

ETSO Workshop 2022 - Industry session -

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**EASA Direktion
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Your safety is our mission.

ETSO certification for Seats in Advance Air Mobility

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ETSO Seats certification for Advance Air Mobility (AAM)

- EASA regulatory framework quickly developing
 - SC-VTOL Special Condition for VTOL and Means of Compliance | EASA (europa.eu)
 - High level performance based requirements (similar to CS23 Amdt 4)
- Means of Compliance (MOC) to EASA SC-VTOL
 - MOC-1 published, par. VTOL.2270 “Emergency Conditions”
 - MOC-2 published
 - MOC-3 currently being consulted
- EUROCAE/EASA developing means of compliance (MoC) to meet the SC
 - Seats, VTOL.2270(c)(d) Emergency landing conditions - Seat

EASA SC-VTOL: Applicability

- weight and passengers
 - MTOM of 3 175 kg (7 000 lbs) or less
 - nine or less passenger seats
 - aligned with CS-27
- low airspeed
 - V_{NO} or $V_{MO} \leq 250$ knots calibrated airspeed (KCAS) or a $M_{MO} \leq 0.6$
 - aligned with CS-23 low speed
- non pressurised
- more than 2 lift units



ETSO Seats certification for Advance Air Mobility (AAM)

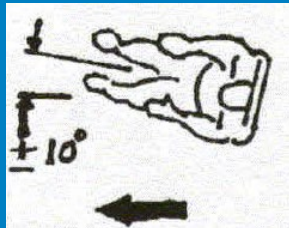
- SC-VTOL.2270 Emergency Landing
- Protect each occupant against injury that would preclude egress when
 - Using safety features (seat belts...)
 - The occupant experiences ultimate static inertia loads likely to occur
 - Must include dynamic conditions likely to occur
- MOC with SC VTOL.2270(b)1, (a) and (c) Emergency landing conditions: (see next slide)

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- *MOC VTOL.2270(b)(1) Emergency landing dynamic conditions*
- *This MOC provides a set of general design conditions that, when used in their entirety, are accepted to ensure adequate protection of occupants against injury in dynamic conditions that are likely to occur in an emergency landing.*
- *(a) CS 27.562(a) Amdt. 6 is accepted as a means of compliance.*
- *(b) CS 27.562(b) Amdt. 6 is accepted as a means of compliance under the following conditions:*
- *CS 27.562(b)(1) Amdt. 6 is accepted as a means of compliance, noting that the 30 g at seat attachment level was based upon the typical underfloor structure of a conventional rotorcraft. Therefore the 30 g is only valid if the structure underneath the seats has equal or better damping characteristics than a conventional rotorcraft. If specific design features are integrated, less than 30g at the seat may be acceptable based on analysis supported by tests*
- *CS 27.562(b)(2) Amdt. 6 is accepted as a means of compliance with the following addition: For CTOL peak floor deceleration should occur in not more than 0.05 seconds after impact and should reach a minimum of 26 g. For CTOL seat/restraint systems not being in the first row, peak deceleration should occur in not more than 0.06 seconds after impact and should reach a minimum of 21 g.*
- *CS 27.562(b)(3) Amdt. 6 is accepted as a means of compliance.*
- *(c) CS 27.562(c) Amdt. 6 is accepted as a means of compliance.*

MOC VTOL.2270(b)(1) (based on CS-23/27.562)

77 kg Test Dummy	Test 1 (downward) 60° canted upwards		Test 2 (Forward) 10° yaw	
	VTOL	VTOL+CTOL	VTOL	VTOL+CTOL
Min. Velocity	9.1 m/s 30 ft/s		12.8 m/s 42 ft/s	
Min. G Force	30 g *		18.4 g	1st row: 26 g Other: 21 g
Max peak floor deceleration after	0.031 s		0.071 s	0.05 s
Floor deformation	Degrees Roll: 10° / Degrees Pitch: 10°			



*Load factor is only valid if the structure underneath the seat has equal or better dampening characteristic than a conventional rotorcraft.

Seat Standard for eVTOL



Performance Standards for Passenger and Crew Seats in
Advanced Air Mobility (AAM) Aircraft

WORK IN PROGRESS!



ED-304

- EASA initiated working Groups with joint effort SAE Seat and EUROCAE to provide MOC material to enable compliance to SC VTOL.2270 (b)(2), (c) and (d), taking into account the emergency landing conditions specified in EASA MOC VTOL.2270(b)(1):
 - Overall design and geometry of the seat and the occupant restrain system
 - Occupant injury criteria
 - Permanent deformation / egress
- Worldwide harmonization of requirements and means of compliance applicable to VTOL seats.
- Streamlined certification of the installation of seats through the ETSO.

Seat Standard for eVTOL

Seat Type	Aircraft Category	Applicable Federal Regulations
D-C	Advanced Air Mobility Aircraft – Conventional Take Off and Landing (CTOL)* Forward/Aft facing only	14 CFR part 23 or 25
D-V	Advanced Air Mobility Aircraft – Vertical Take Off and Landing (VTOL)* Forward/Aft facing only	14 CFR part 27 or 29
D-VC	Advanced Air Mobility Aircraft – Vertical Take Off and Landing with characteristics of both CTOL and VTOL aircraft* Forward/Aft facing only	14 CFR 23, 25, 27 & 29 as appropriate

* An aircraft with characteristics of both CTOL and VTOL means that it has the ability to land both vertically and conventionally, on a runway. Seat type selection shall be defined by the aircraft Type Design holder, or applicant, appropriate to the vehicle.

Definition of CTOL

- VTOL aircraft present an intrinsic capability to take-off and land vertically. Some VTOL aircraft may additionally be able to take-off or land as conventional aeroplanes, accelerating and/or decelerating on a runway. This mode of operation as conventional aeroplanes, also named CTOL or “conventional take-off and landing”, is currently not defined in detail in the EASA SC/MOC on EVTOL.
- EASA has developed a proposal for a definition of CTOL: currently under discussion with the FAA.

Seat certification for Advance Air Mobility (AAM)

- Certification of seats within the TC certification process
- Could be the only path in case of seats integrated within aerostructures and not as “add-on” typical design for current A/C categories
 - More “integrated” approach would be necessary, ETSO path not applicable
 - The definition of additional SC and MOC may be required depending on the level of complexity of the design

Seat certification for Advance Air Mobility (AAM)

- ETSO process
 - Under the current ETSO-C127C
 - As Type B/Type C seats plus deviations to the current standard (i.e. 4-point restraint system etc.), or
 - By means of a unique Deviation to include categories as defined in SAE AS6849 once consolidated
 - Future Revision of C127 under CS-ETSO future amendment to include direct reference to SAE AS6849
 - Mid/Long term rulemaking update

Questions

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An Agency of the European Union 