the legs, triggering the ejection process. So far as material, what follows is beyond the pilot's control, crudely summarised as follows:

a) An explosive cord is detonated, shattering the perspex canopy above and around the pilot;

b) A gun fires and starts to propel the seat upwards, out of the cockpit, along extending rails;

c) A series of rockets is activated, rapidly taking the entire seat, with the pilot still strapped in, up and out of the aircraft;

d) The pilot becomes separated from the seat, the main parachute will deploy and the pilot returns to the ground, suspended under the main parachute.

The main parachute is packed in a headbox immediately behind the pilot's head and fixed to the ejection seat. There are also two smaller drogue chutes in the headbox. To deploy the main parachute, a drogue weight is fired automatically into the air. It is attached to the smaller of the two drogue chutes, in turn attached to the larger of the two drogue chutes. The larger drogue chute is then attached to the main parachute. As the two drogue chutes deploy, they are inflated and slowed by wind resistance, applying force to deploy the main parachute. The drogue chutes thus pull the main parachute out of the headbox, deploying the main parachute. They need to apply sufficient force to cause the two shackles holding the main parachute to free from one another. If the drogue chutes become disconnected from the main parachute, they just disappear without deploying the main parachute; if the connecting mechanism between the main parachute and the drogue chutes jams, the main parachute will also not be deployed.

If the pilot ejects at a very high altitude, a barostatic timing release unit ("BTRU") responds to the atmospheric pressure by allowing the pilot to descend to about 10,000 feet without the main parachute opening. If there is an ejection below 10,000 feet the BTRU device, referred to before me as "the brain" of the assembly, is triggered after 1.5 second's delay, since the atmospheric pressure is of no consequence, and the ejection seat mechanisms function rapidly.

In a zero-zero ejection, which as already indicated can be triggered inadvertently, the pilot and seat are propelled over 200 ft upwards in the air, sufficient for the main parachute to deploy and bring the pilot safely to the ground. The ejection seat mechanism works in exactly the same way. However, at a low speed, as in a zero-zero ejection, the drogue chutes are caught by much lower wind resistance, and so exert much less force to free the two shackles holding the main parachute.

The shackle assembly consists of these two shackles:

a) The drogue shackle, fastened by a nut and bolt, connecting the lines to the main parachute and the drogue chute. It is a horseshoe shape with two lugs, each with an unthreaded bore. The shackle is put through two strops which hold the cords to both the drogue and main parachutes together. A bolt is passed through the bores in the shackle's lugs and secured by a nut. The drogue and main parachutes are then connected together;

b) The scissor shackle holds the drogue shackle in place in the head box. It is permanently bolted to the back of the ejection seat, even during ejection. In the early stages of ejection it holds the drogue shackle in place, preventing the main parachute deploying out of the head box too early. Then the force of the drogue chutes pulls the scissor shackle from a horizontal into a vertical position, acting as a hinge. The scissor opens, the two shackles separate as the outer ends of the lugs of the drogue shackle pass over the scissor shackle. The main parachute is then released. The force of the drogue chutes pulls it out and it deploys. If the two shackles do not separate,

the drogue shackle remains held to the ejection seat by the scissor shackle and the parachute is not released and cannot deploy. The end of the drogue shackle lugs have to pass over the scissor shackle which cannot happen if the two shackles jam together.

This design is now an "old" design. Since about 1984 MBAL has not designed any new seats with a mechanical scissor shackle. Rather it uses an improved gas-release shackle system, available for new aircraft and also for retro-fitting. The MoD contracted MBAL to carry out such retro-fitting on all in-service ejection seats, with the exception of the seats in the Hawk aircraft.

8th November 2011

On Friday 21st October 2011 one of the Red Arrows' Hawks, XX177, was due for a routine inspection to ensure that there was no cracking to part of the ejection seat block assembly. This was an exercise that was, since 15 months previously, to be carried out after every 50 flying hours. For this purpose it was necessary to swivel the scissor shackle into a vertical position, disconnecting the two shackles and then reconnecting them. Two RAF ground crew, that is to say engineering technicians, carried out the work that day. Following the inspection, and non-destructive testing, the shackles were reconnected on Monday, 24th October 2011. During the reconnection, one of the technicians tightened the nut onto the bolt of the drogue shackle to 1.5 threads. There was no instruction to the engineer to the contrary. That work was carried out in cramped conditions. Whilst it was possible, to a limited degree, to check whether there was free movement between the shackles, it was not possible to check whether the scissor shackle could be released.

On 8th November 2011 five Red Arrow pilots, including Flight Lt Cunningham, were due to undertake a routine training flight. Flying conditions in Scampton were not suitable and it was decided that the pilots should fly to RAF Valley, Anglesey, to carry out their training. Flt Lt Cunningham was flying XX177. At around 11am each pilot was in his aircraft, with engines running but stationary on the pan. Flight Lt Cunningham was heard and seen to eject, following an inadvertent ejection, being propelled strapped into his ejection seat into the air. Whilst the two drogue chutes deployed and inflated correctly, they failed to deploy the main parachute because of an interference fit between the drogue and scissor shackles causing them to jam. Flight Lt Cunningham fell to the ground without a parachute to slow his descent and sadly died.

