The C-130J passenger evacuation trial: facing the challenge.

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This presentation describes a live passenger evacuation trial on the Lockheed Martin C-130J which was conducted by DERA CHS at DERA AT&E Boscombe Down last year. We had been tasked with assessing the adequacy of the exits for the occupants of the rear cabin for a variety of loading and mishap configurations.

My intention is to describe the planning and execution of the trial rather than the outcome as far as the aircraft is concerned.

BACKGROUND

Although serious ground incidents which may endanger life are rare, loss of life on the ground, but not as a direct consequence of the mishap, is especially tragic. In the civilian world, review of procedures and regulation often follows serious incidents, and the "route" to civilian certification is well described in Appendix J to Section 25 of the Joint Aviation Requirements. In essence, these regulations require that the maximum passenger load must be able to evacuate the aircraft in night conditions with half of the exits unuseable within a time of 90 seconds. In the past there has been the need to demonstrate this by a live ground evacuation before certification of a new aircraft type on the civil register could take place.

In Western Europe and North America there is no military requirement for such certification. Our customer, the Defence Procurement Agency (DPA, formerly MOD PE), considered that it should form part of our duty of care to our military and civilian passengers that this aspect of safety should be considered and assessed before introducing this new variant – which is capable of holding a larger passenger load than many civilian aircraft – into service.

With the exception of research into the psychological aspects of emergency passenger egress it is rare nowadays for live trials to be performed. Indeed the last live passenger evacuation trial on a large aircraft in Western Europe for certification purposes took place about ten years ago. We thus had no recent experience on which to draw, although this did give us the opportunity to design our trial completely from scratch.

TRIAL DESIGN AND OBJECTIVES

Aircraft configuration and seating in civilian passenger aircraft are well standardised. Because of this, civilian passenger evacuation trials can be staged in a set manner. This is not the case for military aircraft. The number of passengers carried, their seating and equipment, as well as the mixing of cargo and passengers (never allowed in civilian passenger aircraft), made us think carefully about the different mishap scenarios to be represented.

We proposed, and agreed with our customer, that four mishap scenarios would be assessed:

1) Ground evacuation – maximum passenger load.
2) Ground evacuation – maximum fully equipped paratroop load.
3) Sea ditching – maximum passenger load.
4) Sea ditching – maximum fully equipped paratroop load.

All of these scenarios would take place under simulated night conditions.

To avoid any "learning" by the subjects, none were used more than once for a similar scenario, and we used two separate groups. A group representative of non-combatant military personnel was drawn from new army

recruits undergoing basic training; experienced paratroops were used for the second group. It is of note that the simulated civilian passenger load were, as far as flying was concerned, inexperienced.

The recruitment of subjects would have caused us real problems but for the intervention of a locally based senior army officer who had agreed to help. He needed to know "how many, what type of person, when, where and for how long". The only possible problem, we were told, was if the paratroops were needed in Kosovo. Fortunately they were not, and the required number of subjects turned up on the day just as he had said they would.

It was not our intention to follow JAR-25 to the letter. Instead our requirement was to demonstrate if: "….troops / paratroops / passengers can be evacuated within a reasonable time under worst case conditions. These tests shall be performed for the worst combination of available exits (i.e. from one side only and with no power available to operate the rear cargo door."

Our prime concern throughout the trial was for the safety of our subjects. Although a small number of minor injuries are reasonably to be expected in some areas of military training, it was our view that, while making the trial realistic (and therefore of value to the tens of thousands of passengers who would subsequently fly in that aircraft) we should not expose our subjects to any preventable hazard. This was in some ways an unpredictable trial and I for one spent many hours trying to think up all the "what if" situations. As an example, no jewellery or spectacles were to be worn and rings were to be taped over to minimise the risk of snagging.
The aircraft used was the only one of its type that could be configured for the trial, it was released from flight trials for one week. We were not allowed to break the aircraft or to over-run the allotted time. This meant a very thorough check of the aircraft interior to pad all edges or corners and board unprotected wells. It also meant padding expensive or easily broken – but convenient - foot or hand holds that were not designed for that purpose.

We decided not to provide any incentive to our subjects for getting out quickly. Historically the presence of an incentive has been justified on the grounds of realism, but has probably been a contributory factor to injuries sustained in these trials. There was considerable debate about whether we should intervene in the event that the subjects started to climb over the high central partition, with a possible awkward fall to the cabin floor. In the end we decided that unless a hazardous situation developed we would not intervene.

