# DOARI 2021-01 Consultation Paper

## 1 Introductory Note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board Decision No 12-2007 products certification procedure dated 11th 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."

## 2 Original PART 21 requirement and/or AMC

21.A.243(a); 21.A.245(a); Part 21 Appendix XII,
AMC to 21.A.143, 21.A.243, 21.A.14(b), 21.A.112B(b) and 21.A.432B(b) Flight Test Operations Manual (FTOM)

## 3 Problem Description

21.A.243(a)(ii) requires holders of a Design Organisation Approval to provide a Flight Test Operations Manual defining its crewing policy including competency in accordance with Appendix XII of Part 21, if flight tests are to be conducted. Appendix XII to Part 21 provides clarification on flight test activity for aircraft certified or to be certified in accordance with CS-23 for aircraft of or above 2.000 kg maximum take-off mass (MTOM), CS-25, CS-27 and CS-29 and "equivalent airworthiness codes". The flight test category is determined based on the certification specification code and MTOM of the aircraft, and for each category the pilot and lead flight test engineer competence level is defined. For pilots involved in flight test activity, for each competence level, there is a reference to Part-FCL (i.e. FCL.820 for flight test rating). For lead flight test engineers there are detailed experience/training requirements to be fulfilled according to the comptetence level.
Requirements related to conduct of flight testing, specifically 21.A.243(a) and Appendix XII, have been introduced in 2015 via Commission Regulation (EU) No 2015/1039.
Part FCL has initially been issued in 2011 by Commission Regulation (EU) No 1178/2011.
At the time these regulations have been published VTOL aircraft driven by electric propulsion and capable of being piloted also remotely were not yet available and their specifics consequently have not been considered neither in Part 21 (including Appendix XII) nor in Part FCL.
Meanwhile there are several applications for certification of such aircraft and a respective certification basis in the form of SC-VTOL has been established. Progress on design activities is fast and first design organisations are approaching the stage where development and certification flights are about to commence.
A clarification is therefore needed for:

a) Should SC-VTOL be considered an 'equivalent airworthiness code' as addressed in Appendix XII, to understand the applicability of the Appendix;

b) How to align aircraft to be certified i.a.w. SC-VTOL with the current Part FCL categorization into 'aeroplanes', 'helicopters' and 'powered-lift aircraft' to establish minimum flight crew licence requirement;
c) What would be EASA expectation for the competency requirements if Appendix XII does not apply.

This DOARI is intended to address flight test crew involved in flight test activities on aircraft that meet the applicability criteria of SC-VTOL-01 i.e.:
- a person-carrying vertical take-off and landing (VTOL) heavier-than-air aircraft in the small category, with lift/thrust units used to generate powered lift and control;
- distinct from conventional aeroplanes by its VTOL capability or;
- distinct from conventional rotorcraft by the use of distributed propulsion;
- with a passenger seating configuration of 9 or less and;
- a maximum certified take-off mass of 3 175 kg (7 000 lbs) or less.

## 4 Industry Position

N/A

## 5 EASA position

**a) Applicability of Part 21, Appendix XII:**

Part 21, Appendix XII states that it "establishes the qualifications necessary for flight crew involved in the conduct of flight tests for aircraft certified or to be certified in accordance with CS-23 for aircraft with a maximum take-off mass (MTOM) of or above 2 000 kg, CS-25, CS-27, CS-29 or equivalent airworthiness codes."
Reference to "equivalent airworthiness codes" had been introduced to also cover aircraft that had been certified with the equivalent JAR predecessors of the mentioned Certification Specifications or the respective FARs. It has not been the intent to address eventual future certification specifications for designs yet unknown at that stage.

Preamble to SC-VTOL-01 further specifies that neither CS-23 nor CS-27 alone had been found adequate to address the design specifics of the various aircraft to be covered by that Special Condition but that it had to be based on a combination of relevant requirements from both CS taking into account some CS-25/29 details to properly address different types of operation.

As the equivalence mentioned in Appendix XII would be related to any single certification specification listed, further content of that Appendix introducing different requirements for those CSs could not be applied to an airworthiness code that in essence is a mix of aforementioned codes.

**Conclusion:**
For the reasons described above, SC-VTOL is not considered to be an equivalent airworthiness code to CS-23 for aircraft with an MTOM of or above 2 000 kg, CS-25, CS-27 or CS-29.