Subsequent investigations revealed that after the nut had been tightened onto the bolt on 24th October 2011, the width of the scissor shackle was wider than the gap between the outer ends of the lugs on the drogue shackle, leading to an interference fit impeding the shackles' separation. Only the force created by the drogue chutes in an ejection at 50 knots or more would have been sufficient to clear the interference fit. The lugs were not parallel, having tapered. The drogue shackle had been tightened with sufficient force to bend the drogue shackle bolt and cut new thread on the bolt. The interference fit would not have been detectable by the ground crew. Later testing, led by Lt Cdr Hamilton, demonstrated that the current method of installing and tightening the nut and bolt on the drogue shackle introduced a hazard that could prevent its release, resulting in failure of the main parachute to deploy.

Since 1959 there have been 24 zero-zero successful ejections across all platforms, 16 of which involved the identical shackles. There was also a successful test in 1995 of a zero-zero ejection using the same assembly. The incident in November 2011 was the only such ejection where the main parachute did not deploy. Following the incident, the RAF/MoD requested that a shoulder bolt be used by way of design modification. The same modification has been offered by MBAL to, but declined by, all other organisations around the world still using the same mechanism.

Victim personal statements

Ms Nicolette Cunningham, Flight Lt Cunningham's elder sister, has spoken for the Cunningham family who have attended court throughout the sentencing hearing, and to represent her late brother. Flight Lt Cunningham's interest in flying started when he was a teenager and he gained his private pilot's licence at the age of 17, having saved up to pay for his lessons. His first love was to fly. He joined the RAF in 2000, graduating in September that year. After a period in Australia he was selected as a fast jet pilot. By 2002 he was training to fly the Hawk aircraft, becoming an instructor on the Hawk aircraft in 2003. In due course he was selected to join the Red Arrows at RAF Scampton, which he did in August 2010. He was excited at the next few years ahead as a Red Arrows pilot, training new pilots and planning new aerobatic manoeuvres. It is clear from the witness statements of other Red Arrows pilots how very popular and respected he was.

Flight Lt Cunningham loved life and lived it to the full. As well as being academic, he excelled in athletics and football. He was successful in his finances and popular with all with his fun and easy-going nature. The family was overwhelmed by the hundreds of cards, letters and messages from friend and colleagues who testify to the huge impact that he had on so many people. His biggest fears in life were being ejected from an aircraft, with the injuries that could be sustained, and dying at young age. Horrifically, he was to experience both. He was the perfect son and brother and the family's pride in him is justifiably immense. Today's further victim personal statement shows how raw and painful the family's grief remains, describing their 6 years of hell and all that they have lost for the future.

Against all of the above, I turn to the framework of the sentencing exercise itself.

Culpability

Given the issues that have arisen on culpability, I address it as a separate issue at the outset.

MBAL admits that in about 1990 it should have introduced a written warning to RAF engineers to guard against overtightening the drogue shackle nut, similar to that introduced into the manuals provided to Egypt, India, Pakistan, Finland and Italy as follows:

> "*WARNING*
>
> *TO PREVENT POSSIBLE PINCHING OF THE SCISSOR SHACKLE, WHICH MAY CAUSE HANG-UP OF THE DROGUE SHACKLE DURING EJECTION, DO NOT OVERTIGHTEN OR TORQUE LOAD THE DROGUE SHACKLE NUT AND BOLT.*"

The post-incident incident warning reads as follows:

> "*WARNING*
>
> *TO PREVENT POSSIBLE BINDING OF THE SCISSOR SHACKLE, DO NOT OVERTIGHTEN OR TORQUE LOAD THE DROGUE SHACKLE LOCKNUT AND BOLT.*
>
> *NOTE*
>
> *Flush is assumed as full thread engagement with the domed end of the bolt protruding….Remove the nut and bolt from the drogue shackle…..Locate the drogue shackle over the closed jaws of the scissor shackle, pass the bolt up through the drogue and scissor shackles and secure with a self locking nut ensuring that the bolt is flush with the end of the locknut. No torque loading is to be applied to the nut and bolt. The nut is to be uppermost*

when the scissor shackle is rotated forward. Make sure the drogue shackle and nut/bolt assembly is free to rotate within the scissor shackle."

This admitted breach arises out of the fact that in early (probably February) 1990 Mr Alan Lowther of MBAL wrote a note (on a MBAL compliments slip) to Mr Mackie in the Quality Assurance department as follows :

"*…..F18 Info as requested.*

We are going to put similar info into our pubs, ie similar illustration to attached and necessary instructions but <u>no</u> dimension for clearance, only that there there should be clearance and scissor shackle should not be pinched.

Alan Lowther

<u>NO</u> TORQUE LOADING[1]."

Thus, by this time at the latest, MBAL was aware that it needed to issue a warning in its publications relating to clearance and warning against pinching of the scissor shackle. There should have been a warning to guard technicians against overtightening the drogue shackle locknut. For reasons which are not explained, this never happened, at least so far as the MoD/RAF were concerned.

