Contents

1. GENERAL / UNRELATED

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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01-01	Rolls Royce (Andy Roberts)	n/a	n/a	The MOC covers only some aspects related to battery systems. Reference to a comprehensive MoC covering batteries to be used as part of power plants is required, including particular aspects related to thermal events.	Include references to the MOC to be applied for all relevant aspects of battery systems.		Yes	Noted	MOC are under development to address different requirements in the Special Condition VTOL with regards to battery systems. In some cases industry standards will be recognised by EASA as means of compliance with the Special Condition VTOL.
01-02	Rolls Royce (M.Kimmerle (RRE))	VTOL.2330	-	A detailed guidance on the definition of a designated fire zone would be helpful as the electrical propulsion itself does not fall into the definition of a designated fire zone as defined in AC25.863-1 Draft.	Please clarify	Yes	No	Accepted	Due to the complexity of this subject, EASA intends to publish the MOC VTOL.2330 in the following incremental steps: (a) Step 1: Air cooled engine with rechargeable batteries as electrical energy storage system not liquid cooled, (b) Step 2: Air cooled engine with the liquid cooled battery (oil, glycol water, etc…), (c) Step 3: Other energy storage technologies (e.g. fuel cells, capacitors) or hybrid propulsion. For instance: liquid cooled engine with liquid cooled battery.
01-03	Rolls Royce (M.Kimmerle (RRE))	VTOL.2330	-	Is the AC25.863-1 Draft an acceptable means to identify zone classification with regards of fire?	Please clarify	Yes	No	Noted	A specific Means of Compliance with VTOL.2330 “Fire protection in designated fire zones” will be published.
01-04	Rolls Royce (Thomas Frank)	general		What are the requirements in respect of thruster vibration strength when subject to ground vibration and translation effects when changing from vertical to horizontal velocity ?	Please clarify	yes	no	Noted	Only fans are covered by the SC E-19. Other kind of thrusters should be considered as part of the SC VTOL. Vibrations are addressed under Subpart E for “lift thrust unit installation” SC-VTOL 2400 (c)(4). More generally, the SC-VTOL 2160 “Vibrations” request the aircraft to be free from excessive vibrations (Subpart B, flight). Further guidance will be provided in the MOC VTOL.2160
01-05	Rolls Royce (Thomas Frank)	general		the electrical safety aspects and hence means of compliance are assuming batteries as power source. However, how to treat alternative sources such as fuel cells ?	Please clarify	yes	no	Noted	The Means of Compliance are being developed stepwise. Initially, they address the technologies that are present in those projects that are likely to be certified first. Fuel cells and other systems will be covered in future updates of the Means of Compliance.
01-06	Rolls Royce (Adam Newman)			I am surprised to see such few references to CS-E derived requirements, although this may be indirectly reached through CS-27 mirroring. Similarly, I am surprised to see few references to electrical standards such as IEC60034 and IEC600349 which could offer acceptable guidance on MoCs for electrical machines	Consider if other regulations and rules could be used to enrich the MoCs	Yes	No	Noted	MOC.2400(b) refers to the EASA Special Condition E-19 on Electric/Hybrid Propulsion System. This Special Condition is based in part in CS-E and its Means of Compliance will also be based on CS-E as well as existing (or future) standards.

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01-07	*Rolls Royce (Adam Newman)*			Considering this document is prioritised with sequential releases planned, consider if any of the following topics (taken from a cursory inspection of CS-E) should be prioritised for this first issue as they may have a similar influence on overall architectural design and / or safety. • Cooling and lubrication systems • Continued rotation after shutdown for any reason while in flight • Ingestion of foreign matter, rain and hail, freezing fog, ice crystals and volcanic ash • Performance and functioning • Vibration • Endurance Emissions		Yes	No	Noted	Some of the topics proposed are noted for the development of future MOCs. In some other cases the proposed topics are not to be addressed at the airframe certification level that the Special Condition is covering, but at the level of the powerplant certification or at the level of the environmental certification.
01-08	FAA SASB Icing	Subpart E	48	MOC for VTOL.2415 is missing. EASA's draft SC E-19 for Electric/Hybrid Propulsion Systems: **"EHPS.280 Icing and snow conditions** The EHPS and any of its sub-system must function satisfactorily when operated throughout the conditions of atmospheric icing (including freezing fog on ground) and falling and blowing snow defined in the propulsive system installation ice protection specifications of the Type-Certification basis of the intended aircraft application, as specified in EHPS.30 (e)." The meaning is unclear. Does it mean that if aircraft is not certified for snow or icing conditions, snow or icing (even inadvertent encounters) don't need to be addressed? Another draft SC E-19 question: **EHPS.270 Rain conditions:** "The EHPS must be designed and/or installed such that it is capable of satisfactory operation throughout its specified operating envelope when subject to sudden encounters with the certification standard concentration of rain."	Add MOC for VTOL 2415. Clarify the snow and rain requirements, including for aircraft not certified to fly in either snow or icing. Also please specify the rain concentration for draft SC EHPS.270.	Yes	Yes	Noted	EASA is developing Means of Compliance with VTOL.2415, they may recognise industry standards that are currently in preparation. EASA is also developing Means of Compliance with EASA Special Condition E-19 on Electric/Hybrid Propulsion System.

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01-09	*FAA*			We would like to thank EASA for the opportunity to comment on the proposed Means of Compliance and acknowledge the excellent work EASA has done. Please feel free to contact us for more information on any of these comments. We would like to clarify that there may be FAA concerns with portions of the proposal, even if no comments were provided in an area. This is due to two reasons: • The FAA is still developing rules, guidance, and MOC for these aircraft, and in some areas is still in the learning phase. As we learn and understand more, it may be appropriate to reconsider some of these MOC in the future. • The proposal covered a very large scope, and due to the limited time available to comment and limited availability of some FAA specialists, we were unable to make coordinated comments on some issues. We look forward to collaborating with EASA on how to best ensure the safety of these aircraft and we are committed to harmonizing as much as possible in this effort.				Noted	EASA thanks FAA for the interest in these Means of Compliance and for the provided comments. EASA looks forward to collaborating with FAA on the certification of VTOL aircraft and is equally committed in harmonising as much as possible in this area. EASA will also contribute to the review the FAA rules, guidance and MOC for these aircraft once they become available.
01-10	THALES Avionics	General		Thales avionics thanks EASA for the opportunity given to comment these proposed MoC to the SC VTOL. From a general viewpoint we concur with the almost content of the proposal but some MoC require modifications or at least clarification. Here after a summary of our main comments: - Need to clarify the scope of the "FBW flight control system" which is the subject of specific requirements and recommendations - Need to introduce the concept of "limit flight envelopes" to limit the scope of certain requirements that refer to - Some requirements overlaps making difficult the identification the applicable baseline - Level of independence of the FCS Back-up to be clarified - Explain why the security requirements defined for enhanced do not apply to Basic **- Errors should not be considered as failures (e.g. no single failure objective of FC Cat)**				Noted	EASA thanks Thales for its review of these Means of Compliance and the submitted comments. Detailed replies to the points mentioned will be provided at each of the comments.
01-11	*Leonardo Helicopters*	General	General	"Shall" and "Should" have both been used within the document.	Clarify if "should" means that a requirement is not mandatory, while a "shall" has to be satisfied to demonstrate compliance.	YES	NO	Accepted	These Means of Compliance are non-binding material. Shall is only used when referring to a regulatory requirement (e.g. in the SC-VTOL) or a definition. The language has been revised to avoid confusion.

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01-12	*Nils Rostedt, Europe Air Sports (EAS)*			Europe Air Sports welcomes the opportunity to comment on this consultation. We have read the proposed MOC and concluded that in this phase it is not part of our major work areas, so we will refrain from detail commenting at this time. Nevertheless, EAS continues to follow the development of this new category of aircraft and its potential use in sports and recreational aviation.		Yes	No	Noted	EASA thanks Europe Air Sports for its interest in these Means of Compliance and for its review of the text and welcomes its engagement to follow its future development.
01-13	*FLUTR*	general		Previous consultation of only 1 round did not consider some inputs sufficiently or thoroughly.	Have 2 rounds of consultation process for this MOC document.	Suggestion	substantive	Not accepted	This is the first consultation of the Means of Compliance, no previous consultation has occurred. All comments received are thoroughly considered by EASA. Insisting on comments already provided would not change the result of their assessment by EASA. The usual public consultation process foresees one consultation round unless the original proposal is extensively modified.
01-14	*GAMA*	Various	Various	There are references to specific tables and sections of several documents, particularly ones that are expecting a revision in the near future (e.g. SAE ARP 4761 and SAE ARP 4754A). These document revisions, and therefore sections and table references will likely then be out of date.	Suggest generalizing references to documents to not specify revision, or sections/tables therein in order to maintain connections with the latest guidance.	Yes	No	Noted	EASA will generalise references whenever possible. At the same time, EASA can only assess the acceptability of existing documents and not of their future revisions, in particular when most of them are not focused on VTOL design and may be revised for reasons not applicable to VTOL aircraft.
01-15	*Boeing*	General		General comment. REQUESTED CHANGE: The Means/Method of Compliance (MoC) need to focus on the unique aspects of Vertical Take-off and Landing (VTOL) design configurations instead of revisiting well established Part 23, 27, 29 and 33 MoCs. Unique aspects include transition mode between VTOL and aeroplane modes, as well as focusing of structural regulatory requirements toward those unique or missing aspects of loads (static strength and fatigue), aeroelastic stability, systems/structures interaction and according novel failure modes not properly covered by the existing regulations that affect Handling Qualities (HQ), performance, loads, structural stability and fatigue. Boeing has preliminary development findings, for example, that fatigue loads may require focus or alternate means/methods of compliance. Thus, the focus of the MoC should be to provide methods that can be used to help VTOL vehicles achieve similar or equivalent safety level as Part 23 airplanes and Part 27 rotorcraft.	JUSTIFICATION: VTOL in aeroplane mode is well covered by Part 23 regulations and advisory materials, and the SC-VTOL should be more fundamentally reviewed and revised to address the above comment. eVTOL in VTOL mode is well covered by Part 27 & 29 regulations and advisory materials, and the SC-VTOL should be more fundamentally reviewed and revised to address the above comment. We believe there should be an enhanced focus that should be put on the appropriate regulations related to this application.		yes	Not accepted	This public consultation concerns the Means of Compliance and not the Special Condition, which was already consulted in the past. EASA has decided to use the Special Condition VTOL as certification basis for those VTOL aircraft referred to in its applicability requirement VTOL.2000. The Means of Compliance offer paths to demonstrate compliance with the objectives prescribed in the Special Condition. When a CS-27 or CS-23 requirement exists that can be followed to demonstrate this compliance, this CS-23 or CS-27 requirement is simply quoted in the MOC. In other cases, the document provides compliance details specific for VTOL aircraft.

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01-16	*Boeing*	General		REQUESTED CHANGE: Include Jacking Loads	JUSTIFICATION: Jacking of the aircraft will be required, and no jacking regulatory guidance is being proposed, akin to CS23.507 (Amdt 4). These regulations, or at least the intent of those regulations, should be added. This seems to be an oversight.		yes	Noted	Ground loads such as jacking and towing will be considered in future Means of Compliance with VTOL.2210 “Structural Design Loads”.
01-17	UK CAA	N/A	N/A	**General** This MoC references CS-23 Amdt 4 and CS-27 Amdt 6. CS-23 Amdt 4 and CS-27 Amdt 6 use requirement 1309 rather than 2510. This means that some of the CS-23 Amdt. 4 and CS-27 Amdt. 6 paragraphs referenced are likely to be influenced by 1309. There are differences between the definitions of the basic failure conditions (Catastrophic, Hazardous, Major, Minor, No Safety Effect) between this MoC (in paragraph 2510) and CS-23 Amdt. 4 paragraph 1309 and supporting guidance. Additionally, some of the paragraphs in this MoC use the Catastrophic and Hazardous failure conditions differently to how they are used in CS-23 Amdt 4 and 27 Amdt 6. This could result in confusion and, potentially, an inconsistent application of the regulation.	Some additional clarification may be helpful in places where CS-23 Amdt 4 and/or CS-27 Amdt. 6 are referenced to ensure a consistent application of the guidance in terms of how the relevant aspects of CS-23/27 1309 and SC VTOL.2510 should be applied.	No	Yes	Not accepted	The use of specific CS-23 and CS-27 paragraphs, for instance in the definition of structural loads, does not imply the applicability of other requirements that are not explicitly quoted, for instance safety. The reference of CS-27 or CS-23 requirements is made with due care, so that it remains fully consistent with the EASA Special Condition.
01-18	UK CAA	N/A	N/A	**General** Some applications for VTOL could involve vectored thrust or tilt rotor implementations. These are not technologies that the small fixed wing and small rotorcraft communities are necessarily familiar with, which could result in some significant flight deck human factors issues. As these aircraft can carry up to 9 passengers, it may be helpful to consider adding a variant of CS-25.1302 to the regulation during a future update.	This is a suggestion for a future update.	Yes	Yes	Noted	Human Factors will be considered in future Means of Compliance.

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01-19	UK CAA	N/A	N/A	**General** The objective of this type of regulation / specification would be more appropriately addressed as a CS rather than a Special Condition. 748/2012 21.A.16B Special conditions states "(a) The Agency shall prescribe special detailed technical specifications, named special conditions, for a product, if the related airworthiness code does not contain adequate or appropriate safety standards for the product". Thus it assumed that there is an airworthiness code prior to considering developing a Special Condition.	It is suggested that the SC is replaced by a CS.	Yes	Yes	Noted	This public consultation concerns the Means of Compliance and not the Special Condition, which was already consulted in the past. In future the Special Condition could give place to a Certification Specification, once this new category of products is confirmed as a reality and a certification practice has been established.
01-20	*(Rolls-Royce) (via ASD)*	VTOL.2330	-	A detailed guidance on the definition of a designated fire zone would be helpful as the electrical propulsion itself does not fall into the definition of a designated fire zone as defined in AC25.863.		Yes	No	Noted	A specific Means of Compliance with VTOL.2330 "Fire protection in designated fire zones" will be published.
01-21	UK CAA	MOC Sub Part G Flight Crew Interface and other Information	85	There should be a comment as to why it is is blank, i.e."to be developed"?	Add note/explanation such as "To be developed".	Yes	No	Partially accepted	The page corresponding to Subpart G will be deleted to avoid any confusion.

2. STATEMENT OF ISSUE

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02-01	*Boeing*	General	1	THE PROPOSED TEXT STATES: "The Special Condition addresses the unique characteristics of these products and prescribes airworthiness standards for the issuance of a type certificate, and changes to this type certificate, for a person-carrying VTOL aircraft in the small category, with lift/thrust units that are used to generate powered lift and control." REQUESTED CHANGE: Please change the statement highlighted as follows: …for a person-carrying, and cargo VTOL aircraft in the small category, with lift/thrust units that are used to generate powered lift and control."	JUSTIFICATION: These aircraft can be used for a multiple of applications constraining only to person-carrying as for hired or recreation does not cover the complete application potential.		yes	Not accepted	This text is copied from the Statement of Issue of the Special Condition for small-category VTOL. This public consultation concerns the Means of Compliance and not the Special Condition, which was already consulted in the past. VTOL.2000 establishes the applicability of the Special Condition to person-carrying aircraft. Point 5 in MOC VTOL.2000 defines that: "An aircraft is considered person-carrying if it carries crew, passengers or both". Aircraft without any human presence on board are outside the scope of the Special Condition VTOL and therefore of the associated Means of Compliance.
02-02	FAA Flight Test	Statement of Issue		Does not adequately specify the air vehicle around which we are attempting to develop standards	Recommend FAA/EASA harmonize the description of these vehicles in anticipation of a Certification Class/safety continuum - suggestion is 14 CFR Part 1 regulatory verbiage "powered-lift" defined as "...a heavier-than-air aircraft capable of vertical takeoff, vertical landing, and low speed flight that depends principally on engine-driven lift devices or engine thrust for lift during these flight regimes and on nonrotating airfoil(s) for lift during horizontal flight."	Yes	No	Not accepted	This public consultation concerns the Means of Compliance and not the Special Condition, which was already consulted in the past. The applicability of the Special Condition VTOL is detailed in paragraph VTOL.2000 of the Special Condition. The Means of Compliance must stay within the exact same applicability.
02-03	UK CAA	Statement of Issue Paragraph 1	1	This paragraph refers to "person-carrying VTOL aircraft" Are non-person-carrying VTOL aircraft considered to be UAS and covered elsewhere? If not, will a subsequent update to this MOC cover non-person-carrying VTOL aircraft?	If non-person-carrying VTOL aircraft are to be covered elsewhere or at a later date, it might be helpful to provide a note that specifically clarifies this point, to avoid confusion between the UAS and VTOL communities.	Yes	No	Not accepted	See reply to comment 02-01
02-04	Rolls Royce (Adam Newman)			Is it is clearly defined when an aircraft is a VTOL and not a rotorcraft as per CS-27 / CS-29 – the definition of rotorcraft in CS-Definitions is "means a heavier-than-air aircraft that depends principally for its support in flight on the lift generated by one or more rotors."	Offer an unambiguous definition or provide reference to one in an pre-existing document (and CS-Definitions)	Yes	No	Not accepted	This public consultation concerns the Means of Compliance and not the Special Condition, which was already consulted in the past. VTOL.2000 establishes the applicability of the Special Condition.

3. MOC VTOL.2000 APPLICABILITY AND DEFINITIONS

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03-01	*Rolls Royce/Andy Roberts*	MOC VTOL.2000 1(b)	5	Suggests that in relation to existing CS (b) "Engine", "Turbine", "Powerplant" and "Rotor" shall be replaced by "Lift/thrust unit". Given the limited definition of lift/thrust unit in para 6 this definition does not cover all potential architectures. The definition of lift/thrust unit in para 6 appears to exclude the energy supply to a lift/thrust unit.	Engine, turbine or powerplant shall be replaced by Lift/thrust system.		Yes	Accepted	New text is: (b) "Engine", "Turbine", "Powerplant" and "Rotor" shall be replaced by "Lift/thrust system"
03-02	*Rolls Royce (Adam Newman)*	MOC VTOL.2000 section 1 (b)	5	I do not see why the term engine has to be replaced by lift/thrust unit CS-Definitions amendment 2 defines an engine as "*means an engine used or intended to be used for aircraft propulsion. It consists of at least those components and equipment necessary for the functioning and control, but excludes the propeller.*" This definition is considered to equally apply to the propulsion system of a VTOL. The difference between lift and thrust is just the vector it is delivered in relative to the free body diagram of the aircraft.	Retain the use of term and principle of an engine but remove turbine and powerplant and consider the inclusion of propeller / rotor. It may be beneficial to note that in a VTOL application accessory power or services (air / hydraulics / LV power) may also be provided. These conditions should apply for the entire engine (propulsion chain) from power generator to thrust producer. For example, if you hypothesise an airframe with just a gas turbine driven electrical generator providing electrical power to multiple distributed electrical propulsors – the thrust / lift unit is the combination of both (not just the propulsor) which cannot provide thrust in isolation of the energy source and the electrical transmission system in between	No	Yes	Not accepted	The purpose of (1)(b) is to provide general considerations that support a read-across of other product's certification specifications when quoted as applicable for VTOL aircraft. The term "engine" as defined in the existing certification specifications is not considered to address all possible configurations of the propulsion system in VTOL aircraft. The definition of "lift-thrust unit" provided in point 6 of this MOC VTOL.2000 clarifies that it includes an "engine" but is not limited to it: "A lift/thrust unit is considered to be any engine that directly contributes to providing lift or thrust and includes its controller, the connected effector (e.g. rotor, propeller, fan) and any related actuators (e.g. pitch change, tilting, vectoring)." See reply to comment #03-01.
03-03	*UK CAA*	MOC VTOL.2000 Applicability, 1. General Considerations Paragraph (d) & (e)	5	These list items specifically replace the terms "Fuel" and "Fuel Tank". Is there a potential for some VTOL aircraft to use fuel instead of an alternative source of energy? If so: i) Will the MOC be updated to address the use of fuel at a later date? or Would it be easier to address the use of fuel in the initial version of the MOC, rather than attempting what could be a complex update that would affect multiple parts of the document in the future?	If there is a possibility that some VTOL aircraft could use aviation fuel, either: • Amend the text such that it addresses the use of aviation fuel Provide a pointer to where guidance for VTOL aircraft that do use aviation fuel is provided.	Yes	Yes	Not accepted	The term "energy" is purposefully chosen to make it independent from its source. It comprises electrical energy but also energy from aviation fuel, fuel cells, etc.

