

ED-307

GUIDANCE ON THE DEMONSTRATION OF ACCEPTABLE OCCUPANT SAFETY – EMERGENCY EGRESS

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CHAPTER 1

INTRODUCTION

1.1 PURPOSE AND SCOPE

This document contains minimum requirements for emergency egress on land.

There is no single MOC covering the full scope of VTOL.2315. The aspect of emergency egress on water has been covered by "MOC VTOL.2315(a) 1. Means of egress and emergency exits for Ditching, Emergency Flotation and Limited Overwater Operations".

Compliance with this standard is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation.

The equipment may also have additional functions for which other MOPS or ETSOs may be applicable or, it may contain additional functions not defined by any MOPS or ETSO and, non ETSO function guidance may be applicable.

1.2 APPLICATIONS

Compliance with this standard by manufacturers, installers and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function(s) under all conditions normally encountered in routine aircraft operations.

Any regulatory application of this document in whole or in part is the sole responsibility of appropriate government agencies.

As the measured values of equipment performance characteristics may be a function of the method of measurement, standard test conditions and methods of test are recommended in this document.

1.3 DESCRIPTION OF EQUIPMENT/FUNCTION

Equipment described in this standard is related to emergency egress on land and the respective functionality aims at enabling safe and efficient emergency egress.

1.4 DEFINITIONS AND ABBREVIATIONS

Table 1-1 Abbreviations

AFM	Aircraft Flight Manual
ETSO	European Technical Standard Order
FCEE	Flight Crew Emergency Exit
FPEEPM	Floor Proximity Emergency Escape Path Marking
MOPS	Minimum Operational Performance Standard
MOPSC	Maximum Operational Passenger Seating Configuration

1.5 REFERENCES

Table 1-2 Reference Documents

Document	Version	Date
EASA CS-23	Amendment 4	15 July 2015
EASA CS-29	Amendment 8	24 June 2020
EASA SC-VTOL	Issue 1	2 July 2019
EASA MOC SC-VTOL	Issue 2	12 May 2021
EASA CS-27	Amendment 9	17 December 2021
EASA CS-25	Amendment 27	24 November 2021
FAA AC 29-2C	Change 4	5 January 2014
EASA NPA 2008-04	-	10 April 2008
FAA AC 25.562-1B	Change 1	30 September 2015
FAA AC 25-17A	Change 1	24 May 2016
EASA NPA 2022-01	-	14 February 2022
FAA AC 25.812-2	-	24 July 1997
EUROCAE ED-14	G	6 May 2011
FAA AC 23-17C	-	17 November 2011
EUROCAE ED-304	-	7 October 2022
FAA AC 20-118A	-	9 March 1987

1.6 RELATIONSHIP TO SC-VTOL

Whilst this standard was developed with a particular view to the European legal framework, namely the EASA Special Condition VTOL Issue 1, it may be applied to support other regulatory frames.

As regards the EASA SC VTOL, this standard supports the showing of compliance with the following requirements and/or complements the following related Means of Compliance:

- VTOL.2315 (a) – limited to emergency egress on land

1.7 RELATIONSHIP TO OTHER DOCUMENTS

- EUROCAE ED-14 is referenced to define testing methods for emergency lighting equipment.
- EUROCAE ED-304 is referenced to define inertia loads on seats.
- ED-xxx (EUROCAE WG-112 SG-1 Document Project 003, currently under development) is referenced for details on the toxicity assessment of energy storage systems.

1.8 DISCLAIMER

The following note is referenced within this document to ensure clear traceability of passages that are reproduced from other documents and mark adaptations or additions.

[1]: This section is a reproduction of the document/paragraph specified hereafter. Any adaption or addition to the original text is marked in brackets as follows: <adapted/new text>.

CHAPTER 2

MEANS OF COMPLIANCE FOR EMERGENCY EGRESS ON LAND

2.1 PASSENGER EMERGENCY EXIT CONFIGURATION

2.1.1 Size and Supporting Features

<Passenger emergency exits should> provide a clear unobstructed opening <of the following size and shape.>

1. <Passenger emergency exits of Category Basic aircraft with a MOPSC of up to six should be> large enough to admit a 48-by-66 cm (19-by-26 in) ellipse.
2. <Passenger emergency exits of Category Basic aircraft with a MOPSC of more than six and Category Enhanced aircraft with any MOPSC should>
 - a. <admit a 48-by-66 cm (19-by-26 in) rectangle with corner radii of maximum 16 cm (6 in); and >
 - b. <provide a flat and horizontal lower sill with the aircraft in normal take-off attitude (compare APPENDIX C); and>
 - c. <have an internal step-up height of maximum> 74 cm (29 in).
 - d. <Openings larger than defined in 2.a that are allowed if the flat surface of the lower sill is at least 16cm (6 in) wide.>

