Exercise 1 – Look at the details of this incident

- **Read about the incident ("ejection seat failure" in the handout)**
- **Highlight some parts of the text that catch your attention, or write some brief notes on these details.**
- **Use the checklist to help you do this**

Description of the incident

- what happened
- sequence of events
- injuries / outcomes

Some contributing factors

- Multiple people / organisations
- Physical layout / environment / equipment design
- Maintenance activities / issues
- Planning
- Briefing / instructions
- Communication
- Unexpected circumstances
- Time available, rushing, deviations from usual
- Safety procedures
- Changes in plans / decisions

Safety concepts

- Rules and regulations, safety instructions
- Culture
- Behaviour
- Risk assessment and control
- Failsafe design
- Accident / incident investigation
- Organisational learning
- Others?

Martin-Baker fined £1.1m for ejection seat failure that doomed Red Arrows pilot

Ejection seat manufacturer Martin-Baker Aircraft Company has been fined £1.1m over the death of a Red Arrows pilot who was propelled into the air and plunged 67 m.

Flt Lt Sean Cunningham, 35, was carrying out pre-flight checks on his Hawk TMk1 XX177 jet at around 11am on 8 November 2011 in preparation for routine training at the Royal Air Force (RAF) Scampton airbase in Lincolnshire. The aircraft's engine was running but it was stationary.

Cunningham's Mk10 ejection seat fired and sent the pilot into the air, known as a zero-zero ejection (zero altitude and zero airspeed). The seat's parachute failed to open and he fell to the ground, sustaining multiple injuries. He later died in hospital.

Martin-Baker director John Martin entered a guilty plea to breaching s 3(1) of the Health and Safety at Work Act on behalf of the company at Lincoln Crown Court on 22 January.

The court was told that the parachute had not deployed

Flt Lt Sean Cunningham

because a drogue shackle and a scissor shackle jammed together. This was a mechanical fault that Martin-Baker had known about since the 1990s, the court was told.

The drogue shackle is horseshoe-shaped and comprises two lugs. It is fastened by a locknut and bolt and connects the lines to the main parachute and the drogue chute. The scissor shackle secures the drogue shackle in the head box, in which the main parachute is packed directly behind the pilot's head.

The drag on the drogue chute causes the scissor shackle to move like a hinge from a horizontal to a vertical position. When the scissor opens, the end of the drogue shackle lugs pass over the scissor shackle and release the main parachute. But if the two shackles jam together this cannot happen.

An investigation found that, during a routine inspection on the Hawk jet in October 2011, an RAF engineering technician overtightened the locknut on to the bolt of the drogue shackle to 1.5 threads. This compression meant the width of the scissor shackle was wider than the gap between the outer ends of the lugs on the drogue shackle, known as an "interference fit". The two parts jammed.

Only the force created by the drogue chute in an ejection at 50 knots (93 kph) or more would have been able to overcome the interference fit.

The Health and Safety Executive (HSE) said that in 1990 McDonnell Douglas, a manufacturer of US military aircraft fitted with Martin-Baker ejection seats, had written to the company warning it of the risk of an interference fit and potential jamming of the shackles. Defence, security and aerospace firm British Aerospace raised similar concerns over the drogue and scissor shackle arrangement a year later.

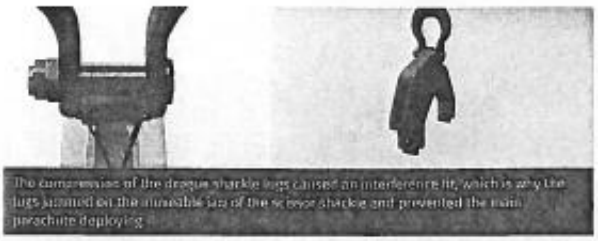
Between 1990 and 1992 Martin-Baker added a caution to its user manuals which read: "Warning. To prevent possible pinching of the scissor shackle, which may cause hang-up of the drogue shackle during ejection, do not overtighten or torque load the drogue shackle nut and bolt."

The manuals were provided to five overseas air forces only, in India, Pakistan, Egypt, Italy and Finland; the RAF/Ministry of Defence was one of several customers that were not told about the issues with the overtightening of the shackles.

HSE inspector David Butter told *IOSH Magazine*: "In light of this correspondence and the overseas manuals, it was our view that Martin-Baker had failed to adequately control the risk of an interference fit."

At the inquest into the pilot's death in 2014, coroner Stuart Fisher criticised Martin-Baker for this "very serious failure of communication".

The ejection seat firing handle had been in an unsafe position and could have accidentally activated the seat. Fisher said the safety pin fitted to the firing handle was "entirely useless" and was "likely to mislead".



The compression of the drogue shackle lugs caused an interference fit, which is why the lugs jammed on the unusable size of the scissor shackle and prevented the main parachute deploying

Butter said: "Regardless of whether Sean needed to exit the aircraft or not, he still should have survived. The HSE didn't look at what initiated [the ejection] because, had he needed to use it, the outcome would have been the same."

After the accident Martin-Baker modified the release mechanism with a shouldered bolt to design out the risk of an interference fit.

Fining Martin-Baker on 23 February, Mrs Justice Carr said: "I have regard to the [sentencing] guideline, considering the very recent authoritative guidance of the Court of Appeal in *Whirlpool UK Appliances Limited v R* (bit.ly/2FOAWsT) [...] 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."

(See the table below for the judge's application of the sentencing guidelines.)

Martin-Baker said after the sentencing: "This tragic accident was the result of an inadvertent ejection and main parachute deployment failure due to the overtightening of the drogue shackle bolt. In November 2017 the HSE confirmed that the inadvertent ejection was not caused by any fault attributable to the company.

"Upon receiving clarification of the HSE's case, the company accepted a breach of s 3(1) of the Health and Safety at Work Act on the basis that it had failed to provide a written warning to the RAF not to overtighten the drogue shackle bolt."

The HSE was given primacy of the investigation after an MoD service inquiry, investigations by the civilian and military police, and technical investigations involving the Military Aviation Authority and the Military Air Accident Investigation Branch.

The HSE's operations manager, Harvey Wild, said: "We understand that a great deal of time has passed since this tragic event. This was an extremely complex investigation and no protection could be initiated until after the inquest and other inquiries had concluded."

Sentencing guidelines application

Culpability:	Medium
Seriousness of harm risked:	Level A
Likelihood of harm:	Low
Harm category:	3, moved up to 2
Number of workers exposed to the risk:	"Significant" number of pilots and potential passengers exposed to the risk of harm over a lengthy period
Size of the organisation:	Large
Turnover:	£216m (2017); £222m (2016)
Starting point for fine:	£600,000, increased to £1.45m because Martin-Baker's turnover exceeds £50m
Mitigating features:	Fine adjusted downwards to £1.25m for good safety and health record, genuine remorse and regret, full co-operation with the investigation
Final penalty:	£1.1m plus £550,000 costs