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03-04	*Airbus Helicopters (FXG)*	MOC Sub part A, VTOL 2000 Section 2	5	§ 2. gives the example of : "flight control system actuator jam" as preventing the continuation of safe flight and landing is misleading According to CS-27 § 695, flight control system actuator jamming should be considered as extremely improbable or alternate system shoud be implemented to ensure safe flight safe landing.	Suppress the example og FCS actuator jam	X		Partially Accepted	The example has been replaced by "flight control system actuator failure". Furthermore, the definition of flight control system has been modified to: *"The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function.* *In reference to the lift/thrust unit definition provided in Section 6 of this MOC, any engine directly contributing to providing lift or thrust, its controller and fans shall comply with SC EHPS while the other elements (rotors, propellers, and related actuators) shall comply with SC VTOL."*
03-05	*Dewi Daniels, Callen-Lenz*	2	5	Section 2 states that "The continued safe flight and landing includes the transition phase from horizontal to vertical flight, if applicable". What do you mean by "if applicable"? As noted in Section 1, some VTOL aircraft may be able to take-off or land as conventional aeroplanes, meaning that transition from horizontal to vertical flight is not necessary for a safe landing.	Change to "If transitioning from horizontal to vertical flight is necessary for a safe landing, failures preventing transition from horizontal to vertical flight should be considered and evaluated".	no	yes	Partially accepted	New text: "The continued safe flight and landing includes any transition phase between horizontal and vertical flight, if included in the applicable procedure, and the ground phase up to the complete stop of the aircraft and evacuation of the occupants." See also comment #03-16
03-06	*Vertical Aerospace*	VTOL.2000	5	Section 2 states that "The continued safe flight and landing includes the transition phase from horizontal to vertical flight, if applicable". What do you mean by "if applicable"? As noted in Section 1, some VTOL aircraft may be able to take-off or land as conventional aeroplanes, meaning that transition from horizontal to vertical flight is not necessary for a safe landing.	Change to "If transitioning from horizontal to vertical flight is necessary for a safe landing, failures preventing transition from horizontal to vertical flight should be considered and evaluated".	No	Yes	Partially accepted	See reply to comment #03-05.
03-07	*Leonardo Helicopters*	MOC VTOL.2000 Para 2. (a)	5	"The remaining energy reserve following a failure condition should be no less than the sufficient reserve accepted for compliance with VTOL.2430(b)(4)."	To comply with the required minimum energy reserve policy is a responsibility of the operator, whose flight planning has to evaluate the aircraft maximum flight range based on the energy policy required by the actual flight operation (weight, winds, VFR,IFR, etc), and verifying availability of alternates vertiport in case of failure of Lift/thrust System elements	YES	YES	Not accepted	The reserve energy in this context is an "airworthiness" reserve that should always ensure the ability of the aircraft to perform a continued safe flight and landing following a failure that is not catastrophic, within established operational limitations. It is independent of the design of the operation and only linked to the design of the aircraft and its certified capabilities.
03-08	*Lilium GmbH*	MOC VTOL.2000 (2)	5	The minimum performance and obstacle margins of VTOL.2115 and VTOL2120 are referenced but are not defined in the document.	The MOC would benefit from further definition of the minimum performance and obstacle margins associated with VTOL.2115 and VTOL2120.	yes	no	Noted	Minimum performance and margins are being assessed for inclusion in future MOCs.

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03-09	*Airbus Helicopters (FXG)*	MOC Sub part A, VTOL 2000 Section 2	5	"*The remaining reserve following a failure condition should not be less than the sufficient reserve accepted for compliance with VTOL.2430 (b)(4)*" is unclear as the reserve for VTOL 2430 (b)(4) is undefined and depending on failures conditions, the standard reserve might be differently affected depending on how reserve is defined as a % of standard flight energy, or energy consumption, etc…". The management of reserve is key especially with electrical propulsion which one of the most used in VTOL currently proposed and clarification on that point is necessary.	Provide AMC 2430 (b) (4), otherwise the AMC VTOL2000 section 2 related to "reserves" cannot be understood.		X	Noted	The concept of reserve energy is being assessed for inclusion in future MOCs.
03-10	*Lilium GmbH*	MOC VTOL.2000 (2) & (10)	5, 8	It is suggested to modify the wording of the requirements to consider failures and combinations of failures that are extremely improbable, as opposed to those classified as catastrophic. The reason for this is that Industry may opt to take a design decision to make a particular failure or failure combination extremely improbable, regardless of the failure classification. In such cases, the failure/failure combination should be exempt from consideration in the CMP.	It is suggested to modify the wording of the requirements to consider failures and combinations of failures that are extremely improbable, as opposed to those classified as catastrophic.	yes	no	Accepted	New text: "The Certified Minimum Performance (CMP) is the set of performance data obtained by considering the effect of single failures and combinations of failures that are not extremely improbable on the nominal performance parameters."
03-11	*Lilium GmbH*	MOC VTOL.2000 (2), (10) & (11)	5, 8	It is understood that MOC VTOL.2000 items (2), (10) and (11) propose a more general definition to the minimum performance condition which for conventional aviation, either rotorcrafts or aeroplanes, is specified as the one-engine inoperative conditon. It is assumed that the intent of MOC VTOL.2000 (11) is such that, when applied to the same conventional aviation mentioned above, the CFP would result in the same one-engine inoperative condition. However, the term "all failures and combinations" used in MOC VTOL.2000 (2) and (10) has a broader scope and could potentially result, even for conventional aviation, in different failure combinations not solely affecting thrust generation capability as the minimum performance condition, thereby resulting in minimum performance conditions more stringent than currently required for conventional aviation.	It is suggested that MOC VTOL.2000 items (2), (10) and (11) reflect this concept in replacing and defining the CMP as: *The Certified Minimum Performance (CMP) is the set of performance data obtained by considering the effect of all failures and combinations that are not classified as extremely improbable and lead to a critical loss of thrust/lift on the nominal performance parameters.*	no	yes	Partially accepted	See comment 03-10 for "extremely improbable" The certified minimum performance is defined to address all failures in VTOL aircraft that have an effect on the nominal performance parameters and is not limited to a critical loss of thrust/lift due to the high level of integration associated with distributed propulsion.
03-12	*Lilium GmbH*	MOC VTOL.2000 (2)(b)	5	References have been made to several performance-related certification requirements (e.g. VTOL.2115 and 2120 for take-off and climb) but not VTOL.2130(b) for transition to the balked landing condition.	Confirm if VTOL.2130(b) is not part of the definition of Continued Safe Flight and Landing, or consider making appropriate reference to it in MOC VTOL.2000)(2)(b)	yes	no	Accepted	New text: *"(b) The performance and obstacle margins should be no less than the minimum accepted for compliance with VTOL.2115, VTOL.2120 and VTOL.2130."*
03-13	*Volocopter*	VTOL.2000 Section 2.	5	Continued Safe Flight and Landing "alternate vertiports" is not in accordance with latest Part-UAM and Vertiport discussions	Aligned wording of "diversion vertiports" to be implemented in MOC S-VTOL.	yes	no	Accepted	The wording "diversion vertiports" is adopted.

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03-14	Volocopter	VTOL.2000 Section 2.	5	"The continued safe flight and landing includes the transition phase from horizontal to vertical flight, if applicable, and the ground phase up to the complete stop of the aircraft and evacuation of the occupants." This statement excludes possibility for the VTOLs that "may additionally be able to take-off or land as conventional aeroplanes, accelerating and/or decelerating on a runway" to perform safe landing using conventional landing procedure. Is this possibility intentionally excluded or how is the statement "if applicable" to be interpreted?	Proposal: "The continued safe flight and landing includes the transition phase from horizontal to vertical flight, **when considered part of an applicable procedure**, and the ground phase up to the complete stop of the aircraft and evacuation of the occupants."	yes	no	Accepted	See comment 03-05 New text: "The continued safe flight and landing includes any transition phase between horizontal and vertical flight, if included in the applicable procedure, and the ground phase up to the complete stop of the aircraft and evacuation of the occupants."
03-15	UK CAA	MOC VTOL.2000 Applicability, 2. Continued Safe Flight and Landing Paragraph 2	5	"All failures affecting continued safe flight and landing should be considered and evaluated. The lift/thrust system loss is not the only type of failure of this system that could affect safe flight and landing: .." This paragraph appears to be focused on things that would negatively impact safe flight and landing. This may be slightly misleading to less experienced applicants that potentially don't realise that they also need to take account of indirect effects.	The first sentence could be reworded to read something like: "All failures that could cause or contribute towards the inability to maintain continued safe flight and landing should be considered…"	Yes	No	Partially accepted	The definition is completed to explicitly refer to failures that "directly or indirectly" affect the continued safe flight and landing. New text: "All failures directly or indirectly affecting continued safe flight and landing should be considered and evaluated. The lift/thrust system loss is not the only type of failure of this system that could affect safe flight and landing: .."
03-16	UK CAA	MOC VTOL.2000 Applicability, 2. Continued Safe Flight and Landing Paragraph 3	5	"The continued safe flight and landing includes the transition phase from horizontal to vertical flight, if applicable, and the ground phase up to the complete stop of the aircraft and evacuation of the occupants." This paragraph could be interpreted as only being applicable to the landing phase of flight. It is possible that some VTOL aircraft could be required to transition from horizontal to vertical flight as part of a flight, rather than a landing (e.g. if it was being used to search for something, it could be required to transition from horizontal flight to vertical flight to take a closer look). Additionally, the text could be interpreted to infer that the text only applies to transitions from horizontal to vertical flight and not to transitions from vertical flight to horizontal flight. It might be helpful to clarify that the MOC requirements apply to any transition between horizontal and vertical flight.	Re-word paragraph 3 to read: "The continued safe flight and landing includes any transitions between horizontal and vertical flight, if applicable…."	Yes	Yes	Accepted	See comment #03-05 New text: "The continued safe flight and landing includes any transition phase between horizontal and vertical flight, if included in the applicable procedure, and the ground phase up to the complete stop of the aircraft and evacuation of the occupants."

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03-17	UK CAA	MOC VTOL.2000 Applicability, 2. Continued Safe Flight and Landing Paragraph 5	5	"Any changes in aircraft performance that affect the capability of the aircraft (e.g. range, expected height loss, remaining rate of climb) to continue the flight and perform a landing after a single failure or combination of failures not classified as catastrophic should be provided (see paragraph 10. Certified Minimum Performance (CMP)." The first sentence of this paragraph doesn't seem to make sense. The sentence refers to data being provided, but it doesn't say what it should be provided to. Is some text missing?	Some clarification of the first sentence is required.	Yes	No	Accepted	New text: *"In order to assess the VTOL's ability to perform a continued safe flight and landing, any changes in aircraft performance that affect the capability of the aircraft (e.g. range, expected height loss, remaining rate of climb) to continue the flight and perform a landing after a single failure or combination of failures not extremely improbable should be considered (see paragraph 10. in this MOC, Certified Minimum Performance (CMP))."*
03-18	UK CAA	MOC VTOL.2000 Applicability, 2. Continued Safe Flight and Landing Para (a)	5	(a) references SC VTOL.2430(b)(4), which refers to a "*standard* flight". It would be helpful if a definition of "*standard flight*", or a pointer to a definition of "*standard flight*" could be provided.	Add a definition of "standard flight" or a pointer to a definition.	Yes	No	Noted	Means of Compliance with VTOL.2340(b)(4) "Energy Reserve" will be provided by EASA.
03-19	UK CAA	MOC VTOL.2000 Applicability, 2. (d) Explanatory Note	6	Mass is favoured over weight to reference loading conditions. Centre of gravity limits and other operational limits for which certification is requested (e.g. steady wind limit) should be included.	Suggest changing weigth to mass and adding centre of gravity limits (or considering the use of loadings conditions as per SC-VTOL) and other operational limits for which certification is requested (e.g. atmospheric disturbance).	Yes	No	Accepted	New text: *"Explanatory Note: The Means of Compliance above mirror CS-27 Category A rotorcraft. It is expected that flight tests will be performed to determine the best repeatable technique(s) for a particular aircraft over the range of mass, centre of gravity, altitude, temperature and other operational limits for which certification is requested. Any landing which results in permanent deformation of the aircraft structure or landing gear beyond allowable maintenance limits is considered an unsatisfactory test point."*
03-20	UK CAA	MOC VTOL.2000 Applicability, 2. (d) Explanatory Note	6	"The procedures for continued safe flight and landing should be designed so as to not injure occupants or people on the ground and should not introduce additional damages to the aircraft due to the landing." 2 (d) includes the requirement to not injure occupants and people on the ground. It does not explicitly consider mid-air collision. Looking at the nature/type of the aircraft, for example air taxies, it is possible that in the future many aircraft may fly and mid-air collision could become a real risk. It is also possible that the variety of aircraft designs could mean that a larger aircraft may collide with a smaller one. Whilst the larger one meets the requirement of not injuring occupants or people on ground, and can continue its operation and landing, the smaller one may not be able to take the blow and the occupant(s) may suffer injuries. It is also possible that an unmanned aircraft could collide with a manned aircraft.	The procedures should also include consideration of the occupants and people on the ground in the event of mid-air collision.	Yes	No	Noted	While fully recognising the importance to avoid mid-air collisions, EASA does not consider it feasible to effectively address it in the airworthiness certification of the type design and in particular in emergency procedures in the flight manual. Prevention of mid-air collisions and other air traffic issues are deemed to be best addressed in airspace and operational regulations and training.

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03-21	UK CAA	MOC VTOL.2000 Applicability, 3. Controlled Emergency Landing Paragraph 1	6	The second sentence states that "…controlled emergency landing procedures could also be published for catastrophic failure conditions". The term "*could*" infers that this might not always be the case. What will the rationale be for determining whether or not they are required and where will this be documented?	Additional clarification on when controlled emergency landing procedures will be required for catastrophic failure conditions within Enhanced Category aircraft would be helpful.	Yes	No	Noted	Also in reply to comments #03-30, #03-32 and #03-38: After any single failure or combination of failures not classified as catastrophic (c.f. VTOL.2005(b) and MOC VTOL.2510): • Aircraft in the Category Enhanced must be shown to be capable to perform a continued safe flight and landing (CSFL) • Aircraft in the Category Basic must be shown to be capable of a controlled emergency landing (CEL) For aircraft in the category enhanced: Aircraft in the Category Enhanced are thus not requested to show a capability to perform a CEL, since they already must demonstrate the ability to perform the more stringent CSFL. Any catastrophic failure condition must be shown to be extremely improbable (c.f. VTOL.2510(a)(1)) in the certification process. Once demonstrated as extremely improbable, it does not need to be further considered in this process. Nevertheless, there may be catastrophic failures, for which an applicant is able to develop controlled emergency landing procedures for a VTOL in the Category Enhanced. Even if this is not mandatory, EASA encourages applicants to develop emergency procedures to address some of those extremely improbable events, when feasible.
03-22	UK CAA	MOC VTOL.2000 Applicability, 3. Controlled Emergency Landing Paragraph 2	6	The first sentence of paragraph 2, in combination with paragraph 1, implies that failures that result in lift/thrust units being unable to provide steering would automatically be classified as catastrophic. Is this the intended interpretation?	If an automatic classification of catastrophic is not the intended interpretation, further clarification may be helpful.	Yes	No	Noted	For Category Basic, failure conditions that would prevent a controlled emergency landing of the aircraft are considered catastrophic (c.f. MOC VTOL.2510) The inability to steer the aircraft towards a touch down area following a failure is deemed to prevent the controlled emergency landing and as such is considered as a catastrophic event for an aircraft in the category basic.
03-23	UK CAA	MOC VTOL.2000 Applicability, 3. Controlled Emergency Landing Paragraph 2	6	Is there a potential for the lift/thrust units to be vulnerable to a version of Thrust Control Malfunction (TCM)? If so, is an equivalent of TCM accommodation needed for these aircraft?	If TCM could be applicable to these aircraft, some guidance (or pointers to guidance) might be helpful.	Yes	Yes	Noted	As the lift/thrust unit plays a role in the Flight Control function, the lift/thrust unit control system must be developed taking into account the Fly-by-Wire requirements and means of compliance Thrust Control Malfunction (TCM) could be a possible failure. Its consequences for the performance of a controlled emergency landing (CEL) or continued safe flight and landing (CSFL) need to be assessed. Even if TCM is shown not to affect the CEL capability of the aircraft, it would probably need to be assessed as a Critical Failure for Performance (see paragraph 11 in MOC VTOL.2000) No specific mention of this particular failure (TCM) is considered necessary in this MOC.

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03-24	*Rolls Royce (Adam Newman)*	MOC VTOL.2000 section 2	6	In reference to the explanatory note If the subject aircraft does not meet the requirements of CS-27 small rotorcraft (for example due to MTOW or number of passengers) what applies?	Provide clarity on applicability to aircraft that do not meet CS-27 regulations	Yes	No	Noted	The SC-VTOL provides the requirements for the airworthiness certification of VTOL aircraft, CS-27 is only mentioned in the Explanatory Note to clarify the origin of the MOC. The applicability of SC VTOL is defined in VTOL.2000. Regarding maximum MTOW and number of passengers, the Special Condition VTOL is aligned with CS-27 (3175kg and 9 passengers) (c.f. VTOL.2005 and CS 27.1(a)).
03-25	*Rolls Royce (Adam Newman)*	MOC VTOR.2000 section 3	6	"…touchdown area with the remaining lift / thrust units…" implies that the airframe architecture has multiple lift/thrust units which may not be the case and may not be able to provide the design flexible described on page 1	Consider if this requirement assumes too much of the architecture or solution rather than the expected minimum level of safety	Yes	No	Noted	As per VTOL.2000: "This Special Condition is applicable to aircraft with lift/thrust units used to generate powered lift and control and with more than two lift/thrust units used to provide lift during vertical take-off or landing." The assumption of multiple lift/thrust units is aligned with the applicability of the Special Condition.
03-26	*Rolls Royce (Adam Newman)*	MOC VTOR.2000 section 4	6	Are special conditions described for operation over metropolitan areas and / or near or over waterways?	Do requirements such as CS27.251 mirror to this MoC?	Yes	No	Noted	As per VTOL.2005 (b)(1), aircraft intended for operations over congested areas must be certified in the Category Enhanced. All design requirements applicable to the Category Enhanced consequently apply to these aircraft. VTOL.2310 provides design requirements for emergency flotation, ditching and water operations. Further details will be provided in MOC for compliance with this and other impacted requirements. Operational Regulations will define the airworthiness certification category required for each operation. The objective VTOL.2160 addresses vibrations for VTOL aircraft, similar to the requirement CS 27.251 for small rotorcraft.
03-27	FAA RSB AdFC	2(c)	6	Exceptional piloting skills are defined later in the document. How are alertness or strength determined?	Remove the alertness and strength requirements as these are too subjective.		Objection	Noted	Alertness and Strength are included in VTOL.2135 requirement (and not in the MOC). The MOC covers only the Handling Qualities aspects, so if it is to be seen only as the "skills" part. However, the Human Machine Interface of the flight controls and associated systems (alertness) and/or mechanical characteristics (strength) will be probably also relevant and affect the overall HQs level. Additional guidance and MOCs for the alertness and strength expectations is under development.
03-28	*FLUTR*	MOC VTOL 2000	6	Non steerable parachutes for MOC of Controlled Emergency Landing following failure. Current wording precludes use of non steerable parachutes. Non steerable parachutes can be shown to reduce fatality rates of occupants from 20% for light GA helicopters to 1.5%, with insignificant changes to fatality rates on ground persons, when appropriately designed and utilized.	Inlcude reference to the ability of a non steerable parachute system that may be allowed subject to demonstration of "equivalent level of safety". Implementing change to the SCVTOL-01 document is too burdensome. Implement the amendment here in the MOC document.	suggestion	substantive	Not accepted	While the installation of non-steerable parachutes may provide a safety benefit for some general aviation aircraft, non-steerable parachutes, by definition, do not provide controllability during the descent. This capability to provide control during the descent is considered fundamental for VTOL aircraft in the category basic after any single failure or combination of failures not classified as catastrophic. The objective is similar to a controlled glide or autorotation for conventional aircraft. VTOL aircraft in the category basic must show by design a capability to perform a controlled emergency landing. This cannot be met by the use of non-steerable parachutes alone.