By this breach MBAL exposed each RAF pilot (and any passenger) flying a Hawk to a material risk, namely that if the pilot was ejected from a Hawk in zero-zero or low speed conditions, the two shackles might not release from one another. Rather they could jam together because of an interference fit. As a result, the main parachute would not deploy and open. The pilot would be several hundred feet in the air, with no main parachute to slow his descent. The result would be death. The risk was present whenever the Hawk was on the ground (zero-zero) or travelling at low speed (up to about 50 knots or 57mph) whilst taxi-ing, during a take-off run or whilst slowing down after touchdown. The importance of a properly functioning parachute in such circumstances is obvious. The absence of such a parachute was a substantial cause of Flt Lt Cunningham's death.

The prosecution case, however, goes beyond this admitted breach. It criticises MBAL's design from inception. The equipment specification for the ejection seat from inception in 1971, both in terms of design and performance, recorded expressly the requirement that it should provide safe escape in all flight cases including zero-zero conditions and perform under all altitudes. The prosecution asserts that there were flaws in design because there was no physical control of the gap between the drogue shackle lugs, even though such control was reasonably practicable. That material risk was not removed by MBAL's redesign in 1991.

The practical effect of an interference fit depends on two factors : how much wider the scissor shackle is than the gap between the drogue shackle lugs and the speed, if any, of the aircraft. The greater the interference fit and the lower the speed, the greater the risk that the two shackles will not separate. The engineering technician, working in a confined space within the headbox, cannot ascertain whether, at the last stage of the movement of the shackles, there is an interference fit or not.

[1] It appears possible from the handwriting layout on the document that the reference to no torque loading was added subsequently following a telephone conversation involving Mr Lowther on 21st February 1990.

The bolt, designed by MBAL, has a hexagonal head. The shank nearest the head is unthreaded and passes through the two smooth bores on the drogue shackle lugs. The other end of the bolt is threaded in a spiral, with 24 threads to each inch. The nut is a standard nut, specified by MBAL. There is an internal thread matching the external thread at the end of the bolt. The bolt is tightened onto the nut. It must be sufficiently tight so that it does not come off, even in high speed aerobatic manoeuvres, but not so tight that the separation of the two shackles is impeded or prevented.

The prosecution contends that MBAL failed to produce an assembly drawing showing the components fitted together, only separate drawings for each component. Thus the risk of an interference fit was not identified and the effect on the shackle dimensions once the nut and bolt were fitted was not shown. In fact, as the nut is fastened onto the bolt, the two lugs of the drogue shackle are drawn together, reducing the gap between them and causing them to taper towards each other. This happens even if the nut is tightened only to full thread engagement. But if the nut is tightened further to 1.5 thread protrusion, both compression and tapering increase significantly. That degree of tightening is a general military engineering standard tightening, in the absence of alternative instruction. DEF STAN 0-970 (ch 400 vol 2) ("DEF STAN 970") provides:

> "*7.8 In all cases where the method of locking…does not demand more, the end of the bolt…shall protrude beyond the nut by a dimension equal to at least 1.5 thread pitches."*

The prosecution contends that MBAL never appreciated the recipe for disaster if there was standard tightening to 1.5 threads, the narrowest lug gap and the widest scissor shackle. This was an obvious risk, not dependent on the application of hindsight. It relies on the expert opinions of Mr Butter, HM Inspector, and Mr Rudland, a health and safety specialist inspector in the field of mechanical engineering, who state that the design of the drogue/scissor shackle assembly was poor. It was reasonably practicable to design out any risk of an interference fit. The possibility of human error, which there was not in any event here, could have been designed out with a) a shouldered bolt or b) a metal sleeve over the bolt or c) specification of a minimum clearance or d) a correct warning.

The prosecution then contends that MBAL was put on notice of the risk of an interference fit and potential jamming of the shackles in 1990 (by McDonnell Douglas) and 1991 (by BAe).

McDonnell Douglas is a major US military aircraft manufacturer and defence contractor, manufacturing the F18 military aircraft, fitted with MBAL ejection seats. In early January 1990 Mr Antol of McDonnell Douglas sent a facsimile to Mr Thompson of MBAL enclosing two pages from its manual workpage (which specified that a minimum of 1 bolt thread needed to be exposed):

> "*As I indicated over the phone, the concern is with the torque callout of 60-85pounds, the clearance of 0.030 inch cannot be met, and this may prevent the main chute from deploying. We are asking concurrence from MBA in writing to delete the torque call out and work to the requirements of a minimum one thread showing above locknut; and (2) minimum 0.030 thou clearance"*

Mr Thompson noted on the facsimile that it should be copied to Neil Mackie (of MBAL's Quality Assurance Department) and stated:

> "*I'm very concerned with the implications made by McAir. Please advise."*

An internal communication within MBAL (from Mr Daw to Mr Petty) dated 15th January 1990 commented:

"*We have not experienced problem, therefore have not addressed same….there may be a problem on our seats supplied with our own publications….perhaps specific measurements could cause problems – a check for freedom of movement might be more appropriate."*

A follow-up letter from Mr Petty the next day stated:

"*..Our own inhouse and customer instructions are merely to fit the nut and bolt, normally nut upwards. We cannot find any reference or intention regarding torque or clearances.*

It is presumed that commonsense is used when fitting the shackle. However, this presumes that the fitter is aware of the necessity for a "slack" fit and the consequences (particularly in a zero/zero ejection) of shackle binding.

