

EASA/FAA Harmonisation on eVTOL certification

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Statement of the scope of this presentation

EASA and the FAA are continuing the harmonization of the certification criteria and applicable means of compliance (MoCs) for eVTOLs in several technical domains.

This presentation would like to share the status of the harmonization effort for the requirements and MoCs that address handling qualities and performance.

The material presented is still under development, **and are only the recommendations the harmonization group have made**, and may change in the future when the authorities will formally publish, according to their internal procedures, the official material.



Agenda

EASA and FAA approach to eVTOL certification

Definitions

Subpart B

Harmonized requirements

Handling Qualities levels

Target Handling Qualities levels

Future roadmap

Questions



EASA and FAA approach to eVTOL certification

EASA revised SC VTOL, now at issue 2, dated 10 June 2024. In addition, a further revision of the Special Condition is planned in the short term to implement further alignments between the European Union Aviation Safety Agency (EASA) and the US Federal Aviation Administration (FAA).

FAA published the Powered Lift and Special class rotorcraft Advisory Circular, so that future eVTOL project would make use of one or the other, depending on their design.

The Federal Aviation Administration (FAA) and European Union Aviation Safety Agency (EASA) have achieved a significant milestone on the path to certifying electric vertical take-off and landing (eVTOL) aircraft. This also marks important progress in our effort to more closely align rulemaking and policy initiatives between the United States and the European Union. We're committed to ensuring the safety of the flying public both at home and abroad.



Definitions

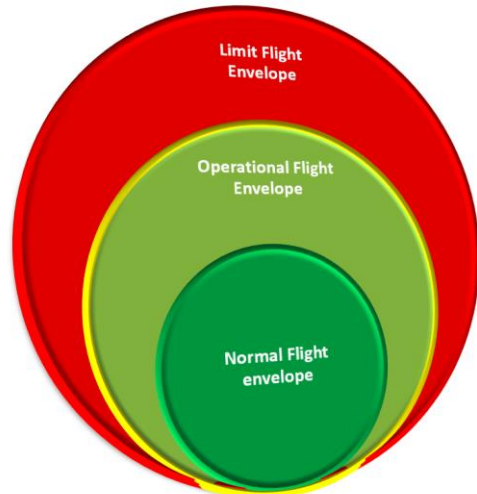
Definitions are key to interpret correctly the requirements, especially in a performance based regulation

EASA and FAA harmonization team went over all the relevant words in both set of requirements, and compiled a list of them that were then discussed in different meetings

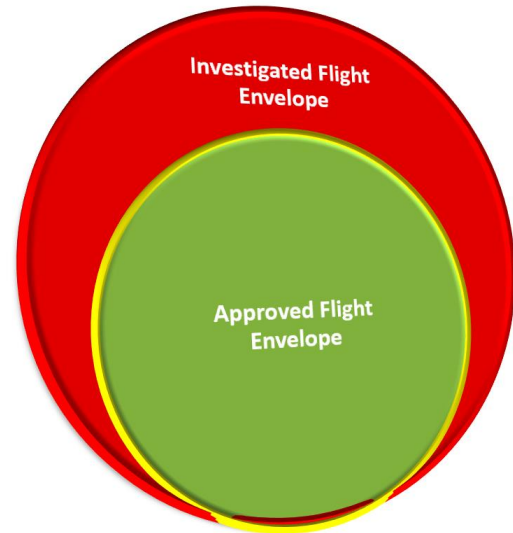
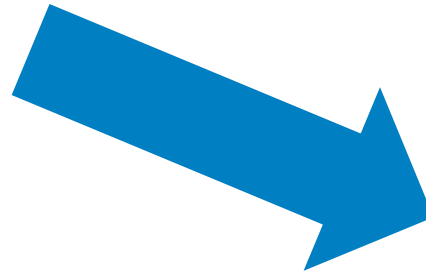
Many words definitions have been harmonized, and will be included in future official documents releases from both EASA and FAA