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03-29	*GAMA*	MOC VTOL.2000, item 2 - Continued Safe Flight and Landing	6	On modern vehicles, safety features enable energy dissipation to protect passengers. This idea is captured at item 3 (Controlled Emergency Landing), which allows "some damage to the aircraft to absorb the impact forces". However, the way the Explanatory Note on item 2 (Continued Safe Flight and Landing) is written conflicts with this idea by considering that "Any landing which results in permanent deformation of the aircraft structure or landing gear beyond allowable maintenance limits is considered an unsatisfactory test point."	The Explanatory Note on item 2 (Continued Safe Flight and Landing) should be rewritten to be aligned with the idea that "some damage to the aircraft to absorb the impact forces can be accepted."	No	Yes	Not accepted	Also in reply to comment #03-31 and #03-33: The text quoted from Section 3, i.e. “some damage to the aircraft to absorb the impact forces can be accepted”, is applicable to Controlled Emergency Landing and thus to Category Basic only. For Category Enhanced and the associated higher objective of Continued Safe Flight and Landing, it is expected (as highlighted in the Explanatory Note) that, similarly to CS-27, flight tests be performed to determine the best repeatable technique(s). Any landing which results in permanent deformation of the aircraft structure or landing gear beyond allowable maintenance limits is considered an unsatisfactory test point. Systems that permanently deform, such as stroking seats or crush zones, are acceptable for the objectives related to crashworthiness, e.g. VTOL.2270.
03-30	THALES Avionics	MOC.VTOL.2000 3	6	“For Category Enhanced, controlled emergency landing procedures could also be published for catastrophic failure conditions.” Should we interpret this statement as “Failures conditions that prevents safe flight / safe landing are Catastrophic, nevertheless the VTOL shall be capable to perform controlled emergency landing after a failure condition that prevents safe flight safe landing” ?		Observation	Substantive	Noted	See comment #03-21
03-31	*Boeing*	MOC VTOL.2000 Paragraph:2	6	THE PROPOSED TEXT STATES: (d) The procedures for continued safe flight and landing should be designed so as to not injure occupants or people on the ground and should not introduce additional damages to the aircraft due to the landing. REQUESTED CHANGE: (d) The procedures for continued safe flight and landing should be designed so as to not injure occupants or people on the ground ~~and should not introduce additional damages to the aircraft due to the landing.~~	JUSTIFICATION: Not certain why the amount of damage to the aircraft would be regulated. Safe Flight and Landing has not (across EASA or FAA requirements) necessitated an aircraft complete CSF&L without any potential damage. This can be supported, for example, with Transport Category requirements allowing landing above MLW (Maximum Landing Weight) in the event of an emergency, where further ICA inspections are mandated to ensure that no damage has occurred, and where repairs are mandated if damage is found. Therefore, the wording should be adjusted accordingly, as the proposed wording significantly exceeds the definition of VTOL.2000 (b)(3) definition of "continued safe flight & landing": ‘continued safe flight and landing’ means an aircraft is capable of continued controlled flight and landing at a vertiport, possibly using emergency procedures, without requiring exceptional piloting skill or strength.” but makes no reference to the requirement for no damage from such an emergency condition.		yes	Not accepted	See comment #03-29

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03-32	Volocopter	VTOL.2000 Section 3.	6	"For Category Enhanced, controlled emergency landing procedures could also be published for catastrophic failure conditions." Is this "could" to be understood, that for the Enhanced category this is not a mandatory matter of type certification process?	EASA is asked to clarify on the addressed comment.	yes	no	Noted	See comment #03-21
03-33	*Embraer*	MOC VTOL.2000, item 2 - Continued Safe Flight and Landing	6	On modern vehicles, safety features enable energy dissipation to protect passengers. This idea is captured at item 3 (Controlled Emergency Landing), which allows "some damage to the aircraft to absorb the impact forces". However, the way the Explanatory Note on item 2 (Continued Safe Flight and Landing) is written conflicts with this idea by considering that "Any landing which results in permanent deformation of the aircraft structure or landing gear beyond allowable maintenance limits is considered an unsatisfactory test point."	The Explanatory Note on item 2 (Continued Safe Flight and Landing) should be rewritten to be aligned with the idea that "some damage to the aircraft to absorb the impact forces can be accepted."	No	Yes	Not accepted	See comment #03-29
03-34	*Collins Aerospace*	Section 3	6	"Active systems could also be acceptable if their reliability is commensurate with their criticality, as per VTOL.2510." There is more than just reliability involved in the safety process.	"Active systems could also be acceptable if the safety process shows this is acceptable with its criticality, as per VTOL.2510." OR "Active systems could also be acceptable per VTOL.2510."	Yes	No	Partially Accepted	New text: "Active systems could also be acceptable if they meet the safety requirements of VTOL.2510."
03-35	FAA RSB AdFC	2(c)	6	The FAA is moving away from this type of HQ rating method.	EASA to consider a HQ method consistent with the FAA's approach/method called Handling Qualities Task Element (HQTE).	Suggestion		Noted	EASA remains available and interested to review the FAA's approach/method for VTOL certification once the FAA shares it with EASA or it is publicly consulted.
03-36	FAA RSB AdFC	2(d)	6	This item seems to be unnecessary. The definition for continued safe lfight and landing already covers this requirement. It can't be considered "safe" if any person is injured.	Remove this requirement or modify the Explanatory Note as the new (d).		Objection	Not accepted	This point is considered to adequately complement the definition of continued safe flight and landing provided in VTOL.2000 (b)(3).
03-37	*Vertical Aerospace*	VTOL.2000 Sub Para 2	6	Flight test is the only prescribed method for compliance in the explanatory note	Considering simulation tools available, should compliance be expanded to include Validated Simulation where appropriate	Yes	No	Noted	Flight test is currently the only approved means to demonstrate Category A helicopter procedures, while helicopters are a conventional product. For the novel type of VTOL aircraft, it is thus expected a fortiori that landing procedures are demonstrated by flight test.
03-38	*Leonardo Helicopters*	MOC VTOL.2000 Par.3	6	"For Category Enhanced, controlled emergency landing procedures could also be published for catastrophic failure conditions."	Please clarify this statement, and explain if it is a requirement (could, should)	YES	NO	Noted	See comment #03-21

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03-39	*Leonardo Helicopters*	MOC VTOL.2000 Par.7	7	Add “energy distribution system” among the components of the LTS	The lift/thrust system is composed of; the lift/thrust units, their related energy supply, energy distribution system and energy management system.	YES	NO	Accepted	See comment #03-46 and #03-49, #03-50 New text: The lift/thrust system is composed of the lift/thrust units and their related energy storage, distribution and management systems as well as any other related ancillary systems (e.g. lubrication, cooling or transmission)”
03-40	*Leonardo Helicopters*	MOC VTOL.2000	7	“Due to their low probability of occurrence, emergency procedures for these design cases are not mandatory” this sentence could be a point of misunderstandings. usually the Flight Manuals reports all the emergency procedure.	Please clarify if it is correct the understanding that emergency procedures for emergency landing and survivable emergency landing cannot be published within the AFM	YES	NO	Noted	Also in reply to comment #03-41: After any single failure or combination of failures not classified as catastrophic (c.f. VTOL.2005(b) and MOC VTOL.2510): • Aircraft in the category Enhanced must be shown to be capable to perform a continued safe flight and landing (CSFL) • Aircraft in the category Basic must be shown to be capable of a controlled emergency landing (CEL) Procedures for Continued Safe Flight and Landing in the Category Enhanced and for Controlled Emergency Landing in the Category Basic must be prepared for compliance with VTOL.2620. The “Emergency landing” and “survivable emergency landing” design cases address “the ultimate consequences at aircraft level of an uncontrolled landing which would be survivable by the occupants if appropriate design features are incorporated”. This corresponds to a catastrophic event (as opposed to CSFL and CEL). Catastrophic failure conditions must be shown to be extremely improbable (c.f. VTOL.2510(a)(1)) in the certification process and do not need to be further considered in this process. Nevertheless, EASA recommends the definition of emergency procedures in these cases, when this would contribute to the survivability of occupants (VTOL.2620).
03-41	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2000, sect.4	7	“Due to their low probability of occurrence, emergency procedures for these design cases are not mandatory…”	I would have thought that procedures for an emergency landing ought be mandatory	No	Yes	Noted	See comment #03-40
03-42	FAA RSB AdFC	8	7	The term “inceptors” is not defined in this document nor the VTOL SC.	Define the term “inceptor”.		Objection	Partially accepted	The definition has been modified to: *“The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function.* *In reference to the lift/thrust unit definition provided in Section 6 of this MOC, any engine directly contributing to providing lift or thrust, its controller, and fans shall comply with SC EHPS while the other elements (rotors, propellers, and related actuators) comply with SC VTOL.”*

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03-43	FAA Mechanical Systems	MOC VTOL.2000 Applicability and definitions Section 8	7	"The flight control system is composed of the crew inceptors, if applicable, flight control computers and network provisions to distribute the rotational speed and actuator commands to the lift/thrust units and to aerodynamic control surfaces if any." The scope of the flight control system in this sentence appears to be incomplete. It does not appear to include secondary controls like flaps, trim, and steering. It does not appear to include actuators and systems that provide power to actuators, like hydraulic systems or electrical systems. It does not appear to include sensors or other inputs used by the flight control system. The scope provided in MOC 1 VTOL.2300 is more comprehensive, but it appears that page 7 is intended to address manual flight controls in addition to fly-by-wire flight controls. Writing a clear scope for flight control systems is difficult, and has been made more difficult with eVTOL design concepts. Two suggestions are provided, but they may also have drawbacks.	Consider reusing the definition of the flight control system from VTOL.2300. For example: "The flight control system is composed of the Fly-By-Wire Control System (reference MOC 1 VTOL.2300) and any manual flight controls." Another option would be to use something like "Any item necessary for the control of aircraft attitude or trajectory should be considered part of the flight control system. This may include pilot controls, computers, propulsion units…"	Suggestion		Partially Accepted	The definition has been modified to: *"The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function.* *In reference to the lift/thrust unit definition provided in Section 6 of this MOC, any engine directly contributing to providing lift or thrust, its controller, and fans shall comply with SC EHPS while the other elements (rotors, propellers, and related actuators) comply with SC VTOL."*

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03-44	FAA RSB HF	2000 Definitions; 9 “exceptional pilot skills”	7	The definition uses the term “average” which begs for a definition of “average” in the context of eVTOL aircraft. The term “average” relates to our current use of the term to describe a target pilot capability based on a multitude of factors . From a certification standpoint, it will be difficult to use an “average” pilot as a template given the novelty and, so far, variance in aircraft design, aerodynamics, and for now, non-standard pilot-automation-aircraft integration. In reality, there is no “average” pilot for eVTOL aircraft. There is no “standardized” aircraft or aerodynamics for these aircraft as there are for existing FW or RW “conventional” aircraft . Nor is there a commonly accepted flight control, pilot-automation-aircraft integration. The transfer of skill sets, etc from conventional aircraft to eVTOL, particularly in stressful, high workload situations, is unknown in the civil pilot population. There are existing operational constraints regarding airspace and operations in specific national states airspace built around conventional aircraft. However, a majority of the eVTOL manufacturers appear to be counting on a modification of those operational rules and resulting constraints. Hence there are only hypothetical CONOPS against which to assess “average” pilot performance coupled with aircraft design and performance. Additionally, the first and likely second cadre of pilots for these aircraft will be experienced airplane and helicopter pilots with commercial multi-engine instrument ratings. The applicability and transfer of these civil pilots’ extensive and ingrained conventional aircraft experience and proficiency to eVTOL and the new-novel concepts of aircraft control, capabilities, and operational constraints are relatively unknown.	Unknown.	Yes		Noted	The fact that no VTOL aircraft have been certified yet does not prevent the definition and consideration of new standards. While it is agreed that there is today no “average” pilot for VTOL, the Regulator is challenged to define a set of skills to which VTOL pilots shall be trained to ensure a certain level of proficiency, which should become at least the “average”. It is against this new “average” benchmark, still to be defined in its very details, against which the pilot skills shall be measured to determine if they are or not “exceptional” (or significantly above the projected average).
03-45	FAA RSB HF	2000 Definitions; 9 “exceptional pilot skills”	7	Will “exceptional pilot skill” include the pilot having to remember where flight control transitions occur and having to remember to change flight control strategies? For example, transitioning out of or into low speed flight changes the inceptor mapping and inceptor behaviour?		Yes		Noted	See comment #03-44 and #03-17
03-46	*Airbus Helicopters (IE)*	VTOL.2000 §7	7	Does the thrust/lift system include the energy storage sub-system?	Explicitly state whether the energy storage elements are part of the thrust/lift system or part of a different system	Suggestion	substantive	Accepted	See comment #03-39

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03-47	UK CAA	MOC VTOL.2000 Applicability, 4. Emergency Landing and Survivable Emergency Landing	7	Although the terms “Emergency Landing” and “Survivable Emergency Landing” are used in the Special Condition, their definitions don't appear in the Special Condition. Is this MoC document the appropriate place to define them or would it be better to define them in the Special Condition?	Question only, no proposed resolution.	Yes	No	Note	The MOC is considered appropriate to provide these technical definitions.
03-48	UK CAA	MOC VTOL.2000 Applicability, 4. Emergency Landing and Survivable Emergency Landing	7	Why bold type face for (**crash**) in Survivable Emergency Landing: Impact **(crash)?**	**’Survivable Emergency Landing**: Impact (crash) which is potentially survivable……’	Yes	No	Accepted	New text without “crash” in bold type face.
03-49	UK CAA	MOC VTOL.2000 Applicability, 7. Lift/thrust System Paragraph 1	7	Editorial, typo.	Remove “;” in the sentence.	Yes	No	Accepted	See comment #03-39
03-50	*Rolls Royce (Adam Newman)*	MOC VOTR.2000 section 6	7 & 8	*Lift/thrust unit and lift/thrust system* This definition does not include elements such as any oil system for lubrication or cooling systems (active or passive) nor does it include any protection devices (electrical or otherwise) nor electrical transmission	Consider if the definition of lift/thrust unit and / or system is complete and unambiguous for a generic set of functions of a VTOL and their potential applicability	No	Yes	Accepted	See comment #03-39
03-51	*Rolls Royce (C Ludena)*	MOC VTOL.2000	8	Assessment to identify critical failure for performance (CFP) should be integrated in the overall safety analysis starting from the FHA as defined in VTOL.2510	Refer to the safety assessment process as defined in MOC VTOL2510	yes	no	Accepted	New text: *“The set of critical failures for performance is used to establish the Certified Minimum Performance and as part of the safety assessment process of VTOL.2510.”*

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03-52	FAA Flight Test	Subpart A		All Azimuth Controllability minimum standards must be defined for the UAM Class of Powered Lift ("Enhanced" in EASA terminology)	This standard must be at least equal to existing rotorcraft – 17 knots	Yes	No	Noted	All Azimuth Controllability minimum standards will be addressed in a separate Means of Compliance Two levels of analysis are already included the Atmospheric Disturbance in MOC VTOL.2135: a) Gusts, and b) Steady wind. Hereafter some extracts from the MOC VOL.2135: *"Atmospheric Disturbance (AD)* *[…]* *Additional steady state relative winds values, for the most critical azimuth, are established to show compliance with the applicable requirements when the aircraft is operating based on ground references (e.g. Take-off, Hover, Landing).* *[…]* *The steady state relative wind values are derived from the experience from CS-27, and have been identified as being 17 kt. This value is the minimum to be used for airworthiness approval; applicants may choose higher steady wind values based on market requirements.* *The steady wind value should be evaluated only in the phases of flight that are close to the ground. The controllability in steady winds should be demonstrated for all FC in Light AD level (without gusts and turbulence)."*
03-53	FAA RSB AdFC	10	8	Are CMP required as part of type data and for all systems? Are they part of a safety assessment?	Not sure what CMP is required for (which regulations) . Needs more explanation.		Objection	Accepted	New text: *"The CMP is part of the type data and is associated with limitations on the continued safe flight and landing for Category Enhanced and on the controlled emergency landing for Category Basic, to be established in accordance with VTOL.2510 and VTOL.2620."*
03-54	FAA RSB AdFC	10	8	Not sure when CFP is required. It looks like it could be required as part of the safety assessment process.	Need more explanation on where (which regulations) are required.		Objection	Accepted	See comment #03-51
03-55	*Leonardo Helicopters*	MOC VTOL.2000	8	Definition of Hazard missing	Please add the definition of Hazard	YES	NO	Not accepted	The word "hazard" in the definition of emergency landing and survivable emergency landing is used with its usual meaning in the English language: an event that is dangerous and can potentially cause harm or damage.
03-56	*Leonardo Helicopters*	MOC VTOL.2000 Para. 10	8	"CMP is the set of performance data obtained by considering the effect of all failures and combinations that are not classified as catastrophic." It should be clarified how this performance have to be obtained and which failures must be tested in flight Minimum performance should also take into consideration power output reduction due to battery discharge, and the degradations of the T/L system not related to failures (motor degradation, battery aging, etc.)	Please specify how performance data should be obtained (analysis, ground test,etc.), at which energy state, and which failure must be tested on flight.	YES	NO	Noted	Degraded performance calculations should be based on the worst cases for the nominal performance parameters. Additional details about the obtention and testing will be provided in different MOCs.

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03-57	*Leonardo Helicopters*	MOC VTOL.2000 Para. 10	8	"A critical failure for performance (CFP) is a failure or combination of failures that results in the maximum degradation for a given flight phase and performance parameter."	Specify which are the flight phases for which the CMP must be defined, and if they are dependent from aircraft architecture? (tilt rotor, fixed wind, etc.)	YES	NOT	Noted	The CMP will be used by the operator to plan a safe flight, also in the event of a single failure or a combination of failures not extremely improbable. All phases of flight will thus have to be considered. The CMP is dependent on the aircraft architecture, e.g. for possible failures and their consequences.
03-58	*Leonardo Helicopters*	MOC VTOL.2000 Para. 10	8	The set of critical failures for performance is used to establish the Certified Minimum Performance.	How this set of minimum performance will be transferred to the pilot? Which information the AFM will contain? If for a given flight phase, the CFP consist of three combined failures, the AFM will contain performance data for a single failure also?	YES	NOT	Noted	To establish the CMP used for flight planning, it will be sufficient to have the highest performance degradation possible from single failures and combination of failures not extremely improbable (i.e. from the **Critical** failure for performance). Performance data, e.g. available controllability margin, from failures resulting in a lesser degradation should also be provided to the flight crew during the flight after the failure occurs. More details on the content of the Aircraft Flight Manual and flight crew displays will be provided in dedicated MOC.
03-59	*Leonardo Helicopters*	MOC VTOL.2000 Para. 10	8	« A critical failure for performance (CFP) is a failure or combination of failures that results in the maximum degradation for a given flight phase and performance parameter. » Thanks to the redundancy, some configuration may allow elements of the Lift/Thrust System to be introduced in the MMEL. Some of this elements may be part of the combination of failures that drives to a CMP.	Please clarify if current MMEL process will be applicable to SC.VTOL certified aircraft.	YES	NOT	Noted	EASA is currently assessing the applicability of the OSD process, and in particular MMEL, to VTOL aircraft. The relation of systems with critical failures for performance and MMEL will be defined.
03-60	*Leonardo Helicopters*	MOC VTOL.2000 Para. 10	8	Due to the distributed propulsion, high number of L/T system elements, and high level of redundancy, there can be many failures (hundreds) impacting the performance of the aircraft.	Issue is how to transfer these data to the pilot to allow prompt evaluation of performance of the aircraft, available controllability marging and residual range. CMP will be related to the CFP, which is only a single case for a given flight phase. Many other combination of failure can happen.	YES	NO	Noted	See comment #03-58
03-61	*Lilium GmbH*	MOC VTOL.2000 (10)	8	The CMP is defined as: '*the set of performance data obtained by considering the effect of all failures and combinations that are not classified as catastrophic on the nominal performance parameters*'. It is not explicitly defined what is meant by the terms '*set of performance data*' or '*performance parameters*'.	The MOC would benefit from further definition of the terms '*set of performance data*' and '*performance parameters*'	yes	no	Noted	Examples of performance parameters are already provided in the definition MOC (range, rate of climb). In this respect, performance parameters and their combination result from an analysis of the ability of a given aircraft design to complete a safe flight. Additional details may be provided in separate MOCs.

