EASA
European Union Aviation Safety Agency

Topics in ETSO Seat Certification

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Video and picture as evidence of test outcome

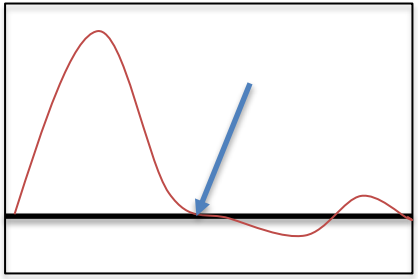
- EASA investigation and subsequent approval/rejection of the design of a seating system is based on evidence from testing (among other data/info available in the certification package)

- It is sole responsibility of the ETSO-Applicant to collect sufficient and exhaustive evidence from testing

- Collecting videos and pictures of dynamic tests is mandatory. Videos and pictures of other certification tests can be extremely helpful to support any determination on the showing of compliance with ETSO requirements.

Retention of occupant through shoulder harness
Seat with three point restraint systems

5.3.9.7 Retention of Upper Torso Restraint Straps: Retention of the upper torso restraint straps on the ATD's shoulders can be verified by observation of photometric or documentary camera coverage. The straps must remain on the ATD's shoulder until the ATD rebounds after the test impact and the upper torso restraint straps are no longer carrying any load. The straps must not bear on the neck or side of the head and must not slip to the upper rounded portion of the upper arm during that time period.



- → Adequate video evidence shall be provided, showing that the shoulder straps stays on the solid portion of the dummy shoulder (from neck to the edge of the upper arm joint)
- → Marking on the shirt and shoulder straps shall be set-up. Shirt can be cut slightly below upper arm joint.

Energy absorbing devices/stress alleviating features

- Features designed with precise geometries and tolerances (“initial configuration”) shall be capable to show an equivalent intended behavior at any particular moment in time and in-service status.
- As a minimum, effect of vibration and life-cycle shall be taken into account prior to conduct the 16g test or any relevant dynamic test which will activate the feature.
- Seat shall be fully inspected after vibration and life-cycle testing prior to undergo dynamic tests
- The application of the floor deformation prior to applying the crash load is an idealization of an event occurring simultaneously with the crash loading. Accordingly, in case of floor pre-stress attenuation, analysis shall unequivocally identify the worst case set-up condition (pitch up/down, roll out/in, etc).

Fitting factor in static testing (1/2)

> 4.1.3 Attachments: The strength of the seat attachments to the aircraft structure and the pelvic restraint or upper torso restraint attachments to the seat or aircraft structure shall be 1.33 times the ultimate loads specified in Table 4 (except as noted for Type A seat sideward).

- → Compliance with the requirement is demonstrated when the seat attachments withstand a load 1.33 times what is measured at these points during the ultimate load
- → Premise: EASA has been experiencing uncertainty as to the correct application of the 1.33 factor in numerous instances in which the static loads have been applied on a non-reinforced seat structure due to:
  - → significant deformation of the structure under load, including twisting, cracking, etc.
  - → reconfiguration of seat sub-assemblies in case of local failures of components or activation of energy absorbing features.

Fitting factor in static testing (2/2)

- EASA requires evidence to substantiate that the seat attachments and belt/harness attachments have effectively been correctly loaded, as required. One of these following test method is acceptable:
  - Using an adequately reinforced primary structure for the execution of the fitting factor test such not to re-distribute the load or cause plastic deformation.
  - Conducting the test on a non-reinforced primary structure with the utilization of floor load cells which shall record the required load a the attachments interface points (use of this option is not considered adequate for belt/harness attachments).
  - Conduct a component level test on the attachment item

HIC testing: selection of test conditions (launch seat place/target seat place)

- HIC Zone C test requires the definition of the worst case point/condition of impact based on head path data specific to the design in object.
- Launch seat: the selection of the seat place occupied by the ATD should ensure that the point/condition of impact identified in the test plan is hit in the test.
- Target seat: the behavior of design features used to attenuate head impact might depend on the local structure/geometry they are mounted on and might not result in equivalent conditions for all seat places
- In case of failure, the re-design of such design features shall be validated on a re-test using the same setup and launch seat occupancy of the initial test.