[1]; [EASA CS-23 Amdt. 4 - 23.807(b) – ADAPTED; EASA CS-23 Amdt. 4 – 23.807 (d)(4)(i) - ADAPTED]

3. <Passenger emergency exits should be provided with an acceptable means to assist the occupants to descend to the ground, if the effective exit threshold is> more than 1.8 m (6 ft) above the ground
 - a. <with the aircraft in the normal boarding/deboarding configuration.>
 - b. <with the aircraft in any likely post-crash resting attitude as defined in 2.3.6.>

[1]; [EASA CS-29 Amdt. 8 - 29.809 (f) - ADAPTED]

- c. <The effective exit threshold should be measured from the lowest point of the opening of the exit, unless there is an obvious and safe path from the passenger emergency exit opening to a “descend point” from which the descend to the ground is intended. In the latter case the exit threshold of that descend point is decisive to judge whether an assisting means is necessary.>

2.1.2 Position and Number

1. There should be at least two passenger emergency exits.
2. There should be passenger emergency exits on two opposing sides of the cabin.
3. If the aircraft architecture does not allow for the passenger emergency exits to be positioned on opposing sides of the cabin, they should be positioned such that
 - a. at least two emergency evacuation routes are available; and
 - b. the emergency evacuation routes are located with sufficient separation to minimize the possibility of an event outside of the aircraft rendering both routes inoperative. This can be achieved by assuming a “180°-hazard zone” in any possible location adjacent to the aircraft and ensuring that for each of these locations at least one emergency evacuation route is available that is not directed towards the hazard zone. A straight emergency evacuation route perpendicular to the aircraft should be assumed. For further guidance compare APPENDIX A.
4. The main door may be considered a passenger emergency exit if it complies with the guidance provided in this document.

5. <The passenger emergency exits should be located to minimize the risk of occupants being subject to> hazards originating from high energy <during and immediately after egress for the normal boarding/deboarding configuration and the attitudes defined in 2.3.6. High energy hazards include, but might not be limited to,> contact with a highspeed rotating part, with a high temperature surface, with a high velocity and/or temperature gas jet, or with an electrically live conductor. <The risk can be minimized by:>

[1]; [EASA CS-23 Amdt. 4 - 23.807 (a)(4) – ADAPTED, VTOL.2320(a)(2) – ADAPTED, MOC VTOL.2320(a)(2) – ADAPTED]

- a. <design precautions (e.g. exit interlock features) to prevent the presence of high energy at a critical location; or>
- b. physical barrier means <that can reasonably be assumed to be intact post crash and effective in the normal boarding/deboarding configuration and for the attitudes defined in 2.3.6; or>
- c. <safe egress volumes>
 - i. <based on occupants ranging from the 5th percentile female to the 95th percentile male; and>
 - ii. <considering likely behaviour of occupants during a quick egress following an emergency landing with body positions and postures that are expected during an emergency evacuation; and >
 - iii. <for each passenger emergency exit with the aircraft in a normal boarding/deboarding configuration; and >
 - iv. <for at least one passenger emergency exit with the aircraft in any of the attitudes defined in 2.3.6; and>
 - v. <combined with warning signs on potentially hazardous components; or>
- d. <a combination of 5.a, 5.b, and 5.c.>

6. <During emergency egress the exposure to toxic gases originating from the energy storage system should be minimized, e.g., by maximizing the distance between the passenger emergency exits and potential sources or outlets for toxic gases as far as reasonably practicable. Details for the toxicity assessment of the energy storage system as covered in ED-xxx (EUROCAE WG-112 SG-1 DP003 under development) may be taken into account.>

[1]; [MOC VTOL.2320(a)(2) – ADAPTED]

2.2 PASSENGER EMERGENCY EXIT FUNCTIONALITY

2.2.1 Internal and external operation

1. <Passenger emergency exits should be> openable from both inside and outside <the aircraft>.