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03-62	UK CAA	MOC VTOL.2000 Applicability, 10. Certified Minimum Performance (CMP) Paragraph 3	8	Is it appropriate to state operational regulations defining types of operation in a design specification? For example SPA.HOFO states design standards for helicopters performing specific types of operation in an operational regulation.	Better that intentions regarding suitability of different categories of VTOL aircraft for different types of operation are expressed in the preamble rather than in the requirement itself.	Yes	Yes	Not accepted	There may be operational regulations which impose certain conditions, in terms of their certified design and capabilities, on aircraft that perform specific operations. This is not related with the mentioned paragraph. The purpose of this paragraph is to clarify that the certified minimum performance is associated with general limitations to be established in the flight manual, independently of the particular operation.
03-63	*Leonardo Helicopters (via ASD)*	MOC VTOL.2000 Para. 10	8	The set of critical failures for performance is used to establish the Certified Minimum Performance. This approach requires evaluation of performance for every combination of failure whose probability is higher that extremely remote. It is not clear how the performance data will be transferred into the AFM and how they will be tested in flight. How this set of minimum performance will be transferred to the pilot? Which information the AFM will contain? If for a given flight phase, the CFP consist of three combined failures, the AFM will contain performance data also for a single failure? This approach will be valid for some aircraft architecture, but for complex LTU made by hundreds of elements (battery packs, bus bars, motors,…) will not work	Please clarify if will be possible to certificate and publish performance data for failures less critics than the CMP	YES	NOT	Noted	See comment #03-58
03-64	UK CAA	MOC VTOL.2000 Applicability, 10. Certified Minimum Performance (CMP) Paragraph 1	8	Editorial, typo.	Remove one additional period on the first sentence of first paragraph.	Yes	No	Accepted	Typo corrected

4. MOC VTOL.2005 CERTIFICATION OF SMALL-CATEGORY VTOL AIRCRAFT

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
04-01	*Leonardo Helicopters*	MOC.VTOL 2005	8	« Aircraft can be certified in both categories Basic and Enhanced by using different AFM supplements and different configurations. »	Will this be managed by two variants under the same TC?	YES	NO	Noted	This does not necessarily lead to different variants, similarly to helicopters that can be operated under Category A with the relevant Rotorcraft Flight Manual Supplement.
04-02	UK CAA	MOC VTOL.2005 Certification of small-category VTOL aircraft Paragraph 1	8	AFM Needs explanation.	Aircraft Flight Manual (AFM)	Yes	No	Accepted	New text: "Aircraft Flight Manual (AFM)"

5. MOC VTOL.2010 ACCEPTED MEANS OF COMPLIANCE

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
05-01	Leonardo Helicopters	MOC.VTOL 2010	8	Are reference to under-development EUROCAE Standards to be introduced?	Specify updating process of the MOCs	YES	NO	Accepted	The following text is added: "The MOCs in this document may be updated with any necessary complement or modification, while additional MOCs with different objectives in the Special Condition may also be incorporated in this document as required. In the course of these revisions, EASA may recognise available industry standards as accepted Means of Compliance with the Special Condition VTOL."
05-02	UK CAA	MOC VTOL.2010 Accepted Means of compliance Paragraphs 2 & 3	8	Paragraphs 2 & 3 appear to conflict with each other. Paragraph 2, as written, infers that the MoC provides acceptable means of compliance that would be applicable to all forms of design approach/implementation. Paragraph 3 infers that this may not be true. This may lead to future confusion.	It may be possible to re-word paragraphs 2 and 3 in slightly e.g.: "Each MOC in this document, when followed in its entirety, is considered an acceptable means for the applicant to demonstrate compliance with the related objectives of the special condition, for the currently foreseen VTOL architectures and technologies." "The MOC in this document may not yet include appropriate means to demonstrate compliance for the certification of all possible designs and/or technologies, including the new and novel application of existing technologies."	Yes	No	Accepted	Text changed as suggested
05-03	Airbus Helicopters (via ASD)	MOC VTOL.2010	8-9	"*Each MOC in this document, when followed in its entirety, is considered an acceptable means for the applicant to demonstrate compliance with the related objectives of the special condition*." "*the MOC in this document may not yet include appropriate means to demonstrate compliance for the certification of all possible designs.*" "*the MOC in this document cannot be considered by default as being acceptable or appropriate for the certification of a particular design*." When designing its vehicle the future applicant has no means to know if the MOC applies or not and if something else will be required during certification.	To define what assumptions are at the basis of each MOC and would make it unapplicable, if not fulfilled.	no	yes	Noted	See comment 05-02. EASA has made an effort to offer means of compliance in a new and novel domain to support the substantiation of compliance with the SC-VTOL of the designs expected to be type certificated in the near future. These MOCs have a general vocation and setting an exhaustive list of conditions or assumptions for their application is deemed unnecessarily restrictive at this point. The purpose of this text, which has been reworded to add clarity, is to highlight that some MOCs may not be suitable in case of specific design features not envisaged today. As in any other certification project, the Certification Basis and the Means of Compliance are proposed by the applicant and accepted by EASA in the Certification Programme (see points 21.15(b) (4) and (5) and 21.A.20 in EASA Part 21, Annex I to Regulation (EU) 748/2012). This usual step in any certification is even more relevant in the case of novel products like VTOL aircraft, in which EASA anticipates a thorough review and an extensive discussion of the Certification Programme with the applicant. The suitability of the Certification Basis and/or the MOCs for the proposed design will be assessed at that time, and specific decisions for that project can be made as appropriate.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
05-04	Airbus Helicopters (AMD)	MOC VTOL.2010	8-9	"*Each MOC in this document, when followed in its entirety, is considered an acceptable means for the applicant to demonstrate compliance with the related objectives of the special condition*." "*the MOC in this document may not yet include appropriate means to demonstrate compliance for the certification of all possible designs.*" "*the MOC in this document cannot be considered by default as being acceptable or appropriate for the certification of a particular design.*" When designing its vehicle the future applicant has no means to know if the MOC applies or not and if something else will be required during certification.	Define what assumptions are at the basis of each MOC and would make it unapplicable, if not fulfilled.		x	Noted	See comment 05-03

6. MOC VTOL.2135 MINIMUM ACCEPTABLE HANDLING QUALITIES RATING

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
06-01	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2135, Sect.3	11	"A pre-requisite to start the MHQRM process is thus to have FHAs (Functional Hazard Assessment) available and have preliminary quantitative assessments for the FCs to be analysed in the MHQRM"	To be clarified which FHAs (systems? Aircraft?) and what quantitative assessments (PSSA? Prelim FTA? SSA? FMECA?) are required	Yes	No	Noted	FHAs encompass in this context AFHA and SFHA: The HQRM process is related to FC that affect HQ (so not only flight control system failures but also for instance lift/thrust system failures). These FCs can be at aircraft level (AFHA) or system level (SFHA). To enter the MHQRM process, it is thus important that FCs that affect HQ are identified and a failure hazard classification proposed for those prior to entering the MHQRM process. A preliminary quantitative assessment for the FCs is also a necessary input for the MHQRM: this assessment can be done by any acceptable quantitative methodologies, typically PSSA Fault Tree Analysis (Dependence Diagram or Markov Analysis may also be used)
06-02	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2135, Sect.5	15	"Usually, to give credit for a Flight Envelope Protection (FEP) provision, this feature should have a failure probability of less than 1 x 10-5"	Explain the rationale behind this figure	Yes	No	Accepted	Figure was provided as a reference only. Further to more detailed verifications it is decided to delete this sentence
06-03	Collins Aerospace	MOC VTOL.2135	10	Change "different to" to "different from"	Change "different to" to "different from"	Yes	No	Accepted	Changed as suggested.
06-04	Collins Aerospace	MOC VTOL.2135	12	"The visual environment, or better the quality of the Visual Cues (VisC), is not defined" - word "better" seems unnecessary	Remove "better"	Yes	No	Accepted	Removed as suggested
06-05	Collins Aerospace	MOC VTOL.2135	12	" probability that is greater than 10-9" should be per hour	add "per hour" or change to "10-9/hr"	Yes	No	Accepted	Added "per hour" as suggested
06-06	Collins Aerospace	MOC VTOL.2135	16	Levels of Atmospheric Disturbance in Table 4 do not correspond to turbulence levels. This will be confusing.	Change atmospheric disturbance classification to "None" or "Minimal", change "Moderate" to "Light to Moderate".	Yes	No	Not accepted	The atmospheric disturbance level includes the turbulence level, there is not a one to one correspondence. These definitions will be postponed until the intensities and probabilities can be defined.
06-07	*Rolls Royce (Jonathan Holt)*	MOC VTOL.2135	12 & 15	GNSS and AFM abbreviations used and not defined	Define GNSS and AFM	Yes		Accepted	Terms added to the List of Acronyms
06-08	FAA RSB HF	Background, first para	10	Delete "Situational Awareness" From a certification standpoint, assessing the overhead cognitive (attentional) requirements of "situational awareness" is extensive. "Situational awareness" is too broad and ill-defined to assess the effects of HQ on it.	Unless SA is going to be defined and used as a metric, delete.	Yes		Noted	The comment is noted, but no change to text is made. Situational Awareness (SA) is mentioned in the introduction part as a narration of the process and to explain to the "less educated readers" why high-quality HQs are necessary. No "metrics" are assigned to it, however SA is a general term commonly used in aviation.
06-09	FAA RSB HF	Background, third para	10	"Usually the Cooper Harper Handling Qualities Rating Scale (CHR) or other workload rating scales (e.g. Bedford). . ." CHR is aircraft handling characteristics, Bedford is pilot workload.	2 different tools, if you want to have an alternative to CHR, select another handling qualities tool. If you want workload, use Modified Cooper Harper (with Beford or NASA TLX as alternatives)	Yes		Accepted	New text: "Usually the Cooper Harper Handling Qualities Rating Scale (CHR) is used to measure the Handling Qualities, while the Bedford rating scale (or NASA Task Load Index as alternative) is used to measure the workload"

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06-10	FAA RSB HF	3.HQRM Process, first para	11	Sentence: " . . . SC VTOL based on the Concept of Operations (CONOPS) for VTOL that is being produced by industry." Other than the ongoing NASA/FAA research at NASA Dryden in Mojave, CA, is there any other "industry activity" researching eVTOL CONOPS? Additionally, if these CONOPS are not yet developed, how will current applicants know how to adapt ADS-33E MTE's? What is the status of this MOC SC if the MTEs or the guidance for deriving them is not developed?	Clarify	Yes		Noted	The MTEs included in ADS 33E were re-evaluated by EUROCAE and a Standard within Eurocae Working Group WG112 SG-4 (Flight) is under development. The manoeuvres will be based on the CONOPS of the VTOLs, which are also described in standards developed or under development by the same Working Group.
06-11	FAA RSB HF	3.HQRM Process, 5th para	12	SENTENCE: "The visual environment, or better the quality of the Visual Cues (VisC), is not defined, and the *assumption is that the VisC, in terms of external visual environment and displays/sensors feedback,* are sufficient to allow the crew to perform their tasks and be able to achieve and assess Desired and Adequate HQ performance criteria" COMMENTS: It appears there are different visual cue variables: Visual cues from ext visual environment; visual cues from displays/sensors feedback. ADS33E uses GVE and DVE both relating to external visual environments. The implication is the applicant can propose and show equivalence of display/sensor feedback with visual cues. Based on the rest of the paragraph, this is not clear	Clarify	Yes		Noted	The visual cues can be external or internal. The assumption is that the visual cues will be sufficient to allow the crew to reach and evaluate their capability to be in Desired or Adequate performance.
06-12	FAA RSB HF	3.HQRM Process, 5th para	12	SENTENCES CONTAINING: ". . . evaluated by using an appropriate external visual environment, while the take-off and landing phase may use a better external visual environment. The VisC will be defined in the evaluation document and should be agreed with EASA on a case by case basis." COMMENT: Will EASA have a standardized set of criteria to apply analogous to what currently exists (for example 200' ceiling with ½ statute mile vis (2400' RVR)?		Yes		Noted	The requested details will be defined once the higher-level regulatory framework has been established (e.g. rules of the air and/or weather minima for UAM, etc.).
06-13	FAA RSB HF	Table 1; SAT description	13	". . . without exceptional piloting skills and minimal pilot compensation". Could be misinterpreted to mean "without minimal piloting compensation." (A lawyer would interpret it this way . . ."	". . . with minimal pilot compensation and without exceptional piloting skills." OR ". . . without exceptional piloting skills and with minimal pilot compensation."	Yes		Accepted	New text: "Handling Qualities allow achievement of desired performance criteria without exceptional piloting skills and with no or minimal pilot compensation"

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06-14	FAA RSB HF	Table 1; ADQ description	13	Handling Qualities allow achievement only of **adequate performance criteria**, or **desired performance criteria <u>with moderate pilot compensation</u>, without exceptional piloting skills**. Not clear. For clarification, does this mean for ADQ, the aircraft has to have Handling Qualities allow achievement only of **adequate performance criteria with minimal pilot compensation and without exceptional piloting skills.** **OR the aircraft has to have** Handling qualities allow achievement of SAT criteria with **moderate pilot compensation and without exceptional piloting skills.**	Clarify	Yes		Accepted	For ADQ HQR, the desired performance can be achieved with moderate pilot compensation, and/or, adequate performance regardless of pilot compensation. See comment 06-86 New text: "Handling Qualities allow achievement of desired performance criteria, or adequate performance criteria without exceptional piloting skills and with moderate to extensive pilot compensation."
06-15	FAA RSB HF	5(a)	14	SENTENCE: "The flight crew should operate the aircraft by definition in the NFE. Excursions into the OFE and LFE are determined by AD, by transient conditions due to failures or malfunctions, *or just by expected human errors (that can have different probabilities based on the design).* COMMENT: 1. Is the parenthetical (that can have different probabilities based on the design) applicable to ". . . expected human errors" or to the entire paragraph? 2. What is an «expected» human error (which leads to the interpretation that the parenthetical statement applies to a human error probability)? As written it implies there is human error (HE) probability that can be applied based on the design. If this the intent, it is very difficult if not impossible to provide a valid and reliable HE probability. Especially since there is a lack of "average" eVTOL pilots . . .	Clarify: The flight crew should operate the aircraft by definition in the NFE. Excursions into the OFE and LFE are determined by AD, by transient conditions due to failures or malfunctions (that can have different probabilities based on the design), or by human errors.	Yes		Accepted	New text: "The flight crew should operate the aircraft by definition in the NFE. Excursions into the OFE and LFE are determined by AD, by transient conditions due to failures (that can have different probabilities based on the design), or by expected human errors."

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06-16	FAA RSB HF	5, table 3,	15	The lines between NFE and OFE are not clear. Using the examples given, Vne is the OFE limit (red line). However, traditionally, a pilot can operate up to the red line because it is, by definition, an upper limit of a "normal" flight envelope condition. NFE seems to indicate an "operationally" constrained envelope like "best cruise", "best endurance" or "best climb" used by the operator to optimize the operational capabilities of the aircraft or provide pax comfort. I do not think an aircraft certification authority should be mandating optimal operational envelopes. COMMENT Requiring a "CAUTION" level alert for transition from one certified portion of the FE into another certified portion of the FE that will not, by definition, endanger the aircraft, is iffy. This assumes the CLAW does not change to compensate (that will add another variable to consider.)	Consider revising definitions and reconsider guidance regarding a "CAUTION" alert between NFE, OFE	Yes		Noted	At the moment EASA would like to retain the "caution" between NFE and OFE with the purpose raise awareness and, in principle, not linked with meeting aircraft limits. A pilot is not expected to operate "up to red line", as this is an approved condition which is not considered to be the "normal flight envelope". EASA is currently discussing the flight envelopes, more guidance will be provided at a later stage.
06-17	FAA RSB AdFC	MOC VTOL.2135 section 1.	10	The regulation is Controllability which, for an advanced controls (FBW), can be demonstrated not just via a handling qualities method but should also include a systems verification method to reduce variability in the evaluation results. It was stated that "This method is different to CS-23 and CS2-7, …". We note that these aircraft have been successfully certified without an HQRM.	Remove the requirement to perform a handling qualities assessment based solely on pilot assessments. Incorporate a strategy similar to one the FAA is developing (MTE, HQTEs).	Suggestion		Not accepted	EASA remains available and interested to review the FAA's approach/method for VTOL certification once the FAA shares it with EASA or it is publicly consulted.
06-18	FAA RSB AdFC	MOC VTOL.2135 section 3.	11	The FAA is moving away from the referenced AC (25-7D). In any case, breaking the tasks down by FE, AD and FC is unnecessary. We already have regulations that require the applicant to test throughout the flight test envelope and within environmental limits.	Remove the requirement for the breakdown of tasks. The test procedures to be included in the HQTE/MTE under development are considering testing at conditions defined in the regulations and at the identified degraded modes.		Objection	Not accepted	See reply to comment 06-17
06-19	FAA RSB AdFC	Table 1	13	The table includes too many subjective parameters "desired", "exceptional" and "minimal." All these translate into … one pilots opinion. Getting several pilots is still pilot opinion that can be overturned by a certification pilot(s) later.	Remove the table and associated aspects of MHQRM. To minimize variability due to subjective parameters, set minimum parameter values for aerodynamic rates and limits for all flight conditions and environmental requirements defined in the regulations.		Objection	Not accepted	See reply to comment 06-17
06-20	FAA RSB AdFC	Table 2	14	This is a very busy table and is tied to subjective parameters previously defined. In addition, it becomes more subjective when determining the requirements for each AD. For example, how was SAT determined for Severe, NFE, Nominal Condtiion? What about degraded modes?	Remove the table and associated aspects of MHQRM. Set minimum parameter values for aerodynamic rates and limits for all flight conditions and environmental requirements defined in the regulations.		Objection	Not accepted	See reply to comment 06-17
06-21	FAA RSB AdFC	Tables 3,4, 5	15-17	The lack of definition in these supporting tables clearly show that the level of detail to determine simple performance criteria are too complicated.	Remove the table and associated aspects of MHQRM. Set minimum parameter values for aerodynamic rates and limits for all flight conditions and environmental requirements defined in the regulations.		Objection	Not accepted	See reply to comment 06-17