**b) Alignment of VTOL aircraft designs with Part FCL definitions (FCL.010)**

Annex IV to Regulation (EU) 2018/1139 establishes the essential requirements for aircrew. Point 1.2 provides a list of minimum theoretical knowledge requirements and point 1.4 specifies the required practical skills.

Both, theoretical knowledge and practical skills, must be "appropriate to the functions exercised on the aircraft" which requires to take into account the actual category, class or type of aircraft, as applicable.

Part FCL further specifies these essential requirements for defined aircraft categories that are determined by requiring sufficiently similar piloting skills (aeroplanes, helicopters, powered-lift aircraft, balloons and airships).

Current VTOL designs could match FCL.010 definitions of either 'powered-lift aircraft' (vectored-thrust designs, i.e. aircraft that are powered by several lift/thrust units that may be tilted to provide the desired lift and/or thrust) or 'helicopter' (multicopter designs, i.e. aircraft that are powered by several fixed rotors each driven by its own power unit).

The required piloting skills however may deviate significantly from the 'conventional' designs, especially as electric propulsion is bringing to the market many new design solutions. The initial assumptions that justify the link between the aircraft categories defined in FCL.010 and the respective training syllabi do not necessarily apply and should therefore be replaced by an overall assessment on the aircraft design, flight controls and lift/thrust architecture, in order to determine what are the required theoretical knowledge and practical skills expected from the aircrew. These could be more comparable to conventional helicopters, airplanes or powered-lift aircraft.

**Conclusion:**
Strict application of FCL.010 definitions on VTOL designs is considered to be inappropriate.
Similar to the 'powered-lift aircraft' approach already established, a pilot licence in either 'aeroplane' or 'helicopter' or both categories could be defined as adequate basic licence for a given VTOL, provided that a gap analysis is performed to identify any required difference training.

**c) Expected competences for flight crew performing development or certification flights**
Competence requirements need to be specified by the DOA holder or applicant in their FTOM and accepted by the Agency. Acceptable competence requirements should at least address
- General flight competences;
- Development/certification flight competences;
- Project specific related competences.

The competences of the flight crew have to ensure that flight testing will be performed safely and will provide valid data to either evaluate the aircraft design in its development phase or to demonstrate compliance with SC-VTOL requirements during certification.

<u>General flight competences:</u>
The competences should be equivalent to Part-FCL prerequisites for applying for Flight Test Rating for the specific aircraft category identified in the overall assessment of the aircraft design as required by point b) above. So in essence at least a CPL (A or H) would be required, while a valid IR rating would only be required if IFR certification is foreseen.

<u>Development/Certification flight competences:</u>
As explored in point a) above Appendix XII to Part 21 does not apply to aircraft to be certified in accordance with SC-VTOL.

Exemptions from Appendix XII applicability, as established for CS-23 aircraft below 2000 kg MTOM, had been introduced to capture the fact that the required competences would not be proportionate to the lower complexity of aircraft falling into this category.
For the time being, until further experience is gained, aircraft certified or to be certified under SC-VTOL are expected to be as complex, at least in some areas, as those certified or to be certified under CS-27 code, regardless of the MTOM.
Therefore a flight test rating is deemed necessary to cover all development and certification flights on this kind of aircraft. In analogy to the Appendix XII alleviation for some CS-23 aircraft, Category 2 competence level is considered to be sufficient to cover the development and certification flight test competence.
The flight test rating may be issued for any aircraft category (i.e. 'aeroplane' or 'helicopter'), as the development/certification competences required are considered to be common to both categories.

Project specific related competences:
these competences should cover the 2 following aspects:

- Design specific competences:
  the crew should receive appropriate training on the specific aircraft characteristics, such as flight control system (FCS), lift/thrust units (LTUs) characteristics, or other "novel" or "unconventional" (compared to helicopters, airplanes) characteristics.
- Flight techniques while performing data gathering according to the applicable Means of Compliance:
  Competences to perform the specific flight techniques defined in the procedures, that will be used to perform certification flights. These techniques are usually based on the conventional helicopter and airplane flight test techniques, with the required adaptations based on the VTOL design and chosen MoCs.

The design organization shall define in a training programme how these competences are conveyed.

## 6 Final disposition after consultation process