We wanted to obtain the maximum information possible from the trial. To this end there was recorded camera coverage from a number of positions inside and outside the aircraft and the subjects all wore numbered bibs which identified their assigned seating position within the aircraft.

It was essential that the start of the evacuation would be clear to those outside and in. The aircraft electrical power was to be switched off. This would be obvious to those outside, as the noise level suddenly fell and the navigation lights went out. Inside the aircraft the emergency lighting went on. However this loss of electrical power meant that the inside of the aircraft would be out of contact with the outside. We had previously decided the "end points" of the trial. Under normal circumstances the "last man out" would signal the end of the trial, but a number of Trials Assessors were stationed inside and outside the aircraft. All of these had been issued with a personal attack alarm with which the evacuation could immediately be halted. In addition any of the subjects could halt the evacuation by shouting "STOP STOP STOP".

One doctor, equipped with night vision goggles, was inside the aircraft. His role was to monitor the progress of the evacuation and to look out for any sign of danger to the subjects.

The usual fire and hangar evacuation briefings were given in case there was a real emergency, in particular a fire in the hangar.

There were other areas to consider. The paratroops came from a number of different regiments and services. Friendly inter-service rivalry can get out of hand in the confines of a dark aircraft interior, and the paratroops were made well aware that the aircraft interior was covered fully by CCTV. In addition a highly visible military police presence was provided!

Our lead-in time was short. From first request *(we need your help with a small project)* to trial date was only three months More than one person commented that they thought we were crazy to take this project on with such a short lead-in time. All aspects of the trial preparation – for example the Safety plan, Ethics Committee approval, subjects, cameras, and not least, aircraft preparation, had to be completed within this very short time frame. It was for us a stimulating but exhausting schedule.

We made every possible effort to make the trial as realistic as possible. The aircraft windows were blacked out and the passengers or troops emplaned via the cargo door as they would in a real case. The seating was in four rows with the passengers seated sideways to the fore and aft axis of the aircraft. Once loaded, and with the aircraft closed up, sense of direction was easily lost. Our simulated civilian passenger load had minimal flying experience, and no experience at all of flying in a military transport aircraft. Despite what we considered to be a clear explanation of the trial at least one passenger was overheard asking one of the Air Loadmasters (ALMs) if they were really going flying! The ALMs gave the passengers the standard emergency briefing for the aircraft. For the ground evacuation a simulated aborted take off was followed by the emergency evacuation. In the case of the sea ditching there was about ten minutes lead in from the first announcement on the aircraft public address system that the aircraft had a problem to the simulated ditching and the start of the emergency evacuation. Those outside listened for the evacuation bell and watched for the exterior lights to go out as the power was cut.

The question of weight and balance was the subject of much discussion. Loading of the aircraft is the responsibility of the Air Loadmasters. The movement of 128 people (almost 10,000kg) in a fore-and-aft direction causes large shifts in the centre of gravity and consequent compression or extension of the nose oleo leg. The scaffolding had been erected close to the hull of the aircraft and movement of the tail could have resulted in puncture of the hull. The ALMs had recognised this risk, and the tail was therefore tied down. However an aft movement of the passengers – as would happen in the simulated sea ditching – would, without additional nose ballast, lift the nose of the aircraft off the ground! Several tons of ballast was attached to the nose gear. Even so the first simulated sea ditching was halted when, as the passengers moved backwards, the nose of the aircraft appeared to be about to lift! The situation was saved by the fire crews who put two 40-ton inflatable lifting bags under the tail of the aircraft.

We judged the success or failure of the trial – as opposed to the result – by the absence of avoidable injury as well as the obtaining of useful data. Our careful planning was directed towards getting the maximum benefit for our customer with the minimum of risk to the subjects.

In the event the trial proceeded relatively smoothly and without mishap. Very reasonable evacuation times were achieved for all the scenarios. There were no incidents or reported injuries; our very thorough preparation was fully justified. The choice of inexperienced subjects for the simulated maximum passenger load was appropriate. We had not expected the first subjects out to be disorientated – they had very little idea where they were in relation to the front and rear of the aircraft. A number of significant recommendations were made to the manufacturer and the customer regarding one of the emergency exits and the simulated sea ditching.

What did we learn? Well, quite a lot. It is possible to set up something you have never done before and do it safely and well. We learned the value of splitting a big project into different areas and assigning single point leadership within these disciplines. And to expect the unexpected, no matter how hard you plan.