

Proposed Special Condition for Installation of structure mounted airbag

Applicable to Airbus A-380

Introductory note:

The hereby presented Special Condition to the EASA Certification Basis 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

With respect to compliance with JAR/FAR 25.562 (c) (5), Airbus is proposing the application of structure mounted airbags as a means to reduce the potential for head injury in the event of an accident. The structure mounted airbag works similarly to an automotive airbag (supplemental restraint system).

Inflatable restraint system in front of passenger operating opposite to flight direction will be denoted as structure mounted airbag.

Structure mounted airbags are an unusual design feature in the passenger seat environment that is not specifically addressed in CS/JAR/FAR 25. Therefore, a special condition and guidance material is needed to address requirements particularly applicable to installation of those systems in an airplane

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- Installation of structure mounted airbag -

Previously Special Condition for the installation of Inflatable Seatbelts (CRI D-47) was agreed. For this new type of installation, the existing Special Condition (CRI D-47) has been amended to reflect the differences in the installation identified during the review of the proposed installation:

- Deflection of the structural item on which the airbag is mounted under crash loads.
- Influence of the brace position on the injury to the occupant of the seat.
- Loss of electrical power supply and use of batteries.

Special Condition

1) HIC Characteristic

The existing means of controlling Front Row Head Injury Criterion (HIC) result in a non-quantified but normally predictable progressive reduction of injury severity for impact

conditions less than the maximum specified by the rule. Airbag technology however involves a step change on protection for impacts below and above that at which the airbag device deploys. This could result in the HIC being higher at an intermediate impact condition than that resulting from the maximum.

It is acceptable for HIC to have such a non-linear or step change characteristic provided that the value does not exceed 1000 at any condition at which the structure mounted airbag does or does not deploy, up to the maximum severity pulse specified by the requirements. Tests must be performed to demonstrate this taking into account any necessary tolerances for deployment.

2) Intermediate Pulse Shape

The existing ideal triangular maximum severity pulse is defined in FAA AC 25.562.1. EASA considers that for the evaluation and testing of less severe pulses, a similar triangular pulse should be used with acceleration, rise time, and velocity change scaled accordingly.

3) Protection During Secondary Impacts

EASA acknowledges that the structure mounted airbag will not provide protection during secondary impacts after actuation. However, evidence must be provided that the post-deployment features of the installation shall not result in an unacceptable injury hazard. This must include consideration of the deflation characteristics in addition to physical effects. As a minimum, a qualitative assessment shall be provided.

Furthermore, the case where a small impact is followed by a large impact must be addressed. In such a case if the minimum deceleration severity at which the airbag is set to deploy is unnecessarily low, the bag's protection may be lost by the time the second larger impact occurs. It must be substantiated that the trigger point for airbag deployment has been chosen to maximize the probability of the protection being available when needed.

4) Protection of Occupants other than 50th Percentile

The existing policy is to consider other percentile occupants on a judgmental basis only i.e. not using direct testing of inquiry criteria but evidence from head paths etc. to determine likely areas of impact.

The same philosophy may be used for structure mounted airbags in that test results for other size occupants need not be submitted. However, sufficient evidence must be provided that other size occupants are protected.

A range of stature from a two-year-old child to a ninety-five percentile male must be considered.

In addition the following situations must be taken into account:

- The seat occupant is holding an infant, including the case where a supplemental loop infant restraint is used:
- The seat occupant is a child in a child restraint device.
- The seat occupant is a pregnant woman

5) Airbag Deployment

Evaluation of the deployment of the airbag must take into account the deflection or deformation of the installation during the crash pulse. If installed in a monument used for stowage, this should include the possible range of loading conditions. The effects of any loads imposed by the airbag deployment on the positioning of the airbag should also be included in the evaluation.

The HIC test may be performed with the airbag deploying from a rigid test fixture provided that the above factors and the occupant size considerations in paragraph 4) are taken into account. A rational analysis supported by static deployment tests would be acceptable.

6) Occupants Adopting the Brace Position

There is no requirement for protection to be assessed or measured for seat occupants in any other position or configuration than seated alone upright, as specified in FAA AC 25.562-1B (dated 1 October 2006). However, it must be shown that the structure mounted airbag does not, in itself, form a hazard to any occupant in a brace position or a person in between the brace position and upright position during deployment.

- 7) It must be shown that the gas generator does not release hazardous quantities of gas or particulate matter into the cabin.
- 8) The probability of inadvertent deployment must be shown to be acceptably low. The seated occupant must not be seriously injured as a result of the structure mounted airbag deployment. Inadvertent deployment must not cause a hazard to the aircraft or cause injury to anyone who may be positioned close to the structure mounted airbag (e.g. seated in an adjacent seat or standing adjacent to the airbag installation or the subject seat). Cases where the inadvertently deploying structure mounted airbag is near a seated occupant or an empty seat must be considered. The above must be demonstrated or the probability of the inadvertent deployment must be shown to be in accordance with the severity of the failure.
- 9) It must be demonstrated that the structure mounted airbag when deployed does not impair access to the seatbelt or harness release means, and does not hinder evacuation, including consideration of adjacent seat places and the aisle.
- 10) There must be a means for a crewmember to verify the integrity of the structure mounted airbag activation system prior to each flight, or the integrity of the structure mounted airbag activation system must be demonstrated to reliably operate between inspection intervals.
- 11) It must be shown that the structure mounted airbag is not susceptible to inadvertent deployment as a result of wear and tear, or inertial loads resulting from in-flight or ground manoeuvres likely to be experienced in service.
- 12) The equipment must meet the requirements of JAR 25.1316 with associated guidance material IM S-1006 for indirect effects of lightning. Electro static discharge must also be considered.
- 13) The equipment must meet the requirements for HIRF (SC S-10.2 and IM S-10.2) with an additional minimum RF test for the threat from passenger electronic devices of 15 Watts radiated power.

- 14) The structure mounted airbag mechanisms and controls must be protected from external contamination associated with that which could occur on or around passenger seating.
- 15) The structure mounted airbag installation must be protected from the effects of fire such that no hazard to occupants will result.
- 16) The structure mounted airbag must provide adequate protection for each occupant regardless of the number of occupants of the seat assembly or adjacent seats considering that unoccupied seats may have active structure mounted airbag.
- 17) The structure mounted airbag must function properly after loss of normal aircraft electrical power and after a transverse separation in the fuselage at the most critical location. A separation at the location of the airbag does not have to be considered.
- 18) It is accepted that a material suitable for the inflatable bag that will meet the normally accepted flammability standard for a textile, i.e. the 12 second vertical test of JAR25 Appendix F, Part 1, Paragraph (b)(4), is not currently available.
In recognition of the overall safety benefit of structure mounted airbags, and in lieu of this standard, it is acceptable for the material of inflatable bag to have an average burn rate of no greater than 2.5 inches/minute when tested using the horizontal flammability test of JAR25 Appendix F, part I, paragraph (b)(5).
- 19) If lithium-ion non-rechargeable batteries are used to power the AMSAFE Aviation Inflatable Restraint (AAIR), the batteries must be RTCA DO-227 and Underwriters Laboratory (UL) compliant. However, if rechargeable lithium-ion batteries are used, additional special conditions may apply.
- 20) Structure mounted airbag systems should not introduce additional hazards in respect to occupant safety when compared to certified systems.
- 21) In case structure mounted airbag systems are installed in or close to passenger evacuation routes (other than for the passenger seat the airbag is mounted for) a possible impact on emergency evacuation (e.g. hanging in the aisle, building a potential trip hazard, etc.) should be evaluated.