CRASHWORTHINESS

Contrary to popular belief, the large majority – around 80 per cent – of aircraft accidents are survivable. And it is crashworthiness that is the key to survivability.

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AIRCRAFT CRASHworthiness is the ability of the aircraft to provide the occupants every chance of escape from fatal or serious injury in the event of a survivable accident. Crashworthiness is the engineering or hardware side of occupant safety. There are 3 main areas:

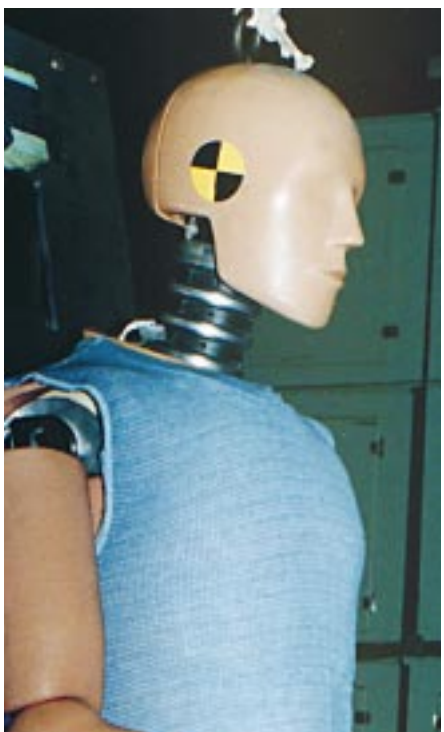
• Occupant crash protection (crash dynamics) involving the design of seats, restraints, and so on.

• Cabin fire protection, including the flammability of materials and the kind and use of portable fire extinguishers.

• Emergency evacuation, which involves the design of exits, aisle widths and emergency lighting.

Recent advances in each of these areas have contributed to a substantial improvement in the chances of survival from an aircraft accident.

Fire protection: Cabin fires account for a high number of aviation deaths and injuries each year, particularly in the larger passenger carrying aircraft, where the longer time needed for all passengers to escape can allow a fire to develop to an unsurvivable state.



Extensive research with crash test dummies has improved design of the seat and restraint systems.

Much research has been done on the flammability properties of cabin materials, and on how to delay build up of combustible gases and heat.

In smaller aircraft, and particularly helicopters, fuel tanks are often in the fuselage behind or beneath the occupants. Developments in the crash resistance of fuel tanks have provided a dramatic improvement in the fire related fatality rate for US military helicopters. A similar requirement has now been introduced for new civil aircraft.

Emergency evacuation: Under panic conditions, obstructions such as cabin partitions can cause major problems. Target areas for improvements have included access space to overwing (type III) emergency hatches and improved emergency lighting, particularly for smoke-filled cabin conditions.

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In small aircraft, issues that are of concern include adequate instructions, operation of emergency exits from both inside and outside, and access to sufficient exits for the crew in cargo aircraft, and both passengers and crew in aircraft. Anyone who may have to open an emergency exit must be adequately briefed on its operation.

Occupant crash protection: The research effort in crash dynamics has concentrated on the seat and restraint and the ability of the structure to maintain a post crash "livable volume" – a necessary aspect of a survivable accident. This includes the behaviour of overhead bins or galley structures in large aircraft, equipment installations such as for rescue ambulance operations, as well as the fuselage structure itself to protect the occupants from outside intrusions.

The most notable advance has been in the design standards for the seat and restraint system.

The seat and restraint system are subjected to specified dynamic tests using instrumented dummies to measure injury criteria for head impact, spinal compression, chest and – for large aeroplanes – femur loads. Because the seat and restraint are treated as a system and their performance is substantiated by tests, the effects of changes to parts of that system are difficult to quantify without further tests on the modified system.

For example, the firmness of the seat cushion has a significant effect on the level of impact down load transmitted to the occupant's spine as well as on the potential for the occupant to slip under the restraint under forward load (submarining).

So in aircraft where this standard is required by certification, any changes such as seat cushion, restraint or seat pitch which have not been covered in the original qualification tests may need further substantiation.

What you can do: An awareness of crashworthiness issues can help improve your survivability in any aircraft accident. Ensuring that your seat belt (or better still harness) is correctly fastened is a good start. Some more subtle, but simple aspects such as the type of seat cushion and emergency exit operation can also be vitally important. A softer seat cushion will increase the potential for spinal injury.

Another area of concern is stowage of items under seats. This empty space may be needed for protection during high vertical impact, particularly in a lightweight helicopter.

Under high vertical loads, whether a design criteria or not, the seat pan and occupant will collapse towards the floor. Any item in the way is going to cause serious injury.

Research has shown that shoulder harnesses provide substantial injury protection against impact forces in any direction. An upper torso restraint increases injury tolerance in the vertical direction by a factor of 6 over a lap belt.

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