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06-22	FAA SASB Icing	Subpart B	17	MOC for VTOL.2165 is missing. MOC is needed for both eVTOL certified for icing and not certified for icing.	Add MOC for VTOL 2165.	Yes	Yes	Noted	MOC VTOL.2165 will be considered in future revisions of the MOC document, depending on the progress of industry's investigation and definition of the prevailing icing conditions for which certification will be requested (e.g. in Eurocae WG-112)
06-23	FAA Flight Test	Subpart B		EASA's MOC allows the applicant to select a pilot rating method, equating the Cooper-Harper scale with the Bedford workload scale. In my opinion, this is a mistake. While workload, i.e., pilot compensation, is a component of the Cooper Harper scale, Handling Qualities ≠ Workload. The Bedford scale addresses ability to complete task with excess capacity – there is no discussion of aircraft characteristics, which are fundamental to handling qualities. As you read on, the intent is clearly to use Cooper Harper as they refer to desired and adequate performance, etc., which is not relevant to the Bedford scale.				Noted	The CHR is expected to be used for designs that are "piloted", while the Bedford scale could be used for designs which include tasks that are automated. New text: "Usually the Cooper Harper Handling Qualities Rating Scale (CHR) is used to measure the Handling Qualities, while the Bedford rating scale (or NASA Task Load Index as alternative) is used to measure the workload"
06-24	FAA Flight Test	Subpart B		ADS-33 is a good approach, but this MOC implies using the document and, in particular, the MTEs in what amounts to a "black box" approach. That is, they are not taking into account the intent of the MTEs, which in ADS-33 were defined for the precision and aggressiveness levels of a military mission. These MTEs should be adapted or re-imagined for the PAV/UAM mission. For example, the aggressiveness of the Depart/Abort task is not likely appropriate for the civilian mission.				Accepted	EASA is currently participating in the development of manoeuvres adapted for VTOLs like the MTEs in ADS-33E.
06-25	FAA Flight Test	Subpart B		The consideration of HQR 7 – 9 as controllable and at some level acceptable is not appropriate. It does not matter if you have exceptional pilot skills, an HQR 7 means that adequate performance is not attainable. I would also argue that the pilot compensation required to retain control with an HQR 8 and especially an HQR 9 is exceptional and thus the statement that "continued safe flight and landing without exceptional piloting skills" is not likely possible.				Noted	CHR 9 would be acceptable only in a transient condition. EASA does not intend to accept CHR 9 of HQs to demonstrate CSFL.
06-26	FAA Flight Test	Subpart B		The acceptance of Table 2 indicates that you accept the premise of Table 1. The previous bullet indicates just one such issue with Table 1.				Noted	See reply to 06-25
06-27	FAA Flight Test	Subpart B		The visual cueing discussion deviates from ADS-33, so which applies? Considerations for increased augmentation in reduced visibility scenarios, as defined in ADS-33, is not directly addressed.				Noted	ADS 33 is a design standard. This MOC only intends to define the minimum acceptable HQ performance. ADS 33 defines the response type based on the usable visual cue, this MOC is intentionally not prescriptive and leaves the choice to the applicants.
06-28	FAA Flight Test	Subpart B		The HQRM method described in this MOC document is based on AC25-7D. Ironically, EASA never accepted this approach and now they are considering to use it on a different class of vehicles.				Noted	As stated in Section 2 of this MOC: "This method is different to from CS-23 and CS-27, since in those certification specifications, the HQ of an aircraft are suitably assessed on the addition of the compliance to static or dynamic stability requirements along with other requirements for controllability and average piloting skills. HQ are evaluated without any specific generally recognised method, and are mainly evaluated to measure the workload to determine the minimum crew in respect to the kind of operations"

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06-29	FAA Flight Test	Subpart B		The HQRM appendix of AC25-7D is problematic, and while it officially remains, there are indications that this approach will be dramatically altered if not deleted in the next AC revision.				Noted	EASA remains available and interested to review the FAA's approach/method for HQ certification once the FAA shares it with EASA or it is publicly consulted.
06-30	FAA Flight Test	Subpart B		The HQRM approach is not clear on its scope. It is unclear which regulations are applicable or whether this approach is to be used for normal operations, failure cases, or both.				Noted	This MOC is intended to be used for both, normal operations, and failure cases, as long as an evaluation of HQs is performed.
06-31	FAA Flight Test	Subpart B		The approach appears to directly tie a certain HQ rating to a compliance finding, when compliance must also consider many other factors besides handling qualities.				Noted	This method is only proposed to find compliance to the HQ requirements. Compliance to other requirements is out of scope.
06-32	FAA Flight Test	Subpart B		This approach gives "credit" atmospheric and envelope probabilities and from FAA part 25 certification experience, this "credit" is difficult to coordinate with specialists in the context of showing compliance to 25.1309, .671/.672.				Noted	The challenge is acknowledged. A common definition of atmospheric disturbance levels and associated occurrence probabilities will need to be found.
06-33	FAA Systems	MOC VTOL.2135 Minimum Acceptable Handling Qualities Rating	10-17	Page 11 notes "In particular, the principle of determining the minimum HQR based on the probability of being in a given Flight Condition (FltC) was adopted." Table 1 appears to imply that requirements are based on severity classification. Text near the end of page 11 implies that this MHQRM could be used for failure condition classification, and could result in failure conditions being reclassified. This seems to be beyond the initial scope. Is the intent of this method to provide guidance on classifiying failure conditions for 23.2510? Is that the purpose of Table 1? Please consider basing this assessment entirely on probability. This would resolve the following potential issues: • Failure conditions that are not very severe, but are very rare. For example, a Major failure condition with probability of E-8. • Failure conditions that affect handling qualities or workload, but the severity is driven by other factors. For example, loss of normal braking during landing. • Inconsistencies in requirements. Table 1 specifies Handling Qualities Rating of CON for Hazardous failure conditions, but Table 2 specifies SAT for Extremely Remote Failure Conditions in the Normal Flight Envleope with Light Atmospheric Disturbance. If a failure condition is hazardous, it must be shown to be extremely remote, so this appears to be inconsistent.	Consider basing the handling qualities ratings completely on probability, and not on failure condition classifications such as minor, major, and hazardous. This would establish handling qualities ratings based on the frequency of the event. A similar approach is used for CS 25.302 to determine load factors for load alleviation systems based on the probability of the event (more likely events must have higher factors) not based on the hazard classification. If there is another objective in this MOC to link MHQRM with severity classifications, consider clarifying that objective and method.	Suggestion		Noted	There is the intention to link the HQR (and not MQRM) to the severity classification according to MOC VTOL.2510. One of the HQR objectives is to validate the Failure Condition classification. The HQR process is entered when an initial classification has already been established and preliminary quantitative assessments are available. If a FC classification is driven by the HQs degradation, then the HQR that results from the evaluation needs to match the initial FHA classification; otherwise the FHA classification needs to be revised accordingly. The probability of occurrence or other mitigations need to be set to meet the updated safety objectives. So, taking the brake failure on landing example (which is borderline, as that is ground handling), if that FC is initially classified as Minor based on the expected crew workload, the severity can be raised to Major during the HQs evaluation in case SAT HQR can't be met, either for very high workload or simply because they cannot maintain the "desired" ground track or because the deceleration is too abrupt. In that case, in order to meet the updated safety objective, either the probability of occurrence is reduced (by design), or mitigations are set so that maybe an additional check on the brakes before touchdown is performed.

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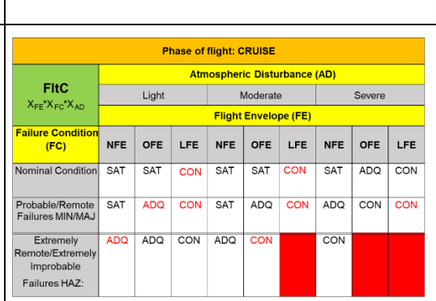
06-34	FAA Systems	MOC VTOL.2135 Minimum Acceptable Handling Qualities Rating	15	"Usually, to give credit for a Flight Envelope Protection (FEP) provision, this feature should have a failure probability of less than 1 x 10-5. The credit given to remain within a given FE based on adding a FEP provision, based on the data collected in real operations in the AMC to 25.1309, is 1x 10-2." This seems appropriate for alerts like stall warning. If the FEP is designed so that limits cannot be exceeded regardless of pilot input, exceeding those limits every 100 flights in real operations seems quite bad.	Please clarify when the probability of exceeding FEP limits should be assumed to be $1x10^{-2}$.	Suggestion		Accepted	Figure was provided as a reference only. Further to more detailed verifications it is decided to delete this sentence See also 06-02.
06-35	*Airbus Helicopters* *(IE)*	VTOL.2135 §5	14	How are human error probabilities quantified? Human error is typically out of the usual Safety process and is extremely difficult to estimate.	It is suggested to find ways to remove the human error probability from the calculations to ease the burden on the applicant and Airworthiness bodies. Solutions can be the classification of the loss of protections against human error to HAZ or MAJ to evaluate the likelihood without human parameters.	Suggestion	substantive	Accepted	See also 06-15. New text: "The flight crew should operate the aircraft by definition in the NFE. Excursions into the OFE and LFE are determined by AD, by transient conditions due to failures (that can have different probabilities based on the design), or by expected human errors."
06-36	*Airbus Helicopters* *(JB)*	VTOL.2135 Table 2	14	Minimum acceptable Handling Qualities Rating depending on Flight envelope/Faillure Conditions/ Atmospheric Disturbance is not always appropriate as it doesn't take sufficiently into account the subsequent effect of Failure Condition and flight envelope limitation impacts on pilot workload and then on HQ level.			Objection	Accepted	Table updated as suggested.
06-37	*Airbus Helicopters* *(JB)*	VTOL.2135 Table 3	15	LFE HQ investigation: *This is the maximum extent in terms of envelope that needs to be investigated from a HQ point of view but should not be included in the AFM.*	HQ Demonstration inside LFE will be limited to the minimum pilotability level needed to come back immediatly inside the OFE	Suggestion		Noted	In the LFE it should be demonstrated that control is retained, and that it is possible to transition to OFE or NFE and regain the appropriate level of HQ.
06-38	THALES Avionics	MOC VTOL.2135/1	10	Notion of "excess workload capacity" not appropriate	Proposed rewording: Satisfactory Handling Qualities (HQ) give the opportunity for the crew to better manage high workload situations, and allow them to operate safely for longer periods, and to be able to deal with aircraft system failures and contingencies. Degraded HQ lead to an increased crew attentional demand for aircraft control, hence reduced high workload capacity for other tasks and for Situational Awareness.	Suggestion	Substantive	Accepted	Text changed as suggested.

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06-39	THALES Avionics	MOC VTOL.2135/3.	12	"approach and landing (including emergency landing and balked landing). " Does "emergency landing" has the same meaning as provided in MOC VTOL.2000 section 4? "Emergency Landing: Impact (crash) where the occupants are given every reasonable chance of escaping serious injury."		Observation	Substantive	Accepted	New text: "*landing following a failure condition and balked landing*"
06-40	*Vertical Aerosapce*	VTOL.2135 Para 1.	10	In the statement 'The aircraft needs to be controllable and manoeuvrable to cope with adverse weather conditions and to avoid late detected obstacles or traffic appropriate to the type.'	Could EASA please provide further clarification on this statement?	Yes	No	Noted	The aircraft needs to be controllable (stability requirements) and manoeuvrable (control response appropriateness) for the intended function, which in this case includes UAM. In UAM operations we expect aircraft to cope with adverse weather conditions (on top of the "normal" ones) that can derive from turbulent airflow conditions from wind/buildings interference, and be "agile" enough to be steered away from other traffic, or late detected obstacles.
06-41	*Vertical Aerospace*	MOC VTOL 2135	10	Vertical Aerospace recognises that the Handling Qualities aspects of MOC VTOL is developing and welcomes the pragmatic approach that for each configuration of VTOL , and it's associated CONOPS, the demonstration of handling to ensure exception skill is not required may differ. The MOC points to ADS-33E as a 'tool' for MOC. As significant portion of the MOC VTOL provides guidance on the application of ADS-33E to VTOL certification; should this be included in a separate guidance document rather than the MOC document.	Guidance on application of ADS-33E to VTOLs moved to a separate guidance document	Yes	No	Noted	A document is being prepared by EUROCAE on manoeuvres similar to ADS-33E for this MOC VTOL MHQRM. Once all the technical elements are defined, EASA will evaluate the best way of presenting the whole approach.
06-42	*Vertical Aerospace*	MOC VTOL 2135	10	The MOC states that the that Visual Cues will be defined in the 'evaluation document' can EASA confirm if this is the Certification Test Programme/Plan?		Yes	No	Noted	Yes. It is the certification plan of the applicant. The visual environment is expected to vary based on the kind of operations for which certification is requested (VFR Day, Night, IFR, Icing).
06-43	*Vertical Aerospace*	MOC VTOL 2135	10	The MOC doesn't provide any clear mechanism for grading the Visual Cues such as those used in ADS-33E (i.e. Usable Cue Environment). Will this form a part of the developing work on VTOL MOC?		Yes	No	Noted	Correct. It may be included in the subsequent work done by EUROCAE.
06-44	*Vertical Aerospace*	MOC VTOL 2135	10	Vertical Aerospace believes that it is worth stating that the origins of ADS-33 and a number of the MTEs therein are potentially overly aggressive for a passenger carrying civilian VTOL. It may also be necessary for the applicant to develop new MTEs appropriate to the configuration and CONOPS, with the agreement of the regulator, due to the unsuitability of many AD-33 MTEs for a civilian VTOL application.		Yes	No	Noted	Agreed. The MTEs included in ADS-33E will not be used as they are. EUROCAE is developing a set of manoeuvres that will be tailored to VTOL designs and UAM CONOPS.
06-45	*Vertical Aerospace*	MOC VTOL 2135	10	FltC (Flight Condition) is not listed in Section 2 - list of acronyms.	Add to list of acronyms	Yes	No	Accepted	Added as suggested

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06-46	*Vertical Aerospace*	MOC VTOL 2135	15	Table 3. The provision of three Flight Envelopes is complicated and probabilities for OFE and LFE are marked 'TBD'. To ensure simple operation of the air vehicle should only one flight envelop be issued for the vehicle?		Yes	Yes	Noted	Applicants may choose to have only 1 FE, but the same HQs requirements will apply.
06-47	*Vertical Aerospace*	MOC VTOL 2135	15	Probability of being in any given envelope is more likely to be driven by system performance and failure modes – It is not clear how flight test will substantiate these values and what the minimum level of data would be needed to validate by flight test.	Probabilities to be derived by System Analysis rather than flight test	Yes	Yes	Noted	VTOLs may be outside the Normal Flight Envelope due to Atmospheric Disturbance, system failures, human error or particular operational needs (go around), etc. When the probability values have been established, the assumptions that during normal and/or emergency conditions there will be situations that may lead to excursions in a certain Flight Envelope should not be invalidated by the flight test data during the compliance demonstration, and possibly the Function and Reliability activity. There should be a link also with Continued Airworthiness activity when comparing occurrences and flight data monitoring during the fleet service.
06-48	*Vertical Aerospace*	MOC VTOL 2135	16	The magnitude of gusts and turbulence may vary substantially depending on the operating location, particularly in Urban environments. Notes in Table 4 link the AD level to aircraft sensor, attitude and altitude response, however, the susceptibility of VTOL vehicles will vary depending on design. The MOC should be developed to explictly relate turbulence classification to quantitative specification of the turbulence and gust strength at locations where the vehicle is to be certified to operate from, rather than the vehicle response, which will likely influence the HQ rating.		Yes	Yes	Not accepted	The aircraft response will affect the HQ rating. The Atmospheric Disturbance level should be a quantitative specification, defining the intensity, direction, frequency and probability. These values will be driven by data collected in different locations, in Urban Environment, and modified in a conservative (reasonable) manner to be used at any other location with a good safety margin. Answer applicable also to 06-53
06-49	*Leonardo Helicopters*	Moc 2135 Sec. 4 Table 2	14	Table 2 shows a green box with multiplication of Xfe, Xfc, Xad. It is not clear if this multiplication is actually to be done numerically, or if it is a qualitative judgment.	Clarify or remove the green box.	YES	NO	Noted	The multiplication is done numerically based on the probabilities assumed for the FE, AD and FC. Based on that result a minimum HQ level is obtained.
06-50	*Leonardo Helicopters*	Moc 2135 Sec. 4 Table 2	14	How many FltCcondition should be tested, how test will be performed?	Please clarify	YES	NO	Noted	All the FltC that have a probability higher than 10-9 should be evaluated.
06-51	*Leonardo Helicopters*	Moc 2135 Sec. 4 Table 3	15	TBD Probabilities in Table 3 are required to be filled by applicant with actual flight test data. It is not clear how applicant may calculate this probabilities.	Flight Test Data will not be available at the time of the design. Iterative process may not be possible because a huge amount of flight hours is needed to have a realistic probability	NO	YES	Noted	The initial predictions will be based on the system performance and failure modes. However, conservative values should be used because if initial flight test shows that the predictions done are wrong, they would need to be adjusted and this would most probably imply a redesign.
06-52	*Leonardo Helicopters*	Moc 2135 Sec. 4 Table 3	15	Flight Envelope Protection role in calculation of the probability is not clear.	What are other type of system to which credit is given? And how should be evaluated in calculation of the probability?	YES	NO	Accepted	Figure was provided as a reference only. Further to more detailed verifications it is decided to delete this sentence See also 06-02.

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06-53	*Leonardo Helicopters*	Moc 2135 Sec. 4 Table 4	16	Probability to encounter atmospheric disturbance varies depending on the geographical usage of the aircraft. Will a probability be given by EASA at a latter stage, with an update of the MOC?	Since a forecast of the usage may not be done in the aircraft development phase, clarify who will produce Xad probabilities, when.	YES	NO	Noted	See comment 06-48
06-54	*FLUTR*	MOC VTOL 2135	16	Definition modification of Atmospheric Disturbance – AD: "Turbulence that causes large, abrupt deviations in altitude and/or attitude. Usually causes large variations in indicated airspeeds." Severe turbulence can be momentary / high frequency abrupt type turbulence, e.g, TS penetration at low speed and low altitude, causing aircraft shaking. Common but unpreferred. Or it can be sustained and hazardous - large and slow or abrupt speed changes, leading to structural failure or loss of controllability e.g. jet stream high speed entry, or mountain wave. Uncommon and requiring ASR.	Consider defining 2 levels of severe turbulence? Severe Turbulence level 1 e.g. TS penetration at low altitude and low speed causing aircraft shaking Severe Turbulence level 2 e.g jet stream shear in fast aircraft e.g. mountain wave "Turbulence that causes, short abrupt deviations in altitude and/or attitude, *Placing the aircraft MOMENTARILY into LFE*." "Turbulence that causes large, abrupt deviations in altitude and/or attitude, *that may be expected to lead to loss of control, or structural exceedance. Placing the aircraft into LFE.* Usually causes large variations in indicated airspeeds."	suggestion	substantive	Noted	In this MOC there is for the moment only a definition of the AD levels. Once more data has been gathered data, splitting the Severe AD level as suggested could be considered.
06-55	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 1	13	Table 1 establishes a correspondence between Handling Qualities ratings and failure classification. It is understood that this correspondence cannot be univocal. For example: Handling Qualities may be rated Adequate (or 4-6 in Cooper-Harper scale), for a given piloting task and failure condition, but the failure itself may be classified as Hazardous (rather than Major), for a reason different than Handling Qualities.	To avoid confusion, it is therefore suggested to either remove the failure classifications from Table 1 (as in FAA AC 25-7D Appendix E Table E-1) or to add a statement in order to clarify that the failure classifications in Table 1 are provided as guidance only. For example: "The failure classifications in Table 1 are provided for guidance. The Handling Qualities Rating Method cannot overrule the Safety process associated with MOC VTOL.2510".	yes	no	Noted	At end of Section 1 of this MOC, a statement is already existing which provides the requested clarification: *"Unless otherwise specified in a special condition, the HQRM does not replace or override any of the systems and equipment requirements of §§ VTOL.2500, VTOL.2505 and VTOL.2510."*
06-56	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 1	13	Table 1 establishes a correspondence between Handling Qualities ratings definitions (Satisfactory, Adequate, Controllable) and Cooper-Harper scale. However, Cooper-Harper scale may not be the only means to substantiate the Handling Qualities ratings.	Assuming that the intent of the Agency is not to prescribe the use of Cooper-Harper scale, it is suggested to add the following statement: "If desired, the Cooper Harper Handling Qualities Rating Scale can be used along with the Handling Qualities rating definitions provided in Table 1."	yes	no	Accepted	In Section 1 of this MOC, the text has been modified (see also comment 06-09): "Usually the Cooper Harper Handling Qualities Rating Scale (CHR) is used to measure the Handling Qualities, while the Bedford rating scale (or NASA Task Load Index as alternative) is used to measure the workload. However, each applicant can choose the methodology to determine the HQ and/or workload"
06-57	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 1	13	The definition of Adequate level in Table 1 describes the performance as "Adequate". This seems to be a circular reference.	The following wording is suggested, as an alternative: "Handling Qualities allow achievement of full or specified reduced performance criteria, with moderate pilot compensation". [This is consistent with the wording used in FAA AC 25-7D Appendix E (HQRM).]	yes	no	Not accepted	The use of "adequate" is intentional, to refer to the adequate performances that will be defined in the ADS-33E type of manoeuvres that are being developed by EUROCAE.