[1]; [EASA CS-23 Amdt. 4: 23.807(b) - ADAPTED]

2. <If auxiliary locking devices are used to secure the aircraft, they should be designed to be> overridden by the normal internal opening means. <An auxiliary locking device is an optional means to lock the door of the aircraft to avoid persons entering, for example when parked and unoccupied.>

[1]; [EASA CS-23 Amdt. 4 – 23.807 (b) - ADAPTED]

2.2.2 Intuitive use and opening effort

1. <Passenger emergency exits should> have a method of opening that is simple and obvious. <This should be achieved through the following design characteristics.>

[1]; [EASA CS-23 Amdt. 4 - 23.807 (b) (2) - ADAPTED]

- a. The handle or respective opening mechanism should be operable with a single hand, so that the other hand can be used to counteract required opening forces.

- b. Where practicable dedicated handles fixed to the airframe should be implemented to support the opening procedure and help occupants to stabilize themselves while opening the exit.
 - c. A placard must be <installed> near each emergency exit control and must clearly indicate the location of that exit and its method of operation. <Compare also 2.4.>
[1]; [EASA CS-27 Amdt.9 - 27.1557 (d) - ADAPTED]
2. <Testing with naïve subjects should be performed in order to demonstrate that opening the passenger emergency exits is simple and obvious.>
- a. The demonstration may be conducted either on the <aircraft> or on a representative mock-up, and it should include all the relevant safety markings and exit opening instructions.
 - b. <Test subjects should not have had any training or rehearsing before the test, and neither should have been involved in designing the emergency exit.>
 - c. <A pre-take-off passenger briefing as intended for normal operations may be provided.>
 - d. The opening of the passenger emergency exit should be demonstrated by a sufficient number of naïve test subjects selected to be representative of the passenger population with respect to gender, age, size, and handedness. Meeting the criteria of <2.7 10> is an acceptable means to achieve a representative age and gender distribution of the participants in the test.
[1]; [EASA CS-25 AMDT. 27 - 25.809(c) and (e) - ADAPTED]
3. The effort required to open the exit <should be> evaluated through <equipment level> tests that consider temperature influence on the opening force.
- a. If the effort required to open the exit is <above 40 pounds, a test subject representative of a 5th percentile female person should be used for an exit opening demonstration. This demonstration may be combined with the test for intuitive use described above and can be performed at room temperature.>
 - b. In any case, the average load required to operate the exit release mechanism and open the exit should not exceed 50 pounds, and the maximum individual load of <an equipment level> test series should not exceed 55 pounds.

[1]; [FAA AC 29-2C 29.809 b. (1) - ADAPTED]

2.2.3

Jamming protection

- 1. There should be means to minimise the probability of the jamming of any passenger emergency exit in a crash landing as a result of fuselage deformation under a vertical impact velocity of 7.9 m/s (26 ft/sec). For configurations with retractable landing gear, the assessment should be carried out with the landing gear retracted.
- 2. There should be reasonable provisions to prevent the jamming of any external door in a minor crash as a result of fuselage deformation up to a vertical impact of 3 m/s (10 ft/sec), except for cargo or service doors not suitable for use as an exit in an emergency. For configurations with retractable landing gear, the assessment should be carried out with the landing gear retracted.
- 3. Compliance with 1 and 2 may be demonstrated by:
 - a. Design <or jettison> features of doors <and passenger emergency exits> which are insensitive to large fuselage deflections for door <or passenger emergency exit> operation; or
[1]; [FAA AC 29-2C 29.783 b. (4)(i) - ADAPTED]

- b. Provision of clearance between door <or passenger emergency exits and the respective frame latching devices> sufficient to allow some relative deflection between the door <or passenger emergency exits and the respective frame,> and still allow their operation. The relative deflections may be determined by validated analysis approved by the <authorities>; or [1]; [FAA AC 29-2C 29.783 b. (4)(iii) - ADAPTED]
 - c. Validated dynamic crashworthiness analysis of the aircraft up to the specified vertical impact velocities, showing that these conditions do not result in jamming of external doors and emergency exits.
4. Under the static inertia loads defined in 2.8.1 items of mass inside the cabin should not cause any interference with the opening of a passenger emergency exit or a deformation of the fuselage structure that could lead to jamming. This may be verified via validated analysis methods. The jamming potential should be assessed post load application, not while the loads are being applied.

2.2.4 Exit hatch disposal

<Passenger emergency exit hatches or jettisonable passenger emergency exits should be designed such that, when opened from the interior, they are always disposed towards the exterior to prevent interference with the evacuation procedure.> [inspired by EASA NPA 2008-04]

2.3 PASSENGER EMERGENCY EXIT ACCESS

2.3.1 Aisles and Passageways

1. For the purpose of this paragraph an aisle is considered a passage which continues along more than one seat row. Note that the aisle width does not refer to the seat pitch between seat rows. The nominal aisle width at any point between the seats should equal or exceed the following values.