Examination here has shown that excess force, when tightening the nut and bolt, can cause a squeezing of the U shackle, sufficient to cause it to pinch o[n] the scissor shackle. …..we intend to examine the tolerances on all seats to highlight this problem. The solution will depend on the outcome of the investigation. We shall probably recommend a clearance check but not a specific measurement, probably ensuring that shackles can rotate slightly after the nut/bolt is tightened…"

On 20th February 1990 MBAL concurred with McDonnell Douglas working to a minimum of 0.030 inch clearance and one thread showing above locknut.

There is no evidence as to what was done by way of investigation. The prosecution contends that there was a failure on the part of MBAL to get to grips with the problem raised despite being on notice that the main parachute might be prevented from deploying.

In June 1991 BAe contacted Mr Neil Mackie of MBAL with a query relating to its Tornado aircrafts:

"*As agreed please find below the measurements recorded from our examination of available bolts at bar:….*

We have found that it is impossible to achieve the normal 1 ½ threads or 0.070" protrusion through the self-locking nut, even when pinching the shackle. On checking protrusion on 3 bolts it varied from 0.026" to 0.034". Defect report will follow but in advance of formal response will you please advise on the acceptability of this situation for continued use in service."

MBAL responded by stating that the current situation was acceptable provided that the drogue shackle did not pinch the scissor shackle when assembled to seat. The prosecution states that this did not cure the problem of an interference fit. It also points to the fact that MBAL did not take issue with the reference to 1 ½ threads being "normal", repeated by BAe in its subsequent defect report. By then MBAL had raised a task request to its design/drawing office seeking advice and suggested modifications to control maximum and minimum clamping dimensions more closely. It referred to the locknuts expanding in height when secured to a bolt/stud. This effectively reduced slightly the clearance between the drogue and scissor shackles. MBAL's solution – noted as a "*compromise only"* was to increase the minimum length of the bolt and control the overall width of the drogue shackle by reducing the width of the lugs. The prosecution contends that, again, MBAL had failed properly to grapple with the problem, in particular failing to appreciate that, even after the bolt was lengthened slightly, an interference fit might still occur.

At various dates between October 1990 and July 1992 MBAL issued amendments to its manuals in the form set out above, sending them to Pakistan, India, Finland, Egypt and Italy. In fact those amendments were incorrect in part, in that they referred to the need to ensure that 1 to 1 ½ bolt threads protruded. Amendments were not sent out to all affected customers, including the RAF/MoD. There was no general circular issued, nor did the warnings identify in terms that the risk was of the main parachute failing to deploy (as opposed to a risk of hang-up).

For these reasons, in summary, the prosecution submits that I should find that MBAL's culpability falls towards the upper end of the category of medium culpability.

I am unable to accept the prosecution case for sentencing purposes as high as it is put. At the outset, MBAL's conduct is not to be judged with the benefit of hindsight and rather by reference to the standards of the day (see for example the comments of Hughes LJ (as he then was) in *R v Tangerine Confectionary Ltd* [2011] EWCA Crim (at [33]). I also accept the defence proposition that MBAL's failures need to be put in context.

As for the original design of the shackle assemble, it was designed in 1949. The prosecution experts, on the material before me, have not addressed its adequacy explicitly by reference to standards in those (pre-Act) days. The prosecution states that there was no material difference, since essentially it is a question of a risk which was always there. The prosecution evidence is not accepted by the defence and has not been tested before me. But I cannot accept without more that there were not differences at least in terms of design awareness and thinking, and engineering and technological skills. The defence throws credible doubt on the suggestion that MBAL ought to have produced an assembly drawing. Each individual element was designed taking into account adverse tolerances, in the absence of a "CAD" computerised design system. I cannot dismiss to the necessary standard the submission that assembly drawings would not have assisted or illuminated the risk of interference fit.

The defence states that the prosecution accepts that there was no risk of interference fit if the locknut was secured to flush but challenges the proposition that MBAL always intended the locknut to be secured to flush (as part of the design), as MBAL says it did. The prosecution points to DEF STAN 970 and the warnings given by MBAL in various foreign manuals where MBAL referred to clearance of "1-1.5 threads", which MBAL says was an unexplained error. It points to MBAL's failure to respond to the McDonnell Douglas and BAe correspondence by challenging the references to such clearance. It points to the MBAL communication of 16th January 1990 which stated that no reference or intention regarding torques or clearances could be found.

The defence says that the DEF STAN 970 is a general rule-of-thumb standard which would obviously need to be modified if necessary on a case-by-case basis (as would be needed here.) Reliance is placed on the fact that it refers not just to 1.5 thread – but to "*at least"* 1.5 thread – demonstrating that it cannot have been meant to apply to the present situation. MBAL's directors state that it never occurred to MBAL that a locknut would be tightened to such an extent that it could result in an interference fit that prevented deployment of the main parachute in zero-zero or slow-moving conditions. There had never been any report of an interference fit.