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06-58	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 1	13	In Table 1, it is stated that “Controllable” level allows continued safe flight and landing without exceptional piloting skills. In the same table, the Controllable level is associated with Cooper-Harper values 7 to 9. However, it could be argued that Cooper-Harper 7-9 may not always be compatible with a landing without exceptional piloting skills (cf FAA AC 25-7D Appendix E, cf NASA TN D-5153).	In the definition of “Controllable” in Table 1, please consider modifying the following statement “Allows however continued safe flight and landing without exceptional piloting skills”. The following alternative is proposed: “Inadequate for continued safe flight and landing, but controllable for return to a safe flight condition, a safe flight envelope, and/or allows a reconfiguration that provides Handling Qualities that are at least Adequate”.	no	yes	Noted	The CON HQ are clearly for LFE and for failure conditions or atmospheric disturbances that can be considered transient conditions. The current text that clearly states that: *“Allows however continued safe flight and landing, without exceptional piloting skills, after a transient condition or reconfiguration to retain control, if necessary”*
06-59	*Lilium GmbH*	MOC VTOL.2135, Section 4	13	Section 4 provides Handling Qualities level targets in Table 2. This table is said to be “an example for the cruise phase of flight”. Does this imply that EASA expects several tables for different flight phases? It can be argued that there should only be one table for all flight phases (i.e. Handling Qualities target levels should not depend on the flight phase). This is the approach in FAA AC 25-7D Appendix E Table E-2, which prescribes minimum Handling Qualities levels applicable to any “given flight condition”. In the case of a VTOL, in NFE, nominal conditions, calm air, it can be argued that all piloting tasks should be rated Satisfactory, with the choice of the tasks depending on the flight phase (e.g. “hover” mission task element during takeoff and landing, “altitude capture and hold” task element in cruise). This would be consistent with the use of the Cooper-Harper scale, where the pilot always assigns a rating in the context of the specific task that he/she is evaluating	It is suggested to prescribe the use of a unique table of Handling Qualities target levels for all flight phases. It is recognized that some tasks require more precision than others. This could be captured in the description of the task (e.g. altitude hold in cruise within 10-20ft, station keeping in hover within 5ft) rather than by relaxing the Handling Qualities level for tasks that require less precision.	yes	no	Noted	Applicants may choose to have a single table. The proposal to split the table was to simplify the definition of the most critical failure conditions that might be different depending of the phase of flight. This MOC may be updated, once experience is gained in actual flight test compliance demonstration activities.

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06-60	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 2	14	In NFE, light AD, Table 2 example prescribes Satisfactory level for Remote and Extremely Remote failures. However, it is commonly accepted that failure conditions will degrade Handling Qualities to a certain extent. In this context, it seems too conservative to require the same "Satisfactory" level for nominal conditions and for all failures, including Extremely Remote failures. To illustrate this, the following examples are provided: • Double hydraulic failure (CS 25 aeroplane): loss of 50 to 66% of roll control authority • Elevator jam: loss of 50% pitch control authority during takeoff (or 25%-33% authority during other flight phases, assuming that a trimmable horizontal plan is available) • Loss of yaw damper Usually, these are Extremely Remote failures. Considering the associated effects (reduction in control authority, degradation of dynamic stability …), these failures will typically not meet Satisfactory Handling Qualities level. For comparison, FAA AC 25-7D Appendix E prescribes Adequate level for Remote and Extremely Remote failures in NFE and OFE, with light AD.	Please consider the following suggestions for modification: • Replace Satisfactory by Adequate for Remote failures in NFE with light AD • Replace Satisfactory by Adequate for Extremely Remote failures in NFE with light AD For analogous reasons, it is also suggested to replace Satisfactory by Adequate for Remote failures in OFE with light AD.	no	yes	Partially accepted	See also reply to comment 06-36. The Table Minimum Acceptable Handling Qualities Rating has been updated. • Replacing Satisfactory by Adequate for Remote failures in NFE with light AD is not accepted because it is not deemed aligned with VTOL.2135. • Replacing Satisfactory by Adequate for Extremely Remote failures in NFE with light AD is accepted

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06-61	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 2	14	In light AD, Table 2 example prescribes the same Satisfactory level for OFE and LFE, both in nominal conditions and with Probable and Remote failures. This seems too conservative, knowing that: • The serial aircraft is not supposed to fly under any circumstances in the region between OFE and LFE, according to MOC VTOL.2135 definition of LFE • By definition, the LFE boundary involves extreme flight conditions (high angle of attack, speeds close to VD, etc) in which the Satisfactory level of Handling Qualities may not be achievable As an example, aircraft stability requirements in CS 23 need only be demonstrated up to VFC (cf 23.175(b) Amt 4 and CS 23 Flight Test Guide 70, 72, 75). VFC can lie at the boundary of the OFE (assuming VNE=VFC). For comparison, FAA AC 25-7D Appendix E always downgrades the required Handling Qualities level between OFE and LFE. Besides, from a practical standpoint, it may be difficult to devise test manoeuvres that are sufficiently complex to verify Satisfactory Handling Qualities level and that can be executed in flight, at the boundary of the LFE.	Please consider the following suggestions for modification: • Replacing Satisfactory by Adequate in nominal conditions in LFE with light AD • Replacing Satisfactory by Adequate for Probable failures in LFE with light AD Replacing Satisfactory by Controllable for Remote failures in LFE with light AD	no	yes	Partially accepted	See also reply to comment 06-36. The Table Minimum Acceptable Handling Qualities Rating has been updated: • Replacing Satisfactory by Adequate in nominal conditions in LFE with light AD is accepted. Actually, CON is used instead • Replacing Satisfactory by Adequate for Probable failures in LFE with light AD is accepted. Actually, CON is used instead

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06-62	*Lilium GmbH*	MOC VTOL.2135, Section 4, Table 2	14	It is commonly accepted that turbulence degrades Handling Qualities. However, in Table 2 example, there are several instances where the required levels are identical for different AD. For example, Table 2 requires Satisfactory level for light, moderate and severe AD in NFE. This seems conservative, particularly when considering the definitions of moderate and severe AD (cf Table 4). These definitions explicitly make reference to changes in attitude, altitude and airspeed, which may not be compatible with maintaining Satisfactory Handling Qualities level for a given flying task. For comparison, FAA AC 25-7D Appendix E or other non-regulatory standards, such as MIL-F-8785C, systematically downgrade the Handling Qualities levels as we move from light to moderate to severe AD. It can be argued that, within a given Handling Qualities level, EASA MOC VTOL.2125 does allow for some degradation (for example, moving from Cooper-Harper rating 1 to 3, while remaining Satisfactory). However, this is still considered to be too penalizing. For instance, an aircraft rated Cooper-Harper 3 on a given task in calm air under a remote failure (which is a good score, compliant with Table 2) will likely be rated 4 or 5 with moderate AD, in which case it will not meet the corresponding requirement in Table 2 (since it will downgrade from Satisfactory to Adequate).	Please consider the following suggestions for modification, consistent with FAA AC 25-7D Appendix E (HQRM): • Replacing Satisfactory by Adequate in nominal conditions in NFE with moderate AD • Replacing Satisfactory by Adequate in nominal conditions in OFE with moderate AD • Replacing Adequate by Controllable in nominal conditions in LFE with moderate AD (assuming that the corresponding level in LFE, light AD is set at Adequate) • Replacing Satisfactory by Adequate for Probable failures in NFE with moderate AD • Replacing Satisfactory by Controllable for Remote failures in NFE with moderate AD (assuming that the corresponding level in NFE, light AD is set at Adequate) • Replacing Adequate by Controllable for Remote failures in OFE with moderate AD (assuming that the corresponding level in OFE, light AD is set at Adequate) • Replacing Adequate by Controllable for Extremely Remote failures in NFE with moderate AD (assuming that the corresponding level in NFE, light AD is set at Adequate) • Replacing Satisfactory by Controllable in nominal conditions in NFE with severe AD • Replacing Adequate by Controllable in nominal conditions in OFE with severe AD Replacing Adequate by Controllable for Probable/Remote failures in NFE with severe AD	no	yes	Partially accepted	See answer 06-36. Table minimum HQ requirements have been updated. • Replacing Satisfactory by Adequate in nominal conditions in NFE with moderate AD <u>is not accepted</u> • Replacing Satisfactory by Adequate in nominal conditions in OFE with moderate AD <u>is not accepted</u> • Replacing Adequate by Controllable in nominal conditions in LFE with moderate AD (assuming that the corresponding level in LFE, light AD is set at Adequate) <u>is accepted</u> • Replacing Satisfactory by Adequate for Probable failures in NFE with moderate AD <u>is not accepted</u> • Replacing Satisfactory by Controllable for Remote failures in NFE with moderate AD (assuming that the corresponding level in NFE, light AD is set at Adequate) <u>is not accepted</u> • Replacing Adequate by Controllable for Remote failures in OFE with moderate AD (assuming that the corresponding level in OFE, light AD is set at Adequate) <u>is noted</u> • Replacing Adequate by Controllable for Extremely Remote failures in NFE with moderate AD (assuming that the corresponding level in NFE, light AD is set at Adequate) <u>is not accepted</u> • Replacing Satisfactory by Controllable in nominal conditions in NFE with severe AD <u>is not accepted</u> • Replacing Adequate by Controllable in nominal conditions in OFE with severe AD <u>is not accepted</u>
06-63	*Boeing*	MOC VTOL.2135 Paragraph: 14	11	THE PROPOSED TEXT STATES: N/A REQUESTED CHANGE: Add NVIS, IMC, and VFR to the list of acronyms	JUSTIFICATION: All these acronyms appear in the text page 12 paragraph 2	yes		Accepted	Terms added to the list of acronyms

<table>
<tr><th colspan="4">Comment</th><th rowspan="2">Comment summary</th><th rowspan="2">Suggested resolution</th><th rowspan="2">Comment is an observation or is a suggestion*</th><th rowspan="2">Comment is substantive or is an objection**</th><th rowspan="2">EASA
comment disposition</th><th rowspan="2">EASA response</th></tr>
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<tr><td>06-64</td><td>Boeing</td><td>MOC VTOL.2135</td><td>13</td><td>THE PROPOSED TEXT STATES:

Cooper-Harter Rating Scale (CHR) column defines 7-9 for controllable row

REQUESTED CHANGE:

Keep the same 7-8 per FAA AC 25-7D Table E-1. Comparison of Handling Qualities Ratings Page E-2</td><td>JUSTIFICATION:

We don’t understand why EASA is deviating from the established standard. EASA should explain the deviation and the safety gain.</td><td>yes</td><td></td><td>Noted</td><td>AC-25 material is not an established standard for EASA. Furthermore, it is applicable to another class of aircraft.

As stated in the first paragraphs, EASA is only basing this MOC on the concept of AC25-7D appendix E but changing this material consistently.

EASA included CHR 9 in the row for CON in Table 1 to give a wider possibility to show compliance with this CHR 9 since although “intense pilot compensation is required to retain control” the aircraft remains “controllable”.</td></tr>
<tr><td>06-65</td><td>Boeing</td><td>MOC VTOL.2135

Table 4</td><td>16</td><td>THE PROPOSED TEXT STATES:

The exact values of the gusts are currently not defined for each AD level. Even the related probabilities (XAD), which are modified in respect to Appendix E to AC25-7D to account for the Urban Environment, will need to be verified by recorded data which are currently not available.

REQUESTED CHANGE:

<table>
<tr><th>Atmospheric Disturbance</th><th>Notes</th><th>Probability XAD</th></tr>
<tr><td>Light:</td><td>No appreciable turbulence and steady state winds less than 3 kt with no appreciable gusts.</td><td>10^{0}</td></tr>
<tr><td>Moderate:</td><td>Light to moderate turbulence. Changes in altitude and/or attitude occur. Usually causes variations in indicated airspeed.</td><td>10^{-3}</td></tr>
<tr><td>Severe:</td><td>Turbulence that causes large, abrupt deviations in altitude and/or attitude. Usually causes large variations in indicated airspeeds.</td><td>10^{-5}</td></tr>
</table>
</td><td>JUSTIFICATION:

The HQRM defines the minimum acceptable handling characteristics as a function of the atmospheric conditions, flight envelope conditions, piloting task, and probability of the particular failure condition being evaluated. EASA is considering that better understanding of urban environment is required, however, it would be impossible to flight an experimental aircraft in an urban environment. If this is EASA consideration, EASA should provide cost-benefit analysis showing the case for an increase safety case. The values provided by FAA AC 25-7D provides a good start and should be used for a beginning. In addition, there are CAT A helicopters performing operations in hostile and congested environment already using for performance the AMC 29.45. CS29.45 PERFORMANCE - GENERAL. Under this AMC, the section winds for testing provides an experience basis to define the probability.</td><td></td><td>yes</td><td>Not accepted</td><td>The values in AC 25-7D are not directly applicable in the urban environment.

Moreover, the data provided in the original HQRM is only reporting cross-wind, windshear and gust values (in the graph only), without any consideration on direction and frequency, which could be of much greater relevance and affect more the HQs on designs based on fixed pitch combined lift/thrust systems.

EASA understands that at this moment the collection of atmospheric disturbance data in an Urban environment is the only realistic way ahead.

Helicopters operate safely in hostile and congested environments based also on their “natural” excess power and higher tolerance to gusts/windshears (proven in service), which cannot be simply assumed at present to be applicable to VTOL aircraft.

The EASA AMC to CS 29.45 consists of AC 29.45 in FAA AC 29-2C. The “winds for testing” paragraph explains which are the maximum winds that can be accepted to collect correct data for performance evaluation, as higher winds would corrupt it. It is EASA’s opinion that this material has little relevance to the AD level determination included in the MHQRM.</td></tr>
</table>

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06-66	*Boeing*	MOC VTOL.2135 Table 3	15	REQUESTED CHANGE: Flight Envelope / Notes / Probability XFE Normal Flight Envelope (NFE) — Generally associated with routine operational and/or prescribed conditions. At the boundaries of this envelope there could be means to raise the awareness of the crew (cautions). — 10^{0} Operational Flight Envelope (OFE) — The crew should be aware that the operation occurs outside the NFE. At the boundaries of the OFE, warnings and/or EFCS envelope protection means could be present. The Aircraft Flight Manual (AFM) limitations should be consistent with the boundaries of the OFE. When considering airspeed to define the envelope, the high speed boundaries of the OFE would be the current Vne. Which VNE is under consideration? Power Off Vne OEI Vne Rotorcraft Vne speeds — 10^{-3} Limit Flight Envelope (LFE) — The crew should never operate in this envelope; a return should be made at least to the OFE. This is the maximum extent in terms of envelope that needs to be investigated from a HQ point of view but should not be included in the AFM. The boundaries of the LFE are associated with aircraft limits. — 10^{-5}	JUSTIFICATION: The addition of VNE should be explained in more detailed the understanding of VNE as it relates to the rotordynamic effects that become critical at never-exceed speed (VNE), especially considering critical Advance Ratios, and also considering potential rotor stoppage during Transition events near VNE. Since Vne can consider also operation in an OEI VNE is generally established through flight test and is usually near the OEI VH of the rotorcraft. It is the highest speed at which the failure of the remaining engine must be demonstrated. For rotorcraft with more than two engines, the appropriate designation would be “one-engine-operating” VNE and would be that speed at which the last remaining engine could be failed with satisfactory handling qualities. EASA needs to clearly define the Vne being considered. Changing these probabilities may represent safety targets higher than a transport category aircraft, which transport hundreds of passengers. EASA should demonstrate thru a cost-benefit analysis that this is required.		yes	Noted	EASA has not assigned any probability so far, and when doing it, will for sure consider what will be the resulting safety objective and make sure that it is in line with the aircraft category. The definition of flight envelopes will be covered in another MOC material. Since the scope of the technical consideration on Vne determination is so wide, we refer to that MOC material and related discussions once it will be made available.
06-67	*Volocopter*	2135 Section 1.	10	It is mentioned, that the crew shall have the opportunity to operate safely for “longer periods”. This wording implies longer periods of operation and may not be subject to all foreseen concepts of operation. The general subject, to reduce the workload of the crew is anyhow shared.	Proposal to enhance the wording in a way: “Satisfactory Handling Qualities (HQ) give the opportunity for the crew to have excess workload capacity, and allow them to operate safely for longer periods **in accordance with the foreseen operation**, and to be able to deal with aircraft system failures and contingencies.”	yes	yes	Noted	The suggested addition, “*in accordance with the foreseen operation”*, is implicit in the HQ evaluation, as the HQs will be evaluated against tasks/manoeuvres that are relevant to the foreseen operation. Consider not only the length of a single flight, but also the crew duty time during a single day/month/year as the “longer periods” in the wider scope also account for fatigue.

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06-68	*Volocopter*	2135	10 and 11	HQs/Stability outside normal flight envelope: Overall, Volocopter strongly supports the new minimum HQR method and sees the benefit for VTOL compared to "traditional" methods. However, it might be difficult to analyze stability characteristics particularly in operational and limit flight envelope via the execution of (traditional) Mission Task Elements. To this end, it might be reasonable to combine this new approach with selected means from CS-23/CS-27.	EASA is asked to combine the newly presente HQR method with applicable means from CS-23/CS-27 for stability characteristics.	yes	no	Not accepted	Stability requirements in CS-23 and CS-27 exist because it was implied that if an aircraft has particular stability characteristics, then the Handling Qualities should be acceptable. Stability requirements worked fine for traditional aircraft, and already with Advanced Flight Control Systems, the concept of stability has become blurred. In fact, ADS-33E (that was created for the RAH-66 Comanche helicopter), which is not a compliance demonstration method but a Design Specification, is already not considering static or dynamic stability requirements, and rather refers to bandwidth and phase delay. Also, these technical design specifications anyway lead to the acceptability of the HQs (with the MTEs demonstration), because in the end, there is no real added value for a given stability, bandwidth or phase delay of the aircraft. The MHQRM is on purpose not given any stability requirements, and is only given minimum HQs, with some mitigation from requiring to meet the optimal HQs, when adding failure conditions, atmospheric disturbance, or when flying in the "corners" of the flight envelope, or the different combinations of the above. These minimum HQs should be demonstrated with a test campaign, including type of operation relevant manoeuvres, the details of which are been discussed within EUROCAE. If an applicant would like to show compliance with the Handling Qualities requirements in SC VTOL with another Means of Compliance, including adding stability characteristics requirements to the MHQRM, it is possible.
06-69	*Volocopter*	2135 Section 3	11	The second paragraph states: "This MHQRM starts by determining the minimum acceptable HQR for a given FltC, defined as a combination of...". It would improve readability and accessibility, if the paragraph would already include the information, that the determination is done separately for different flight phases.	Proposal: "This MHQRM starts by determining the minimum acceptable HQR **for each phase of the flight and for a** given FltC, defined as a combination of...".	yes	no	Accepted	Changed as suggested
06-70	*Volocopter*	2135 Section 3	12	Minimimum requirements of simulator are unclear.	Could EASA please provide additional guidance to determine mimumum requirements for simulators?	yes	no	Noted	The requirements for simulators that could be used to show compliance to the HQs will be discussed in future material prepared by EASA and/or prepared by industry and recognised by EASA.