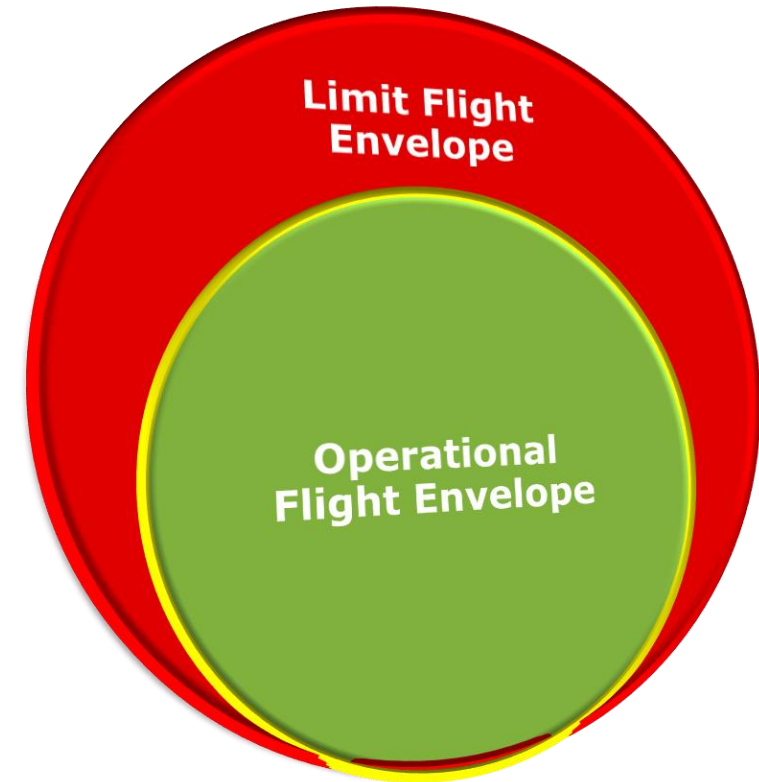
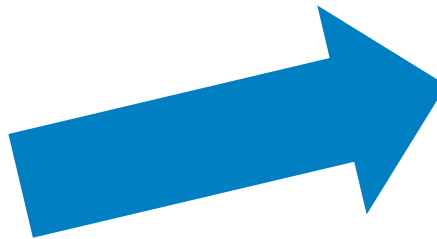
Definitions - Flight Envelopes



EASA



FAA



Definitions - Flight Envelopes

Operational flight envelope:

- Operational flight envelope refers to the range of conditions within which it is deemed safe to operate an aircraft. These conditions encompass various combinations of weight and CG, flight profiles, ambient conditions, and likely failures.

Limit flight envelope

- Limit flight envelope refers to the range of conditions within which an aircraft has been thoroughly evaluated during its certification process. This envelope includes various combinations of flight profiles, ambient conditions, and possible failures that have been explored to show compliance to the applicable requirements.



Subpart B – requirements overview

Performance

XX.2100 Mass
and centre of
gravity

XX.2105
Performance
data

XX.2115
Take-off
performance

XX.2120
Climb
requirements

XX.2125
Climb
information

XX.2130
Landing

**Future activity, except
XX.2105 (g)**

Flying qualities

XX.2110 Flight
Profiles

XX.2135
Controllability and
Manoeuvrability

XX.2140 Control
forces

XX.2145 Flying and
Handling qualities

XX.2150 Minimum
safe speed
characteristics and
warning

XX.2155 Ground
and water handling
characteristics

XX.2160 Vibration,
buffeting, and high-
speed
characteristics

Mainly harmonized

Future activity

Icing

xx.2165 Performance
and flight
characteristics
requirements for flight
in atmospheric icing
conditions.