I cannot be sure that MBAL did not always intend the locknut to be secured to flush and design on that basis. I refer in particular to MBAL's redesign in 1991. The amendments, approved internally in August 1991, resulted in the locking mechanism being fully engaged even in an adverse tolerance situation. They were made so as to increase the length of the bolt by 0.005"and to reduce the overall width of the shackle by 0.012". This, supported by a design/drawing office request no. 2698, points

strongly towards MBAL having the intention that the locknut would be secured to flush, since the amendments were designed to achieve that. In addition, there are the statements of Messrs Thomas and Gaunt, and the expert evidence of Dr Jones, who concludes that in his opinion there was no design intention for 1.5 bolt thread turns to protrude beyond the locknut face. There is also evidence that (since at least 2007) engineers at RAF Lossiemouth and RAF Coningsby have tightened the threaded fasteners used with the drogue shackle to flush (despite the absence of any express instructions to do so). The prosecution points to the fact that these were gas-operated shackles with a different release mechanism; the defence says that the parts are nevertheless identical, albeit that the risk is only of the bolt coming undone. On any view, this experience undermines the prosecution's case that the standard of 1.5 thread is applied universally in the absence of instruction to the contrary.

As to what MBAL was entitled to expect in terms of the installation, operation and maintenance of the ejection seat, the design and manufacture were founded on the premise that the specification requirements applied to equipment which had been correctly installed and serviced (as evidenced in contractual correspondence in 1972). It appears to be recognised that an engineer is expected to use his/her training to interpret instructions in Air Publications. As Mr Lowe, head of engineering and the subject matter expert for the ejection seat, has commented, MoD Air publications assume a level of engineering competency. MBAL contends that the application of professional common-sense should have prevented tightening to 1.5 thread protruberance and it was entitled to proceed on the basis that that is how the maintenance would be carried out. MBAL submits that it reasonably relied on the application of "common sense", considered to be "*the first line of defence"* underpinning the establishment of a questioning and learning culture (see Regulatory Article 1020 at [6]). In internal correspondence, in the context of the McDonnell Douglas correspondence, MBAL stated that it was presuming that "common sense" was used when fitting the shackle.

There is evidence that here "*abnormal"* force was applied at the time (see pp. 7 and 8 of the discussion by Dr Raistrick, chief of aviation services and a prosecution expert). New thread had been cut on the plain shank of the bolt close to the unthreaded portion. The presence of 2 scores indicated that a nut had either been fitted twice or backed off and re-tightened, with the faces of the bolt's threads undergoing adhesive wear. Dr Jones, the defence expert, comments that an applied torque of roughly 30 to 40 Nm would normally be required to cut some new thread onto a bolt while simultaneously clamping a drogue shackle onto a scissor body. Assuming an applied torque of 30Nm, that would have been 27% more than the 23.7Nm upper limit defined in AP119A-0428-1 for this size of locknut. (According to JAP 100A-01, AP 119A-0428-1 sets out the detailed requirement for aircraft tradesmen to carry out specific checks when installing or re-installing self-locking fasteners.)

There is in this context a dispute as to how MBAL provided its training up to 1983. The prosecution contends that MBAL did not train that the nut should only be tightened to flush. All that I can say on the material before me is that it is possible that MBAL's understanding was that the requirement for a shackle to retain mobility was viewed as obvious by those RAF personnel who attended MBAL's training and that it is possible that there was training by MBAL to the effect that the nut should only be tightened to flush (see for example the statements of Messrs Thomas and Gaunt).

MBAL raises issues relating to the quality of the training of RAF/MoD engineers on the Hawk at RAFAT after 1983. Reference is made to various statements, in particular one from Martin Lowe, head of engineering for aircraft assisted escape systems for Defence Equipment and Support, a branch of the MoD, who describes the lack of formalised or structured training packages. There are

statements from former and current RAFAT engineers suggesting that the training was "on the job". Reference is made to a MoD quality audit report from January 2011 referring to RAFAT technicians being "*left out on a limb"*. I make no findings in this regard, save to accept that there is no evidence that MBAL was ever on notice at any material time of any shortcoming in training standards at RAFAT. The prosecution points to the fact that any failures in training did not contribute to the incident on 8th November 2011. However, the defence relies on the issue not as a contributory factor, but rather as the context in which to assess MBAL's conduct in terms of design and warnings.

As for the correspondence with McDonnell Douglas and BAe, MBAL states that it did not relate to the risk of interference fit but, at worst, to the risk of a "hang-up" (a recognised risk of a momentary delay in the release of the mechanical drogue shackle as it aligns during the ejection process). The McDonnell Douglas correspondence, rather than relating to the inherent risk of clamping as a result of the drogue shackle's design, requested MBAL's concurrence to the US Navy's removal of its own requirement when servicing F-18 seats to torque load the locknut to 60-85 inch-pounds because it was not meeting its own requirement for 0.030" clearance. The US Navy does not carry out onplane servicing. For every nut and bolt it has a separate torque requirement. The correspondence was not viewed as a concern as to the main parachute not deploying because of the shackle's design. It was seen in the context of the torque requirements and clearance checks specifically belonging to the US Navy. The risk of "*non-deployment*" referred to correlates to the US Navy's requirement to torque-load the locknut, which did not originate from MBAL or apply to the RAF.