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06-71	*Volocopter*	2315 Section 4.	13	Description of table 2 states: "Table 2 is an example for the Cruise phase of flight, and shows the minimum HQR for each FltC, defined as a combination of the FE and the level of AD, relative to the probability of the FC being evaluated." It would improve readability and accessibility, if it would include the information, that a similar table must be created for each phase of the flight. Also, it should be emphasized, that this is an example, so the actual minimum HRQ levels might be different (ideally: add this information to Table 2 caption).	Add information, that a similar table is to be created for each phase of the flight.	yes	no	Accepted	The following text was added: *"Similar tables could be created for the other phases of flight, as the type of FC, most critical from a HQs point of view, could vary depending on the phase of flight. The minimum HQR for each table will not vary across the different tables, but, since the FC, FE and AD levels may vary depending on the phase of flight, including the probabilities of occurrence, it might be beneficial to have different tables or groups of tables depending on the phase of flight"*
06-72	*Volocopter*	2135 Section 4.	13	"It is important to highlight that NOT every combination of AD, FC and FE should be tested." The description of the method limits its mandatory application but does not define how the tested cases are defined. Is it planned to calrify this as it directly affects the scope of evaluation to be planned and applied?	EASA is asked to clarify on the addressed comment.	yes	no	Noted	The FltC that are less probable than extremely remote, based on the multiplication of the different probabilities, are beyond the safety objective and may not be evaluated, unless there is any specific requirement other than the HQs requesting it.
06-73	*Volocopter*	2135 Section 5, Table 3	15	"This is the maximum extent in terms of envelope that needs to be investigated from a HQ point of view but should not be included in the AFM." Does this imply that the evaluations (flight tests) shall be performed at the boundaries (in LFE) to demostrate the compliance to 2135?	EASA is asked to clarify on the addressed comment.	yes	no	Noted	The LFE is the design limit of the aircraft. It is a certification envelope, not to be published in the AFM. More information on flight envelopes will be provided in future MOCs dealing with flight envelopes.
06-74	*Volocopter*	2135 Section 5	16	"The exact values of the gusts are currently not defined for each AD level. Even the related probabilities (XAD), which are modified in respect to Appendix E to AC25-7D to account for the Urban Environment, will need to be verified by recorded data which are currently not available." Basically this data is necessary for the applicant to apply the proposed rating method. Will the approach of the probabilities definition be proposed in a "tool" stage of the MoC development?	EASA is asked to clarify on the addressed comment.	yes	no	Noted	Yes. The intensity, direction and frequency of the gusts, and their related probabilities, are still under research. As soon as this data will be available, it will be introduced in the MHQRM. See also 06-65
06-75	UK CAA	MOC VTOL.2135 1. Background and Introduction Paragraph 4	10	This Modified Handling Qualities Rating (MHQRM) - missing word Method? Note: MHQRM is in list of Acronyms at para 2 to this section and is defined correctly as Modified Handling Qualities Rating Method.	"This Modified Handling Qualities Rating Method (MHQRM) is an accepted means….."	Yes	No	Accepted	*"Method"* added.

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06-76	UK CAA	MOC VTOL.2135 1. Background and Introduction Paragraph 1	10	Paragraph 1 states that the aircraft needs to be able to "…avoid late detected obstacles or traffic appropriate to the type." The reference to "obstacles or traffic appropriate to the type" could be misleading for less experienced applicants, who may not realise that emergencies and/or failure conditions, faults, errors etc can result in aircraft types flying in areas they do not usually enter. It would be helpful if the reference to "obstacles or traffic appropriate to the type." could be clarified.	It would be helpful to have clarity on what the reference to "obstacles or traffic appropriate to the type." means.	Yes	No	Noted	See comment 06-40
06-77	UK CAA	MOC VTOL.2135 1. Background and Introduction Paragraph 2	10	"All the other characteristics of the flight controls such as number of inceptors, size and mechanical forces (friction, breakout etc.) are out of scope of this MOC. These other characteristics however will influence the achievable HQ, so they will be indirectly assessed." Where are the other characteristics of flight controls that are not addressed by this MoC addressed and will they be subject to modification to align with this MOC?	It may be helpful to provide a pointer to where the characteristics of flight controls that are not addressed by this MoC will be addressed and an indication as to whether they are likely to be subject to modification in line with this MOC.	Yes	No	Noted	There are intentionally no details on flight control characteristics, since for VTOLs, based on the very different designs, there could be a too wide variety of type of controllers (joysticks, sticks, wheels, pedals, twistgrips, levers) and also the number of inceptors could be substantially different from one design to the other, from a single to 3 or 4 inceptors. The design characteristics required to achieve acceptable HQs, which is the desired end result, may vary from one design to the other. For this reason, at this stage, EASA is not providing neither mechanical or other characteristics of the flight controls.
06-78	UK CAA	MOC VTOL.2135 1. Background and Introduction Para 4	10	This Modified Handling Qualities Rating (MHQRM) - missing word Method? Note: MHQRM is in list of Acronyms at para 2 to this section and is defined correctly as Modified Handling Qualities Rating Method.	This Modified Handling Qualities Rating Method (MHQRM) is an accepted means…..	Yes	No	Accepted	See comment 06-75
06-79	UK CAA	MOC VTOL.2135 2. List of Acronyms	10/11	Missing: - AFM - FHA - SC - VTOL Note: VisC is abbreviation for Visual Cues not Visual Cue. (4th Line page 12)	Add: - AFM - FHA - SC - VTOL VisC Visual Cues	Yes	No	Accepted	Acronyms added, visual cues fixed
06-80	UK CAA	MOC VTOL.2135 3. MHQRM Process Para 2	11	'Failure Conditions (FC)' occurs after it has already been used earlier in the paragraph as does Functional Hazard Assessment (FHA).	Insert the acronym for the terms earlier in the paragraph.	Yes	No	Accepted	Text adjusted
06-81	UK CAA	MOC VTOL.2135 3. MHQRM Process Para 2	11	MHQRM process could be used for validating Failure Conditions (FC) classification at aircraft level.	Suggest revising the last sentence of second paragraph as follows: "If this MHQRM process is intended for validating Failure Conditions (FC) classification in the Aircraft Functional Hazard Assessment (AFHA), early coordination with EASA is advised."	Yes	No	Accepted	New text: "If this MHQRM process is intended for validating Failure Conditions (FC) classification in the Aircraft FHA, early coordination with EASA is advised."

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06-82	UK CAA	MOC VTOL.2135 3. MHQRM Process 4th paragraph form top of page	12	Clarity Fourth Paragraph: "For each phase of flight, the different FltCs that have a probability that is greater than 10-9 are then identified."	"For each phase of flight, the different FltC's that have a probability of <u>being encountered of</u> greater than 10^{-9} are identified."	Yes	No	Accepted	Text changed as suggested
06-83	UK CAA	MOC VTOL.2135 3. MHQRM Process 4th paragraph form top of page	12	The bracketed text within the final sentence "(so not only flight control system failures but also lift/thrust system failures)" reads as if it is an exhaustive list, which may be misleading. It is possible that fuel/power management and a number of other types of system could affect handling.	It may be helpful to clarify the bracketed text.	Yes	No	Accepted	Text changed as follows: *"not only flight control system failures, but any other, including lift/thrust system failures"*
06-84	UK CAA	MOC VTOL.2135 3. MHQRM Process Final Paragraph	12	Clarity. Final Paragraph: "The applicant should then show compliance by using an approved rating tool in actual flight test, or even in a simulator, as long as it has been validated and has been shown to be representative for the test."	Revise text as follows: "The applicant should then show compliance by using an approved rating tool in actual flight test, or <u>in a simulator that has been validated and shown to be representative for the test</u>."	Yes	No	Accepted.	Text changed as suggested
06-85	UK CAA	MOC VTOL.2135 4. Minimum ACCEPTABLE HQR Table 1 Satisfactory (SAT) Description	13	Clarity in Table 1. 'Handling Qualities allow achievement of desired performance criteria met without exceptional piloting skills and <u>minimal pilot compensation</u>.'	Revise text as follows: "Handling Qualities allow achievement of **desired performance criteria** <u>to be</u> met **without exceptional piloting skills and <u>with no or</u> minimal pilot compensation."**	Yes	No	Partially accepted	New text: "Handling Qualities allow achievement of desired performance criteria to be met without exceptional piloting skills and with no or minimal pilot compensation."
06-86	UK CAA	MOC VTOL.2135 4. Minimum ACCEPTABLE HQR Table 1 Adequate (ADQ) Description	13	Consistency in Table 1. Order of Sentence: ADQ Description should be worded as per SAT description. 'Handling Qualities allow achievement only of **adequate performance criteria,** or **desired performance criteria with moderate pilot compensation, without exceptional piloting skills. '**	Revise text as follows: "Handling Qualities allow achievement ~~only~~ of **~~adequate~~desired performance criteria,** or **~~desired~~adequate performance criteria <u>to be met</u> ~~with moderate pilot compensation,~~ without exceptional piloting skills <u>and with moderate to extensive pilot compensation</u>."**	Yes	No	Partially Accepted	See comment 06-14

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06-87	UK CAA	MOC VTOL.2135 4. Minimum ACCEPTABLE HQR Text and Table 1	13	As stated in the text "Exceptional piloting skills should not be required for the achievement of any HQ performance criteria." Hence, the maximum acceptable HQR is 6. Anything above 6 in the Cooper Harper Rating Scale "Requires Improvement" and so would need to be addressed before achieving certification. For an HQR of greater than 7, controllability is in doubt and passengers should not be exposed to risks associated with loss of, or reduction in, controllability.	Make it clearer in the text before Table 1 that the maximum acceptable HQR is 6 and that for an HQR of greater than 7, controllability is in doubt. Revise text as follows: "Exceptional piloting skills should not be required for the achievement of any HQ performance criteria i.e. the maximum acceptable HQR is 6. For an HQR of greater than 7, controllability is in doubt. Passengers should not be exposed to risks associated with loss of, or reduction in, controllability. The evaluation should assess whether Desired or Adequate performance criteria are met, and the associated workload in terms of physical and/or mental compensation required by the crew." **Please see revised Table 1 at the bottom of this comment document.** ***[Reported at the end of this CRD Section]***	Yes	No	Not accepted	EASA considers the use of CHR as follows: Starting from the bottom, the first question to be asked is: Is it controllable? If the answer is yes, then controllability is not in doubt, and then CHR is lower than 9. From CHR 7 to 9, the aircraft is controllable (out of ADQ criteria), with different degrees of pilot compensation. As per the Minimum HQR table, the CON HQR is acceptable only in the LFE, or in OFE in moderate AD and extremely remote FC, or in the NFE in severe AD and extremely remote FC. In the OFE case we expect the applicant to prove he can return to NFE and regain ADQ. In the NFE case, this is considered to represent corner cases, and applicant should demonstrate Continued Safe Flight and Landing only.
06-88	UK CAA	MOC VTOL.2135 4. Minimum ACCEPTABLE HQR 1st Paragraph on page	14	Wherever 10^0 is used please include (or 1) next to it, this will help the reader know that 10 power to 0 is 1.	Revise text as follows: " ……event may require an escape operational procedure that results into entry in the LFE, resulting in an LFE probability of 10^0 (i.e. 1 or certain). Similarly, an aircraft flying at the boundaries of the NFE, may experience overspeed due to a gust and fall into the OFE, hence the modified FE would be 10^0 (i.e. 1 or certain)."	Yes	No	Accepted	Text modified as suggested
06-89	UK CAA	MOC VTOL.2135 5. Probability definitions and determination Table 3	15	Depending on the aircraft type and how the design dive speed V_D/M_D is established, the Operational Flight Envelope may be defined by V_{NE} or V_{MO}/M_{MO}. This is also for consistency with SC-VTOL 2000(d) which specifies that this Special Condition applies to aircraft with a V_{NO} or $V_{MO} \leq 250$ knots calibrated airspeed (KCAS) or a $M_{MO} \leq 0.6$.	Suggest revising Operational Flight Envelope (OFE) notes in Table 3 to include V_{MO}/M_{MO}. E.g.: "When considering airspeed to define the envelope, the high speed boundaries of the OFE would be the current V_{NE} or V_{MO}/M_{MO}."	Yes	No	Noted	This will be discussed in future MOCs related with flight envelopes.
06-90	UK CAA	MOC VTOL.2135 5. Probability definitions and determination Table 3	15	When will the TBD probabilities for OFE and LFE be defined?	Question only, no proposed resolution.	No	Yes	Noted	The probabilities should be defined at project level, as they will be dependent on the design. More guidance on flight envelopes from EASA will follow.
06-91	UK CAA	MOC VTOL.2135 5. Probability definitions and determination Table 4	16	When will the probabilities for Moderate and Severe be defined?	Question only, no proposed resolution.	No	Yes	Noted	The Atmospheric Disturbance level should be a quantitative specification, defining the intensity, direction, frequency and probability. These values will be driven by data collected in different locations, in Urban Environment, and modified in a conservative (reasonable) manner to be used in any other location with a good safety margin. The data is not available at the moment. See 06-48, and 06-53

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<tr><td>06-92</td><td>Airbus Helicopters (via ASD)</td><td>VTOL.2135 Table 2</td><td>14</td><td>Minimum acceptable Handling Qualities Rating depending on Flight envelope/Failure Conditions/ Atmospheric Disturbance is not always appropriate as it doesn’t take sufficiently into account the subsequent effect of Failure Condition and flight envelope limitation impacts on pilot workload and then HQ level.</td><td>
<table>
<tr><th colspan="10">Phase of flight: CRUISE</th></tr>
<tr><th rowspan="3">FltC
X_{FE}*X_{FC}*X_{AD}</th><th colspan="9">Atmospheric Disturbance (AD)</th></tr>
<tr><th colspan="3">Light</th><th colspan="3">Moderate</th><th colspan="3">Severe</th></tr>
<tr><th colspan="9">Flight Envelope (FE)</th></tr>
<tr><th>Failure Condition (FC)</th><th>NFE</th><th>OFE</th><th>LFE</th><th>NFE</th><th>OFE</th><th>LFE</th><th>NFE</th><th>OFE</th><th>LFE</th></tr>
<tr><td>Nominal Condition</td><td>SAT</td><td>SAT</td><td>CON</td><td>SAT</td><td>SAT</td><td>CON</td><td>SAT</td><td>ADQ</td><td>CON</td></tr>
<tr><td>Probable/Remote Failures MIN/MAJ</td><td>SAT</td><td>ADQ</td><td>CON</td><td>SAT</td><td>ADQ</td><td>CON</td><td>ADQ</td><td>CON</td><td>CON</td></tr>
<tr><td>Extremely Remote/Extremely Improbable Failures HAZ:</td><td>ADQ</td><td>ADQ</td><td>CON</td><td>ADQ</td><td>CON</td><td></td><td>CON</td><td></td><td></td></tr>
</table>
</td><td>no</td><td>Yes (Objection)</td><td>Accepted</td><td>See Comment 06-36</td></tr>
<tr><td>06-93</td><td>Leonardo Helicopters (via ASD)</td><td>Moc 2135 Sec. 4 Table 3</td><td>15</td><td>“TBD Probabilities in Table 3 are required to be filled by applicant with actual flight test data.”
It is not clear how applicant may calculate this probabilities.</td><td>Flight Test Data will not be available at the time of the design. Iterative process may not be possible because a big amount of flight hours is needed to have a realistic probability</td><td>NO</td><td>YES</td><td>Noted</td><td>See Comment 06-51</td></tr>
<tr><td>06-94</td><td>Leonardo Helicopters (via ASD)</td><td>Moc 2135 Sec. 4 Table 4</td><td>16</td><td>Probability to encounter atmospheric disturbance varies depending on the geographical usage of the aircraft.
Will a probability be given by EASA at a later stage, with an update of the MOC?</td><td>Since a forecast of the usage may not be done in the aircraft development phase, clarify who will produce Xad probabilities, when.</td><td>YES</td><td>NO</td><td>Noted</td><td>See Comment 06-53</td></tr>
</table>

Annex to CAA UK Comment No 06-87 (Reported here because of space reasons):

MOC VTOL.2135 Minimum Acceptable Handling Qualities Rating

Table 1: Handling Qualities Ratings definition

Handling Qualities Rating (HQR)	Description	MOC VTOL.2510 Failure Conditions Classifications	Cooper Harper Rating Scale (CHR)
Satisfactory (SAT)	Handling Qualities allow achievement of **desired performance criteria** to be met **without exceptional piloting skills and with no or minimal pilot compensation.**	Up to Minor	1-3
Adequate (ADQ)	Handling Qualities allow achievement ~~only~~ of **~~adequate~~desired performance criteria,** or **~~desired~~adequate performance criteria to be met ~~with moderate pilot compensation,~~ without exceptional piloting skills and with moderate to extensive pilot compensation.**	Major	4-6
Controllable (CON)	Handling Qualities DO NOT allow achievement of adequate **performance** criteria WITHOUT exceptional piloting skills. Allows however, after a transient condition or reconfiguration to retain control if necessary, **continued safe flight and landing without exceptional piloting skills.**	Hazardous	7

Not permitted for carriage of Passengers:

Controllability in Question	Handling Qualities DO NOT allow achievement of adequate **controllability** WITHOUT considerable or intense pilot compensation.	Hazardous	8-9
UnControllable (UCON)	Handling Qualities DO NOT allow achievement of adequate controllability. Control will be lost.	Catastrophic	10

See EASA's reply to this Suggestion under Comment No. 06-87

7. MOC VTOL.2200 STRUCTURAL DESIGN ENVELOPE

Explanatory Note 7.1: The design airspeeds section of the structural design envelope has been simplified in order to be applicable to all VTOL designs. Design airspeeds should be established for each aircraft configuration or flight mode as appropriate. Therefore, for some VTOL aircraft, more than one set of design airspeeds should be defined. The maximum design speed should be defined from the selected never-exceed speed, with a minimum specified margin. Design Cruising Speed is no longer specified as a necessary design speed in the MOC as the flight load cases should be considered up to VH, VNE or VD as specified in MOC VTOL.2215.