Use of SAE ARP6337 in ETSO projects

- For seat Types “A-T” and “C”, ETSO-C127c Appendix 1, section 5.0 mandates the use of SAE ARP 6337 (Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures, issued November 2020). For seat Types “B”, reference is made to the guidance in AC 20-107B.
- Demonstration of compliance to ARP6337 has been investigated under the ETSO-C127b to support seat installation projects. The ETSO certification exercise will not be completed unless compliance to ARP6337 is achieved.
- The conduction and outcome of testing for compliance to ARP6337 shall be reported to the ETSO PCM. In case of failure and re-design during such testing, the impact of re-design on ETSO design/testing will have to be reported to the ETSO PCM.
- Coordination with Cabin Safety Expert in charge for the installation project will ensure the correct flow of information.

Occupant injury during rebound/ Representation of seat-associated furniture

- The 16g forward test condition might result more critical in terms of head impact at rebound than frontal impact with target seat/monument

- Worst case conditions that might create the highest HIC value during rebound shall be identified.

- Representation of seat-associated furniture in occupant injury tests may influence:
  - ATD flailing
  - Impact during rebound
  - performance of airbags

Naïve subject test for life vest retrieval: pre-test briefing

→Subjects must receive no retrieval information other than a typical preflight briefing, which will have to be explicitly reported on a test plan.

→no reference to markings or safety instructions shall be given or used during the test.

→the test video shall clearly report the audio of the test conductor.

Evaluation of life vest retrieval after dynamic testing

- The life-vest pouch or life-vest container are expected to be available and conformed to serial production on all pax places

- Evaluation of life vest retrieval shall be conducted on all pax places, unless evidence can be provided that the post-crash local conditions are identical on all pax places

Variation in backrest upright position greater than ±3 degrees from the tested seat (1/2)

FAA AC 25.562-1B Ch.1:

c. Variations and post certification changes requiring retest. Variations in the seat back structure materials, manufacturing processes, or construction method from the tested seat(s) may require retest.

(g) Variation in the seat back upright position of greater than ±3 degrees from the seat back to the seat structure from the tested seat, unless an acceptable analysis is provided per paragraph b. above.

- The rationale analysis must be considered specific to the geometry, design, test conditions, approximations and available test results applicable to the case investigated.
- In subsequent design changes, the proposed rationale analysis shall not be considered acceptable in absolute terms as a method of demonstration of compliance to HIC requirements.

Variation in backrest upright position greater than ±3 degrees from the tested seat (2/2)

- The proposed rationale analysis shall account for, but not limited to, the following aspects:
  - Low baseline HIC value
  - Comparable head path results
  - Comparable H-point
  - Equivalent point of impact
  - Equivalent Velocity and angle at impact

Consideration of tolerances in certification tests

- Relevant lap belt angle complying with ARP5526C paragraph 3.3.2 (f) (as modified by the ETSO) depends on the position of the SRP.
- The SRP measurement is affected by a tolerance. Accordingly this tolerance should be taken into account when determine the lap belt angle.
- Head path data acquisition is affected by an inherent photographic instrumental tolerance
- In case of demonstration of no impact with an object in front of the seat, the clearance with the object in front shall take into account the tolerance of head path data measurement and the tolerances applicable to the installation of the launch seat and target seat/monument.

Test article “BOM” vs Serial production “BOM”

- EASA is recently experiencing ETSO-Applications lasting relatively longer in time. As a consequence, the seat design may undergo design changes in parallel with the certification exercise, based on various inputs including industrialization and production deviations.
- The differences between the configuration of the test articles and the serial production seats shall be continuously tracked during the certification exercise, and justified before each test is performed.
- Dynamic test articles should be ballasted considering such differences and ensuring that the CG location and stiffness of the seat is not altered.
- A comparison between the certified configuration and the serial production configuration shall be provided at the end of the certification exercise.

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Thank you for your attention

Any question?

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