Future activity

Flight information

XX.2170
Operating
Limitations



Subpart B – flying qualities overview

Controllability, Manoeuvrability, Flying and Handling qualities

VTOL.2135
Controllability and
Manoeuvrability

VTOL.2140
Control forces

VTOL.2145
Flying and
Handling
qualities

Profiles, minimum and high speed characteristics

VTOL.2110 Flight
Profiles

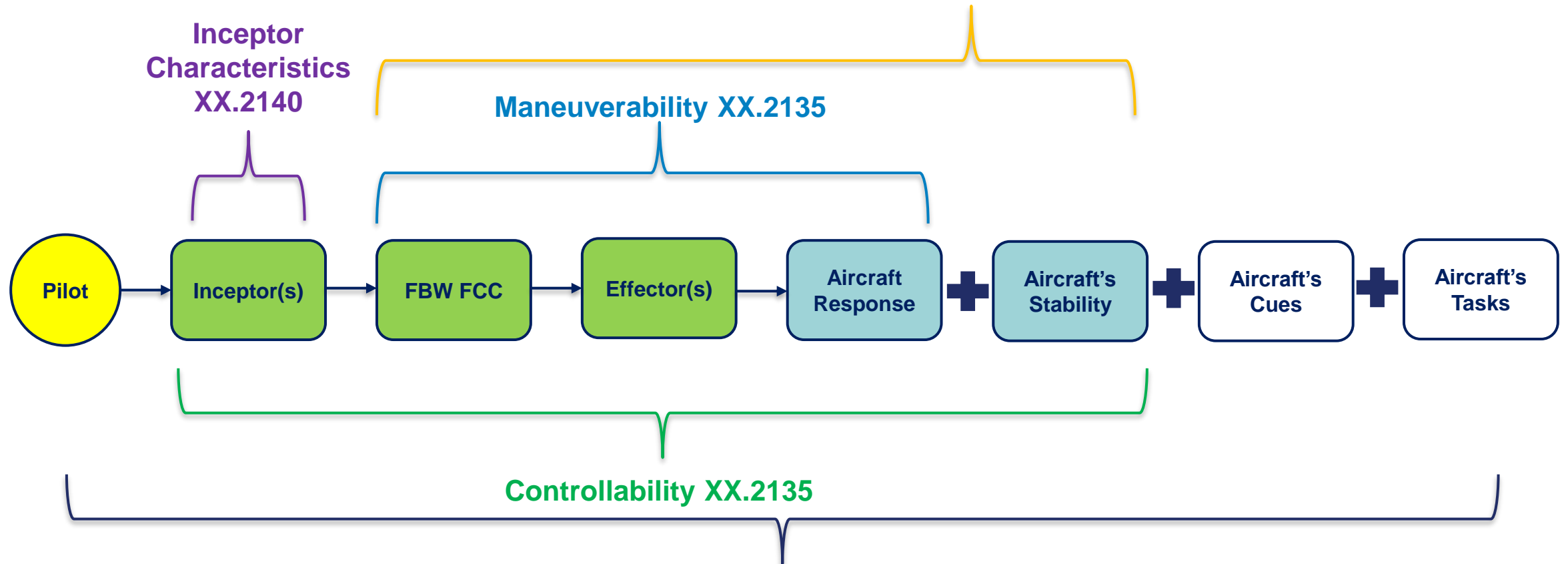
VTOL.2150
Minimum safe
speed
characteristics and
warning

VTOL.2160
Vibration,
buffeting, and
high-speed
characteristics



Subpart B Controllability and Handling Qualities

Flying Qualities XX.2135 + XX.2145



XX.2135 Controllability and Manoeuvrability

(a) The aircraft must be controllable and maneuverable, without requiring exceptional piloting skill, alertness, or strength, within the operational flight envelope

- (1) At all loading conditions for which certification is requested; In all ambient conditions expected in service;
- (2) During all phases of flight
- (3) in all likely degraded flight control system operating modes and likely failure conditions;
- (4) During configuration changes;
- [...]



XX.2135 Controllability and Manoeuvrability

- [...]
- (6) the applicant must demonstrate controllability in wind from zero to a wind limit appropriate for the aircraft type. [EASA]
- (6) In thrust-borne operation, and must be controllable in wind velocities from zero to at least 17 knots from any azimuth angle; and [FAA]
- (7) The aircraft must be able to safely complete a landing using the steepest approach gradient procedures.
- [...]



