

Proposed Special Condition on “Crash Survivability for CFRP Fuselage”

Applicable to Airbus A350-941

Introductory note:

The following Special Condition has been classified as an important Special Condition and as such shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

Statement of Issue

The A350 will be fabricated with carbon-fibre reinforced plastic CFRP-metal structure. This includes novel and unusual design features for a large transport airplane certificated under CS25, e.g. composite fuselage. Structure fabricated from CFRP may behave differently to metallic structure in crash conditions because of differences in material ductility, stiffness, failure modes, and energy absorption characteristics.

Therefore, the impact response characteristics of the A350 must be evaluated to ensure that its survivable crashworthiness characteristics provide at least the same level of safety as those of a similarly sized airplane constructed from traditionally used metallic materials.

In the absence of existing Certification Specifications and under the provisions of IR21A.16B, the Agency prescribe a special condition that requires Airbus to conduct an assessment to ensure that the A350 will not reduce the existing level of survivability to that found in previously certificated designs.

There is no aircraft-level survivable crash condition specified in the airworthiness regulations and metallic aircraft have not been specifically designed against survivable impact conditions at this level. However, the structural behaviour of previously certificated aircraft in a survivable crash event and the associated limits are considered generally acceptable. It is therefore reasonable to expect that a design using new materials (such as the A350) should be evaluated in a way that ensures the currently accepted level of safety is maintained.

In this context the concept of Limit of Reasonable Survivability (LRS) has been introduced on previous Airbus programmes and is also used on A350. The LRS is defined as a vertical impact speed V_z level at which survivability would begin to become impaired on already certificated designs. This is the level at which a conventional metallic fuselage begins to show signs of significant structural disruption such that the normal cabin survivability provisions begin to become ineffective.

Based on the similarity to Special Conditions used on previous aircraft Type Certification programmes, the new or modified text in the below Special Condition is highlighted in yellow. Even though the full Special Condition text is presented for this public consultation in order to keep the context for understanding, only the highlighted parts are subject of consultation and commenting.

Airbus A350-941 - Special Condition C-01

- Crash Survivability for CFRP Fuselage -

1. The A350 must provide an equivalent level of crash survivability to that demonstrated on conventional large transport aircraft (CLTA). This may be achieved by demonstrating for a representative fuselage section that, for a range of impact conditions and corresponding to vertical descent rates up to the values representing the Limits of Reasonable Survivability (LRS) for the CLTA that have been chosen for the comparative analysis:
 - a) The survivable volume is comparable to that of a CLTA. This means that structural deformation will not result in infringement of the occupants' normal living space, so that passenger survivability will not be significantly affected.
 - b) The occupants will be protected from injury as a result of release of seats, overhead bins and other items of mass due to impact loads and resultant structural deformation of the supporting airframe and floor structures. The attachments of these items need not be designed for static emergency landing loads in excess of those defined in CS 25.561 if impact response characteristics of the A350 yield load factors at the attach points that are equal to or less than those of a CLTA.
 - c) The selected injury criteria used for the comparison should demonstrate that the potential for the occupant injury will be equal or less than that experienced on CLTAs.
 - d) The suitability of the egress paths following a vertical impact event must be shown comparable that of a CLTA.
2. The loading configurations of the fuselage for this evaluation must be agreed with EASA, particularly with respect to the loading of the cargo compartment and the likely effect of this on the dynamic impact characteristics of the fuselage section.
3. As an alternative to a fuselage section analysis, a complete aircraft analysis may be performed to demonstrate an equivalent level of crash survivability to CLTA. In this case, the conditions must be also agreed with the EASA Structures Panel.