As for the BAe correspondence, MBAL states that this related to a different problem, namely to a single bolt. It did not highlight the risk of an interference fit, but rather stated that the 0.070" protrusion could not be achieved even when pinching the shackle. MBAL investigated and responded that the levels of thread protrusion were acceptable. The investigation also revealed that the locking section of the locknut could fail to engage completely by 0.017", which is what led to the re-design referred to above. In August 1991 the MoD's on-site quality controller, Mr Barry Cowell, signed a Suppliers Investigation and Quality Report, confirming that he was satisfied that the outcome to the BAe enquiry had been achieved in accordance with the correct procedures.

There is force in the prosecution submissions on this 1990/1991 correspondence. Even on a narrow basis, being put on notice that torque-loading the locknut could create a risk of pinching can be said to have put MBAL reasonably on notice of the risk of impediment or failure in deployment of the main parachute through excessive tightening more generally. The communication of 16th January 1990 in the context of the McDonnell Douglas correspondence is particularly striking : there is express reference to the need for an awareness that the fit must be slack and refers to the particular risks of shackle binding in a zero-zero ejection. The 1990 correspondence on any view appears to have triggered an internal safety review of the shackle assembly more generally, given Mr Lowther's subsequent note to the Quality Assurance Department.

But, as I have noted, MBAL takes strong issue with the prosecution's interpretations and states that it did not understand or ignore the implications of the correspondence in the manner suggested.

Ultimately, resolution of the debate would not advance matters materially for my sentencing purposes, even had I been able to resolve it on the criminal standard of proof (which I have not been). First, as MBAL itself points out, it did not need to be put on notice of the risk of over-tightening. That was a matter of common sense. Secondly, at around the very same time – early 1990 – MBAL in any event identified the need for better warnings. This is the basis of its guilty plea.

In this sense, it is common ground that it was on notice by this stage of the need for more action, which it failed to implement.

I therefore proceed when assessing culpability on the basis of MBAL's admitted breach in 1990 and thereafter in failing to give proper written warning to the RAF/MoD, as set out above, the giving of which was clearly reasonably practicable. That breach should be seen in broad context, including that it was committed in circumstances where MBAL was nevertheless entitled to expect the application of common sense by properly trained RAFAT engineers when fitting and servicing the shackle assembly in question.

Sentencing Council Guideline and authority

I have regard to the Guideline, considering the very recent authoritative guidance of the Court of Appeal in *Whirlpool UK Appliances Limited v R (on the prosecution of Her Majesty's Inspectors of Health and Safety)* [2017] EWCA Crim 2186. There reference was made to *R v Thames Water Utilities Ltd* [2015] EWCA Crim 960 where the principles governing the sentencing of very large organisations run for profit set out in *R v Sellafield Ltd* [2014] EWCA Crim 49 (at [3]) were adopted. The Court in *Whirlpool* addressed in particular the correct approach to sentencing large and very large organisations, and the relevance of the offender's financial circumstances. The decision in *Whirlpool* makes it clear that no two health and safety cases are the same. There is inherent flexibility in the Guideline, which is not a straitjacket. The Guideline provides for very substantial financial penalties in appropriate cases, particularly when the offender is a large or very large organisation. Yet it is "*subtle enough*" to recognise that culpability, likelihood of harm and harm itself should be properly reflected in any fine, as well as turnover (see [42]). I have also taken into account the comments of the Court of Appeal in *R v John Henry & Sons Ltd* [2018] EWCA Crim 30.

Step 1: Offence category: culpability and harm

There are features of high culpability offending including breach over a long period of time. The breach persisted from the 1990s onwards through to November 2011. It was not an "isolated" breach in this sense.

I conclude, however, overall, that MBAL's admitted breach falls into the category of medium culpability offending. MBAL fell short of the appropriate standard in a manner falling between the descriptions in "high" and "low" culpability categories. Within that category, I place MBAL's culpability in the middle of the medium culpability range. In reaching this decision, I bear in mind the full context of MBAL's conduct, as set out above. But MBAL's failure was a serious one. I take into account in particular the following:

a) The length of time over which the breach occurred, spanning decades;

b) The informal manner in which such an important instruction as that of Mr Lowther in February 1990 was issued within MBAL – a manuscript note on a MBAL "compliments slip". It is perhaps not surprising that the instruction was not given the attention that it deserved and did not lead to the action that it required. Even taking into account the standards that may have prevailed at the time, this was not a reliable way of proceeding, as proved by the subsequent lack of implementation. I have not been taken to any evidence of any system or review within MBAL that should have ensured follow-up;

c) The wider evidence of inaccuracy/failing within MBAL on this matter, namely the inaccurate instructions in the amendments distributed in some of MBAL's foreign manuals to others,

referring to clearance of "1-1.5 threads". This again suggests a lack of attention within MBAL to the detail and significance of the issue;

d) The fact that MBAL's updated warnings between October 1990 and July 1992 were distributed inconsistently, both in terms of timing and destination. Thus, it was not only the RAF/MoD that was not sent the updated warning.

As for harm, the offence is in creating a risk of harm. The assessment of harm requires a consideration of both the seriousness of the harm risked by the breach and the likelihood of that harm arising. Here the risk was of the highest level A (death) but the likelihood of such harm arising was low, because the only circumstance under which harm was likely was the uncommon instance of a zero-zero or low speed ejection. Post-incident "Duty Holder Advice" to Hawk TMK 1 Duty Holders by the MoD estimated the risk of inadvertent ejection as occurring once in every 115 years. Thus this was, on initial categorisation, harm category 3.