XX.2135 Controllability and Manoeuvrability

[...]

(b) The applicant must determine critical control parameters, such as limited control power margins, and if applicable, account for those parameters in appropriate operating limitations.

(c) It must be possible to make a smooth transition from one flight condition to another or response-type changes without exceeding the operational flight envelope.



XX.2140 Control Forces

(a) NOT HARMONIZED

(b) NOT HARMONIZED

(c) Control forces must not fatigue or distract the flight crew during normal operations of the aircraft and likely abnormal or emergency operations. There must not be any undesirable discontinuities in control force gradients.



XX.2145 Flying and Handling Qualities

(a) Within the operational flight envelope, the aircraft handling qualities and stability must be such so that the flight crew is capable to maintain safe operation of the aircraft and to perform any task required for the intended kind of operation:

- In all nominal and likely failure conditions
- In all ambient conditions expected in service
- Considering excursions from the operational to the limit flight envelope

(b) Reserved.

NEW!!



XX.2110 Flight profiles

(a) The applicant must determine the flight profiles used in the operational flight envelope. The flight profiles determination must account for the safe speeds and the most adverse conditions.

NEW!!



XX.2150 Minimum safe speed characteristics and warning

(a) The aircraft must have controllable minimum speed characteristics, including stalls, in straight flight, turning flight, and accelerated turning flight including a **sudden change of thrust** with a clear and distinctive warning that provides sufficient margin to prevent inadvertent departure from controlled flight

NEW!!



XX.2155 Ground and water handling characteristics

For aircraft intended for operation on land or water, the aircraft must have controllable longitudinal and directional handling characteristics during taxi, takeoff, and landing operations

NEW!!
(for EASA)



XX.2160 Vibration, buffeting, and high-speed characteristics.

(a) Each part of the aircraft must be free from excessive vibration and buffeting throughout the limit flight envelope.



XX.2105 Performance data

[...]

(g) An aircraft must be capable of a controlled emergency landing when the aircraft is unable to provide the rated power for continued safe flight and landing unless a means to mitigate or avoid the associated risks is provided.



Handling Qualities levels

Handling Qualities Level	Description	Cooper-Harper Rating Scale (CHR)
Level I	Handling Qualities allow achievement of desired performance with no or <u>minimal pilot compensation</u> .	1-3
Level II	Handling Qualities allow achievement of desired performance criteria or adequate performance criteria <u>with moderate to extensive pilot compensation</u> .	4-6
Level III	Handling Qualities DO NOT allow achievement of neither desired nor adequate performance. Allows however continued safe flight and landing .	7-9



Target Handling Qualities levels

FLIGHT CONDITION	Atmospheric Disturbance (AD)			
	Up to Moderate		Severe	
	Flight Envelope (FE)			
Aircraft State/Failure Condition-effect on HQs (FC)	Approved Envelope	Investigated Envelope	Approved Envelope	Investigated Envelope
Nominal Condition to Minor	Level I	Level III NOTE 2	Level II NOTE 1	Level III NOTE 1 NOTE 2
Major to Hazardous	Level II		Level III NOTE 1	
NOTE 1: This is considered to be a transient condition, and it is expected that better HQR will be achieved when the AD level is decreased. NOTE 2: It should be demonstrated that better HQRs are achieved in the more favourable Flight Envelopes; such transition should be relatively quick and without requiring exceptional piloting skills.				



Future roadmap

Develop common MoC material

- Develop MoC XX.2145
- Develop MoC 2105 (g)

Continue developing common MoC XX.2150 based on the principles already shared

Continue harmonizing the flying qualities requirements

Performance requirements and applicable MoC material harmonization (planned starting end of 2024)

Draft a “eVTOL Subpart B flight test guide”, starting with the flying qualities section

Work with industry partners to align standards recognized by FAA and EASA

Draft MoC. XX.2110, MoC XX.2135 (“new”), MoC XX.2140, MoC XX.2160



Thank you
for your attention!

Your safety is our mission.