	Less than 63 cm (25 in) from floor	63 cm (25 in) and more from floor
Aisle width	30 cm (12 in)*	38 cm (15 in)

[1]; [EASA CS-29 Amdt.8 – 29.815 - ADAPTED; The values for less than ten passengers chosen in alignment with the maximum passengers allowed as per SC-VTOL.]

* <For less than 63 cm (25 in) from the floor a narrower width not less than 23 cm (9 inches) may be approved when substantiated by tests found necessary by the authority.>

[1]; [EASA CS-29 Amdt. 8 – 29.815 - ADAPTED]

The defined minimum aisle widths consider the adverse effects of possible post-crash seat deflections. This is assuming that the deformed seat does not encroach more than the following values in the sideward direction under the seat tests defined in EUROCAE ED-304 and the static inertia loads defined in 2.8.1:

- 1.5 inches (38 mm) into the required longitudinal aisle space at heights up to 25 inches (635 mm) above the floor
- 2.0 inches (50 mm) into the longitudinal aisle space at heights 25 inches (635 mm) or more above the floor

[1]; [FAA AC 25.562-1B, Change 1, Appendix 2]

2. For the purpose of this paragraph, a passageway is considered a passage that connects an aisle or seat with a passenger emergency exit. A passageway passes along a seat row, or between seat rows. A passageway with the characteristics defined in this section is only required if the number of passengers expected to use the respective exit is greater than three under the assumption that all emergency exits are functional.

- a. The passageway should provide an unobstructed width of at least
 - i. 25.4 cm (10 in) for interior arrangements in which the adjacent seat rows on the exit side of the aisle contain two seats, or
 - ii. 33 cm (13 in) in width for interior arrangements in which the adjacent seat rows on the exit side of the aisle contain three seats.
- b. The width of the passageway must be measured with adjacent seats adjusted to their most adverse positions.
- c. Under the dynamic conditions (for seats only) defined in EUROCAE ED-304 (dependent on seat type) and under the static inertia loads defined in 2.8.1 (for any item of mass within the cabin) no item should encroach into any required passageway, unless it is a minor obstruction in accordance with 2.3.2 2. For seats the assessment should include deployable features like leg rests or tray tables.
- d. At least 25.4 cm (10 inches) of the required passageway width must be within the required projected opening width of the exit.
- e. For category Enhanced VTOL that utilize the main passenger door as certified emergency exit passageways leading to the main passenger door should be at least 51 cm (20 in) wide irrespective of the number of seat places along which the passageway continues.
[1]; *[value based on EASA CS-23 Amdt.4 – 23.813 (b) (1)]*

Compare also APPENDIX B.

Note that this section is valid for aircraft with a maximum passenger seating configuration of nine in line with EASA SC-VTOL-01 (compare also 0)

2.3.2

Passenger Emergency Exit Access

1. Access to passenger emergency exits should not be obstructed by <seats, seat backs or any other components.
 - a. The projected opening of the passenger emergency exit should not be obstructed by seats, seat backs or any other components for a distance from the exit of not less than the width of the narrowest passenger seat installed on the aircraft.
 - b. <This should be assessed for any intended position or configuration of the components, or alternatively the most critical configuration anticipated for take-off and landing. The nominal seat dimensions should be used for the assessment.>
[1]; *[EASA CS-23 Amdt. 4 – 23.813 (a) - ADAPTED]*
 - c. The permanent deformations recorded in the seat tests defined in EUROCAE ED-304 and under the static inertia loads defined in 2.8.1 should not affect the operation of any passenger emergency exit or encroach into an emergency exit opening for a distance from the exit not less than the width of the narrowest passenger seat installed in the aircraft or 40 cm (15.75 inches), whichever is the least, unless it is a minor obstruction in accordance with 2.3.2 2. The assessment should include deployable seat features like leg rests or tray tables.
[1]; *[FAA AC 25.562-1B, Change 1, Appendix 2]*
2. <However, minor obstructions can be accepted>, if there are compensating factors to maintain the effectiveness of the exit.
[1]; *[EASA CS-25 Amdt.23 - 25.813 (c) (4) (ii) - ADAPTED]*
 - a. An item may be acceptable as meeting the intent of a minor obstruction provided that, as soon as an occupant begins to open the passenger emergency exit using only the required and visible operating handle, the obstruction moves such that the occupant instinctively understands how to complete removal of the obstructive item. Examples of such items are