In assigning the final harm category, I consider whether the offence exposed a number of workers or members of the public to harm and whether the offence was a significant cause of actual harm, namely one which more than minimally, negligibly or trivially contributed to the outcome. These are factors to be considered in the round in assigning the final harm category. If one or both of these factors apply, the court must consider either moving up a harm category or substantially moving up within the category range.

Both factors apply:

a) A significant number of pilots (and also potential passengers) were exposed to the risk of harm over a very lengthy period;

b) The offence was a significant cause of actual harm. The fact of death is highly relevant and without more would justify moving the harm category up to category 2. As was stated in *Whirlpool* at [30] and [31], such an event alone justifies a very significant elevation in categorisation, although I accept the defence submission that it does not justify an automatic lift to the top of the category.

The Guideline enjoins me to consider the extent to which other factors contributed to the harm. MBAL does not suggest that there are any relevant factors to consider in this context. The question of RAF/MoD training is only relied upon to inform the assessment of MBAL's level of culpability, as set out above.

In circumstances where a significant number of pilots (and passengers) were exposed for many years and MBAL's breach was a significant cause of death, I am quite satisfied that the correct final categorisation of harm is category 2, and towards the upper end.

<u>Step 2: Starting point and category range</u>

For a "large" organisation, defined as an organisation with turnover or equivalent of £50million and over, the starting point for medium culpability and harm category 2 is £600,000 with a range of £300,000 to £1.5m.

There is no definition of what is to be treated as a "very large organisation" for the purpose of the Guideline. In *R v Thames Water Utilities Ltd* (supra) the Court saw no advantage in any particular definition, for example by reference to turnover exceeding £150million per year.

Here, MBAL's 2017 turnover was over £216million and in 2016 over £222million, over 4 times the starting threshold for a "large" organisation. Its profit before taxation in 2017 was £47million and in 2016 over £60million. Directors' emoluments totalled £1.1million in 2017. MBAL's report and financial statements for 2017 indicate a confidence in what is a geographically diverse operation.

In my judgment, despite the fact that MBAL's turnover significantly exceeds £50million, MBAL can properly be treated as a "large" organisation for the purpose of the Guideline. The Guideline expressly contemplates a "large" organisation having turnover beyond £50million, indeed "greatly" beyond. However, I consider it appropriate to rise within the category range to take account of the fact that MBAL's turnover is so significantly "over" £50million (albeit not on any strict mathematical or extrapolated basis). I also consider it appropriate to rise within the category range to take account of the level of actual harm as identified above. On this basis I reach a figure beyond the starting point of £600,000 of **£1.45million**.

There are no aggravating factors. By way of mitigation,:

a) MBAL is a highly respected and respectable family company. Its work has saved thousands of lives over the years. In 1997 Mr James Martin was awarded a CBE for services to the defence industry;

b) MBAL has a good health and safety record. It has one previous conviction arising out of a quite different type of activity. It pleaded guilty in 2016 to breach of s. 2 of the Act and reg. 6(1) of the Control of Substances Hazardous to Health Regulations 2002. These offences related to the exposure of up to 65 employees to mists from metal working fluids. 4 employees were injured, 3 suffering a serious respiratory condition, 2 being rendered substantially disabled, and 1 suffering dermatitis. On the basis of high culpability and harm category 2, MBAL was fined £800,000 (after discount for guilty plea);

c) MBAL has expressed genuine remorse and regret, with full apology to the Cunningham family;

d) There is no suggestion that MBAL has not co-operated fully with the health and safety authorities and investigation. There is no suggestion that it has responded deficiently to its customers in any way following the incident in November 2011.

Taking all these factors into account, I make a downwards adjustment for the available mitigation to reach a figure of **£1.25million** before turning to step 3.

<u>Step 3: proportionality to MBAL's overall means</u>

I remind myself then whether the proposed fine based on turnover is proportionate to MBAL's overall means, taking into account s. 164 of the Criminal Justice Act 2003 which requires that the fine must reflect the seriousness of the offence and that the court must take into account the financial circumstances of the offender. The level of fine should reflect the extent to which the offender fell below the required standard. It must be sufficiently substantial to have a real economic impact which will bring home to both management and shareholders the need to comply with health and safety legislation. The profitability of an organisation will be relevant.

I have referred to MBAL's turnover, profitability and directors' emoluments above. In addition, MBAL paid dividends of £32million in 2017, and £40million in 2016 to MBAL's holding company, Killinchy Aerospace Holdings Ltd ("Killinchy") in which each of MBAL's directors was a shareholder. This was some 80% of profits in 2017. The holding company then distributed dividends from its

group turnover, over 90% of which derived from MBAL. In 2017 shareholders in the holding company were paid dividends totalling over £51million in 2017 and over £41million in 2016. 13 individual shareholders each received over £1million in dividend. MBAL's directors in total received dividends of £20.8million in 2017.

The defence submits that I should ignore this wider financial position and limit myself to a consideration of MBAL's position alone. In my judgment the "economic reality" here for sentencing purposes (see [40] of *Whirlpool*) must take into account the overall picture including the matters relating to Killinchy. This is not a question of assessing the financial strength of MBAL by reference to the financial strength of another associated company. Rather, this is information "*relating to the organisation before the court"* within the meaning of the Guideline. The (perfectly legitimate) manner in which MBAL's directors and (direct and indirect) shareholders have chosen to structure their affairs should not be allowed to mask the reality of the financial position.

I have reflected carefully whether this is a case where it is necessary to move upwards again from a fine of £1.25million in order to achieve a proportionate sentence, taking into account all of MBAL's circumstances identified above and that the object of the sentence is to bring home the appropriate message to the directors and shareholders of the company. I have concluded that it is not. I have already taken into account the strength of MBAL's direct financial circumstances in reaching the figure of £1.45million (before mitigation). MBAL's (direct and indirect) shareholders have indeed made very handsome rewards. But there is no need to increase the fine in order to impress on them further the need to comply with health and safety legislation or otherwise. MBAL remains a family-owned company, never having sought Government investment or having sold out to private equity investors. Its accounts show very significant profit re-investment in the company, retained for research and development purposes. It has designed the new ejection seat to be installed in the UK's joint strike fighter. It remains at the forefront of design and engaged in the business of saving lives as a result of that investment. As the current directors of MBAL put it, the ethos of the company is that an ejection seat is the pilot's lifeboat and must work as it was intended each time, every time. I am satisfied that the message is appropriately understood at this level of fine and there is no need to go higher or out of the range of fines suggested for large organisations.

There are no factors that would warrant any adjustment as identified in steps 4 and 5 of the Guideline.

<u>Guilty plea</u>

The only remaining matter to consider is the question of any potential reduction for a guilty plea in accordance with s. 144 of the Criminal Justice Act 2003 and the Sentencing Council Guideline on Reduction in Sentence for a Guilty Plea (2007 version – since the first hearing was before 1st June 2017).

As already indicated, MBAL did not plead guilty until the first day of trial on 22nd January 2018. The summons was issued in October 2016 following the service of an initial case summary. The matter was sent to the Crown Court by the Magistrates' Court in January 2017. A draft indictment was served in March 2017 and a PTPH took place on 17th May 2017, with a not guilty plea being entered and trial being set for 22nd January 2018. A full defence statement was lodged. A further case management hearing took place on 1st December 2017. Not until 15th January 2018 did MBAL indicate an intention to plead guilty, by which time a full prosecution opening note was in existence and full preparations for a 6 week trial were essentially complete. The final basis of plea was not produced to the court until the first day of trial.

There has been debate as to whether or not the prosecution has somehow narrowed the issues along the way, and in particular as to whether until recently the prosecution also relied on a case based on flawed design of the seat firing handle. The summons has always referred in terms only to non-deployment of the main parachute. The waters were muddied by the service of an initial case summary which referred to design failure in the pin of the seat-firing handle, and the service of exhibits relating to that issue. MBAL's defence statement addressed this additional matter. However, the prosecution immediately pointed out MBAL's misapprehension in this regard to MBAL's solicitors. Further, any potential uncertainty was removed in November 2017 when the prosecution responded to disclosure requests from MBAL on the basis that its case was limited to non-deployment of the parachute, and certainly by the time of the case management hearing on 1st December 2017 when HHJ Pini QC put the matter beyond doubt.

But in any event, it was always open to MBAL at any time a) to seek clarification in the light of the discrepancy between the summons and the initial case summary and b) (and independently) to plead guilty on the basis that it ultimately did. It is said that these matters were difficult to admit, not least give the passage of time. But this was a very late plea in circumstances where MBAL is a sophisticated party which has been fully and privately represented throughout in a matter going back many years. The critical document on MBAL's case, namely Mr Lowther's note of February 1990 to MBAL's Quality Assurance Department, and the knowledge that the instructions there contained were not actioned, were always available to MBAL. The lateness of the plea will no doubt have extended the period of uncertainty for the Cunningham family, and also disrupted court, staff and judicial resources.

For these reasons, I do not consider that more than a 12% credit for guilty plea is justified by reason of the indication on 15th January 2018 to the court that a trial would no longer be necessary.

Compensation and costs

There has been no application for a compensation order and I make no order for compensation. Compensation orders are for straightforward cases, which it is common ground this is not, nor have any sums been identified, agreed or proved. No order for costs is necessary, since MBAL has already paid the prosecution costs agreed in the sum of £550,000.

Conclusion

For the reasons set out above, I impose a fine of **£1,100,000** to be paid within a period to be fixed. This is in my judgment a level of fine which represents both the seriousness of the offence and the extent to which MBAL fell below the required standard, together with the relevant financial circumstances. It is also a proportionate one which is sufficiently substantial to meet the objectives of the health and safety legislation and sentencing regime.

This has been a sensitive sentencing exercise carried out under the long, dark shadow cast by the tragic death of Flight Lt Cunningham. It is, I hope, appropriate that I should conclude by paying a collective tribute to him and his family who have so bravely and patiently sat through these difficult proceedings. I would also wish to record my thanks to the parties' representatives for their attentive assistance throughout this matter.