Explanatory Note 7.2: Minimum values of the design positive and negative manoeuvring load factors are defined in the MOC to provide a minimum structural design capability. Absolute maximum values are not specified as these are aircraft specific. A conservative value should be defined based on the maximum capability of the aircraft, taking into account the flight control system (without failure cases). For aircraft without load factor limiting capability of the flight control system, an absolute maximum value may be proposed for discussion and agreement with EASA. This value may be based on those defined in current Certification Specifications (e.g. CS-23 and CS-27) as appropriate for the aircraft design and operation. MOC is reworded.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
07-01	*Geely Terrafugia*	MOC VTOL.2200 Structural design envelope	18	'MOC VTOL.2200 (c) Design Airspeeds: (1) In VTOL Mode, the following values should be established: (i) The maximum forward speed for each rotor or propeller rpm within the ranges determined in (b), VD_VTOL; ' is not applicable for lift plus push configuration VTOL. For lift plus push configuration VTOL, during the transition phase (from VTOL mode to Aeroplane mode), the maximum forward airspeed of VTOL mode could be extremely large in the specific situation described as followed: When the vehicle flies with nose-down attitude, the fixed wing will produce few lift force or even down force, assumes that all of the lift and thrust rotors are working at the maximum power, which will accelerate the vehicle to a forward speed not needed. It's not reasonable to define the $V_{D\text{-}VTOL}$ of lift plus push configuration VTOL this way.	The VTOL mode design airspeeds of lift plus push configuration VTOL, especially maximum forward airspeed could be defined by the operational missions instead of the maximum power of motors. Which means the maximum forward airspeeds of VTOL mode will be limited by the FEP.	YES	YES	Accepted	See Explanatory Note 7.1
07-02	*Airbus Helicopters (MB)*	VTOL.2200 (c)(2)(iii)(B)	18	"*VD should be established… exceeded is being extremely improbable*". The demonstration cannot be given by a probability. Also on page 19 (f)(1), how can a flight test be a representation for extremely improbable.	The approach should be a physical maximum speed in a defined dive angle. Proposal: VD should be established ~~so that the probability of being exceeded is extremely improbable.~~	Suggestion		Partially accepted	See Explanatory Note 7.1
07-03	*Airbus Helicopters (AMD)*	MOC VTOL.2200 (f)(1) (g)	19	"*within the design altitude and temperature range*" clerarly indicates the need to compute loads in the whole density range. For helicopters, AC 29.351 states that "*For the purpose of this section, the analysis may be performed at international standard atmosphere (ISA) sea level conditions*" whereas the maneuver described in CS 29.351 is very similar to the yaw maneuver of MOC VTOL.2215 and even has some angle limitations that do not exist in the MOC. What is the rationale for strengthening the requirement ?	Accept loads to be computed in SL ISA conditions		x	Not accepted	The full operational envelope including temperature and altitude should be considered for limit flight load determination. The design flight loads should cover the operational loads, and therefore the effects of temperature and altitude should also be taken into account.
07-04	*Airbus Helicopters (AMD)*	MOC VTOL.2200 (f)(3)	19	Minimum load factor values to be substantiated are the same than in CS 29.337. CS29.337 also had maximum values that did not need to be exceeded. These maximum values have not been considered in the MOC. What is the rationale for strengthening the requirement ?	Include as well maximum values of loads factor		x	Not accepted	See Explanatory Note 7.2.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
07-05	*Lilium GmbH*	MOC VTOL.2200 (c)(2)(iii)	18	VD is defined in MOC VTOL.2200 (c)(2)(iii)(A) as no less than 1.25VC. This is the same as in CS 23.335(b)(1) Amt 4. However, in CS 23 Amt 4, paragraph 23.335(b)(4)(i) offers the possibility to replace the default +25% margin between VC and VD, by the margin obtained in the dive flight test maneuver. This provision is absent from MOC VTOL.2200.	It is suggested to reinstate this provision, by adding a paragraph (C) with a wording similar to CS 23.335(b)(4). For example: "Compliance with sub-paragraph (A) and (B) need not be shown if VD is selected so that the minimum speed margin between VC and VD corresponds to the speed increase resulting when, from the initial condition of stabilised flight at VC, the aeroplane is assumed to be upset, flown for 20 seconds along a flight path at least 7.5 degrees below the initial path and then pulled up with a load factor of 1.5g (0.5 g. acceleration increment). At least 75% of the powerplant power required for VC must be assumed until the pull-up is initiated, at which point power reduction and/or pilot-controlled drag devices may be used".	no	yes	Not accepted	This manoeuvre is not relevant for VTOL designs, as is specific for traditional aircraft configurations of CS 23. See Explanatory Note 7.1.
07-06	*Lilium GmbH*	MOC VTOL.2200 (c)(2)(iii)	18	VD is defined in MOC VTOL.2200 (c)(2)(iii)(A) as no less than 1.25VC. This is the same as in CS 23.335(b)(1) Amt 4. However, in CS 23 Amt 4, paragraph 23.335(b)(4)(ii) and (iii) allows replacing the default +25% margin between VC and VD, by a fixed margin expressed in mach number (at altitudes where MD is established). This provision is absent from MOC VTOL.2200.	Please consider the possibility of limiting the necessary margin between VC and VD to Mach 0.05 or 0.07 (at altitudes where MD is established), as per CS 23.335(b)(4)(ii) or 23.335(b)(4)(iii) Amt 4. (However, it is recognized that first generation of eVTOL will probably not fly at the altitudes and speeds where MD is established).	yes	no	Noted	M_D and associated margins may be added in a future issue of the MOC. It is not expected that the first VTOL aircraft will fly at the altitudes where M_D will be established.
07-07	*Boeing*	VTOL.2200(a)	18	THE PROPOSED TEXT STATES: (a) "The design maximum and design minimum weights" REQUESTED CHANGE: (a) "The design maximum and design minimum weights, including any weight that may be critical for loads, including but not limited to, zero fuel weights for those type designs utilizing consumable fuel"	JUSTIFICATION: The proposed SC-VTOL regulations and MoC do not preclude, and in fact allow, designs which still utilize hydrocarbon or otherwise consumable fuels that may reduce and change weight distributions, which will then affect critical loads. Assuming such designs are intended to be covered by these regulations, then EASA should require explicit investigation of zero fuel weight (ZFW) and any such critical weights that may be critical for strength and/or aeroelasticity. Current wording does not appear to sufficiently require applicants to consider ZFW effects on loads and aeroelasticity.		yes	Noted	For aircraft with consumable fuel, the design fuel weight and effect on the loads and aeroelasticity will be addressed under MOC.VTOL.2210
07-08	*Boeing*	VTOL.2200 (b)	18	THE PROPOSED TEXT STATES: (b) "The lift/thrust units rpm ranges with power on and power off, if applicable." REQUESTED CHANGE: (b) "The lift/thrust units minimum and maximum permissible rpm ranges with power on and power off, if applicable."	JUSTIFICATION: "RPM ranges" is vague, and applicants should be directed to explicitly declare and investigate the proposed RPM limits across these speed rages, and the "permissible" intent is to ensure that either control systems and/or published operating limits are coordinated properly.		Yes	Partially accepted	Design rpm ranges should be defined to provide adequate margin to accommodate the variations in rpm speed occurring in any manoeuvre.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
07-09	*Boeing*	VTOL.2200 (c)(1)(ii)	18	THE PROPOSED TEXT STATES: (ii) “The maximum rearward and sideward flight speeds” REQUESTED CHANGE: (ii) “The maximum capable rearward and sideward flight speeds, unless effectively limited otherwise”	JUSTIFICATION: Requirement is ambiguous. “effectively limited” is intended to consider automated systems and their corresponding reliabilities, as well as flight limitations with open-loop control provided such limitations are “measurable and readily achieved” using normal pilot skills.		yes	Partially accepted	The maximum design rearward and sideward speeds should be defined having a minimum specified margin over the maximum permissible operational values. MOC is reworded.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
07-10	*Boeing*	VTOL.2200 (f) Structural design envelope	18	THE PROPOSED TEXT STATES: (f) The positive and negative limit manoeuvring load factors should be defined based on the maximum capability of the aircraft, for which: 1) The probability of being exceeded is shown by analysis and flight tests to be extremely improbable within the design altitude and temperature range; 2) The selected values are appropriate to each weight condition between design maximum and minimum weights; and 3) The positive load factor is not less than 2.0 and the negative limit manoeuvring load factor is not less than -0.5. REQUESTED CHANGE: We recommend EASA to reference or point to CS 29.337 amendment 8.	JUSTIFICATION: CS 29.337 amendment 8 Limit maneuvering load factor. The rotorcraft must be designed for-- [(a) A limit maneuvering load factor ranging from a positive limit of 3.5 to a negative limit of -1.0; or (b) Any positive limit maneuvering load factor not less than 2.0 and any negative limit maneuvering load factor of not less than -0.5 for which--] (1) The probability of being exceeded is shown by analysis and flight tests to be extremely remote; and (2) The selected values are appropriate to each weight condition between the design maximum and design minimum weights. EASA is requesting to go beyond CS 29 requirements, which is for transporting higher number of passengers in which the risk should be higher than a smaller VTOL with e.g. 4 passengers. Further, Per EASA regulation, CAT A rotorcraft can fly in congested airspace and municipal environments and they are not required to meet this type of requirement, which does not appear proportionate with the risk and/or economic burden for including such requirements. It would be recommended that, if such regulation is required, EASA should provide a cost-benefit analysis comparing it with PART 29 aircraft demonstrating that this is not an increase in safety above Transport Category requirements, also considering the economic burden. Per AMC 29.337, The maximum positive design load factor is +3.5 generally at a weight below maximum gross weight. The maximum thrust capability of the main rotor combined with incremental lift of wings or sponsons, if installed, results in a maximum design positive load factor. An example of a load factor - gross weight curve is shown in figure AC 29.337-1. Note the minimum positive design load factor is +2.0 even though the required analysis and flight demonstration may prove the rotorcraft is not capable of achieving this load factor. This curve also illustrates compliance with § 29.337(b)(2) since the design load factor varies with gross weight. The intent of the existing CS 29 regulations should be used and otherwise adopted, with modifications as needed for any unique aspects of eVTOL.		yes	Partially accepted	See Explanatory Note 7.2.

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NR	Author	Section, table, figure	Page						
07-11	*Boeing*	VTOL.2200 (c)(2)(v) and VTOL.2215(f)(2)(i)(C)	18-21	THE PROPOSED TEXT STATES: [Entire paragraph] REQUESTED CHANGE: Eliminate this requirement in its entirety, or at a minimum, clarify and re-assign this requirement to a higher societal risk type design such as Enhanced Category, but a VB gust encounter requirement should not apply this requirement to all Basic categories. Thus, it could read: "(C) For Enhanced Category, Positive (up) and negative (down) and lateral rough air gusts of 20.12 m/s (66 ft/s) at VB should be considered at altitudes between sea level and the maximum design altitude or 6096 m (20 000 ft)."	JUSTIFICATION: Fundamentally, this MoC SC proposal is attempting to adopt higher VB gust encounters in the airframe design criteria without a clear intent of a safety or risk need for smaller seat count aircraft such as CS-VTOL Basic categories, but with significant economic impact due to unnecessary airframe weight. Although uncertain, there appears to be confusion about the role or need for VB in small aircraft requirements, as indicated by the overlapping gust velocity requirements in MOC CS-VTOL.2215(f)(2)(i)(A) and (C) requiring both a 50 ft/sec and 66 ft/sec gust velocity requirement without traditional delineation to Commuter Category per CS-23.333(c)(1)(iii) from Amdmnt 4. VB requirements were historically set in place for CS23 "Commuter" category aircraft with significantly higher societal risk from catastrophic structural failure from extreme gust encounters of 20 m/s (66 ft/s), defined as a passenger capacity up to 19 and a gross weight (GW) up to 8618kg (19000 lbs). The existing CS23 non-commuter-category fleet accident history shows no obvious benefit of the additional structural weight of applying these more severe VB gust encounters, and thus should not be applied to an aircraft such as a Class I CS-VTOL carrying 0-1 passengers, as existing CS23 fleet history clearly shows no accident history indicating this need to apply CS23 Commuter-category standards.		yes	Accepted	MOC reworded
07-12	*Boeing*	VTOL.2200 and VTOL.2215	18-21	THE PROPOSED TEXT STATES: N/A REQUESTED CHANGE: Revise MOC VTOL.2200 Structural design envelope and MOC VTOL.2215 Flight load conditions to point to existing Part 23 and 27 regulations instead of providing duplicate or conflicting information (Example: CS 23.XXX Amdt. YYY, and AMC XYZ are accepted means of compliance). This MOC should focus on gaps or unique aspects of VTOL.	JUSTIFICATION: In order to avoid conflicting or duplicate information, point to existing Part 23 and 27 regulations. This MOC should focus on gaps or unique aspects of VTOL.		yes	Noted	Noted. Where applicable, CS23 and CS27 is directly referenced. However, when adaptation is necessary, new MOC has been proposed.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
07-13	*Boeing*	VTOL.2200	19	THE PROPOSED TEXT STATES: N/A REQUESTED CHANGE: Add a paragraph (j) or otherwise to include a requirement to consider the effects of variations in AoA from maneuvers and/or maximum descent conditions in combination with other pertinent conditions within CS-VTOL.2200. Add a paragraph (k) or otherwise to include a requirement to consider the effects of ground effect on rotor inflow assumptions when modeling hovering load conditions.	JUSTIFICATION: Maximum/minimum rotor airfoil AoA/incidence should be considered by applicants for evaluating worst case loads and providing guidance to operational limitations needed to protect the systems and structures during conditions such as high descent rates or high inherent rotor inflow angles from transition conditions. Given the novel nature of small rotors planned to be used on VTOLs and significantly higher disc loading, the possibility of higher rotor disc aerodynamic incidence is expected and thus should be considered for worst-case loads. Additionally, for multiple lift rotor configurations with distributed propulsors, the aggregate lift rotor field may increase the effective disc area well beyond any individual rotor diameter, and thus ground effects on inflow angles are expected to create appreciable loads effects. Ground effect will alter rotor inflow conditions per well-known helicopter theory, and applicants should be required to at least consider those effects when establishing worst-case loads conditions in ground effect.		yes	Partially accepted	The flight load conditions specified in MOC.VTOL.2215 are intended to cover conservative and aggressive manoeuvres, resulting in maximum/minimum rotor airfoil AoA/incidence angles, considering the limitations (e.g. altitude, velocity) defined by the structural design envelope of MOC VTOL.2200 and the flight control system. Consideration of ground effect is now included in the flight load conditions specified in MOC VTOL.2215 when applicable.

07-14	*Boeing*	VTOL.2200 (f)(1)	19	THE PROPOSED TEXT STATES: "(f) The positive and negative limit manoeuvring load factors should be defined based on the maximum capability of the aircraft, for which:" "(1) The probability of being exceeded is shown by analysis and flight tests to be extremely improbable within the design altitude and temperature range;" REQUESTED CHANGE: "(f) The positive and negative limit manoeuvring load factors should be defined by the applicant as a function of airspeed, for which:" "(1) "The probability of being exceeded is shown by analysis and flight tests to be extremely improbable within the design altitude and temperature range for those type designs utilizing Fly-by-Wire control systems or equivalent control augmentation systems;"	JUSTIFICATION: "maximum capability" is ambiguous and needs to be changed and/or clarified. A given wing at greater than Va but less than Vc could possibly generate > 4 or 5gs (perhaps even higher) under certain design and operational conditions, which is not necessary for normal operation. Historically, the regulation defines a prescribed N-z maximum limit which then becomes an operational limitation, which required either a human pilot and/or augmentation system to ensure that N-z limits are not exceeded to a reliable degree. There appears to be no need or appreciable accident case history that requires a mitigation of stronger airframes due to unreliable pilot inputs. Proposed verbiage attempts to eliminate this requirement for generating such an extreme load case, and simply requires an applicant to "define" or establish a proposed V-n envelope for the type aircraft in lieu of an ambiguous and overly conservative "maximum capability" envelope. Additionally – fundamentally, Pilot-in-the-loop (open loop or non-augmented) should not (are not currently) excluded under this part, and thus flight control systems for such open-loop aircraft should not require a regulatory load case based on "maximum capability" of the airframe at all speeds, but rather to the long-existing and well-established safety standard of either 2.5g or 3.8g from Transport and Small Aircraft Category respectively. These prescribed values have proven extremely safe and reliable without augmentation systems, as humans can inherently and readily detect, and easily mitigate, a Nz command that would exceed 3.8g or even 2.5g. This is proven over billions of flight hours to-date on open-loop flight control systems, which have not required that the airframe have the ability to react the "maximum capability" at all airspeeds, but rather only designed to the N-z envelope limits. Most importantly, for open-loop systems, there is no rational way to prescribe a reliability to open-loop inputs beyond the "defined" maximum N-z limits, regardless of their quantitative magnitude, considering the extremely variable nature of humans in the loop. With regards to augmentation flight control systems [i.e. fly-by-wire (FBW)], these systems should indeed be able to mitigate N-z limit load envelope exceedances to an extremely improbable degree (which is an existing industry design standard), and thus, paragraph (f)(1) should be clarified to address ONLY FBW or augmentation systems, and not pilot-in-the-loop (open loop) flight control inputs. Requiring pilot-in-the-loop reliability / probability assessments of faulty human pilot pitch inputs greater than existing design standards of 2.5g or 3.8g Nz is an extremely difficult and nebulous task, with no safety or economic benefit. The above is offered assuming that, fundamentally, open-loop flight control systems could be permitted		yes	Partially accepted	See Explanatory Note 7.2.

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					under these rules, as otherwise, these regulations would therefore mandate that each type design have a certified FBW flight control system, which may not be required and thus is a severe economic burden on an applicant's design.				
07-15	*Boeing*	VTOL.2200 (f)(2)	19	THE PROPOSED TEXT STATES: (2) "The selected values are appropriate to each weight condition between design maximum and minimum weights; and" REQUESTED CHANGE: (2) "The selected values are appropriate to each weight condition between design maximum and minimum weights also considering worst case CG conditions; and"	JUSTIFICATION: Center of Gravity (CG) effects on the ability of an aeroplane to achieve an V-n limit are significant and should be considered by the applicant via regulation.		yes	Accepted.	MOC reworded.

8. MOC VTOL.2215 FLIGHT LOAD CONDITIONS

Explanatory Note 8.1: The intention of the MOC is to specify a set of flight conditions to be evaluated to conservatively cover the most extreme manoeuvring capability of the aircraft. The MOC has been modified to clarify the intent of the manoeuvre (i.e. movement of the aircraft). The flight load cases may be simulated or defined by combining conservative combinations of parameters, or a combination of these approaches. Full control input ranges should be considered when determining the flight load cases. The limitations imposed by the flight control system, without failure cases, may be taken into account when defining the load cases.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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08-01	*Embraer*	MOC VTOL.2215 (b) and (c) - Flight load conditions	19, 20	Considering that flight controls of VTOL vehicles may be decoupled and different from those of traditional aircraft or helicopters, it is necessary to define the meaning of longitudinal control and the intent when it is mentioned at MOC VTOL.2215 (b) and (c). Similarly, it is necessary to consider that pitching upwards may not cause change in altitude on a VTOL, but deceleration. So it is necessary to define the intent of the maneuver.	To define the meaning of longitudinal control. To define the intent of pitch upward maneuver.	No	Yes	Accepted	See Explanatory Note 8.1.
08-02	*Airbus Helicopters (AMD)*	MOC VTOL.2215	19	"*Failure conditions need not be considered, except as specified in paragraph (g) of this MOC.*" VTOL with multiple thrust-lift units will most probably be controlled through advanced control systems and not via direct mechanical links. Such systems will certainy be used to protect the structrure from too high loads and it shall be shown that these systems are reliable enough and, when failed, do not increase the loads in an unacceptable way.	Include a similar approach as in Appendix K of CS.25		x	Noted	MOC VTOL.2205 “Interaction of system and structure” will be published in a future update.
08-03	*Airbus Helicopters (AMD)*	MOC VTOL.2215 (b)(c)(d)(e)	19-20	The loads are defined in terms of control inputs and VTOL response and therefore ask for validated simulation models. Developping such models and validating them in the extreme maneuvers that are described is putting a heavy burden on manufacturers. A specified maneuver and minimum load factor values, possibly exceeding the VTOL capability, are not consistent.	Describe the maneuvers in terms of result to be reached, not in terms of control inputs If not accepted, delete the minimum values in (f)(3)		x	Partially Accepted	See Explanatory Note 8.1 Minimum values of the design positive and negative manoeuvring load factors are defined in the MOC to provide a minimum structural design capability.
08-04	*Airbus Helicopters (AMD)*	MOC VTOL.2215 (b)(c)(d)(e)	19-20	Displacing the controls to the maximum deflection makes an implicit assumption on the control system.	Describe the maneuvers in terms of result to be reached, not in terms of control inputs		X	Accepted	See Explanatory Note 8.1
08-05	*Airbus Helicopters (AMD)*	MOC VTOL.2215 (b)(c)(d)(e)	19-20	Asking to displace the controls up to the stops on any axis and in the whole speed range is excessive. This is not possible on cars and should be avoided on helicopters. This adds a new requirement : "it must be possible to bring controls to the stops in the whole flight envelope and beyond "(VD is not part of the flight envelope).	Describe the maneuvers in terms of result to be reached, not in terms of control inputs		X	Partially accepted	See Explanatory Note 8.1
08-06	*Airbus Helicopters (AMD)*	MOC VTOL.2215 (b)(c)(d)	19-20	At zero speed, longitudinal stick inputs will induce little change to the load factor. How to fly the prescribed maneuvers ?	Describe the maneuvers in terms of result to be reached, not in terms of control inputs		X	Accepted	Cases to be considered at zero speed are clarified. Forward flight cases should be considered at critical speeds up to the specified maximum. MOC is reworded.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
08-07	*Airbus Helicopters (AMD)*	MOC VTOL.2215 (f)	20	All VTOLs will operate in the same conditions. Why would gust be different for a VTOL in VTOL mode and a VTOL in aeroplane mode ? One has to consider horizontal gusts, the other only lateral gusts. Maximum gust is 50ft/s in the first case and 66 ft/s in the second. At VD, maximum value are respectively 30 ft/S and 25 ft/s.	Have a unique gust definition		X	Accepted	MOC reworded
08-08	*Leonardo Helicopters*	MOC VTOL.2215, e)	20	V_NE_VTOL and V_NE are not defined in MoC VTOL.2200 c). Are we assuming the same definition used in CS27.1505?	Include definition of V_Ne(_VTOL) in MOC VTOL.2200 c)	Yes	yes	Accepted	V_{NE} definition added to MOC VTOL.2200 Structural Design Envelope.
08-09	*Leonardo Helicopters*	MOC VTOL.2215, e)	20	No information given wrt sideslip limitations	See CS27.351 and AMC No1 to CS27.351	yes	no	Not accepted	A design sideslip envelope is not defined as it is dependent on the aircraft. The aircraft should yaw to the maximum transient value. The limitations imposed by the flight control system, without failure cases, may be taken into account
08-10	*Leonardo Helicopters*	MOC VTOL.2215, e)	20	No differentiation between VTOL mode and AP mode. Is this intentional?	Apply dedicated AP and VTOL approaches to Yawing flight: - see AMC No 1 to CS 27.351 for VTOL mode approach see CS23.441 or CS25.351 for AP mode approach	Yes	No	Not accepted	VTOL mode and Aeroplane Mode now removed from the MOC. The yaw manoeuvre is common to all flight modes and configurations.
08-11	*Leonardo Helicopters*	MOC VTOL.2215, f) 2) ii) B)	21	No further information given on gust load factors.	Use similar approach or refer to CS23.341	Yes	No	Not accepted	Gust load factor determination, as appropriate to the VTOL aircraft and configuration, should be proposed by the Applicant
08-12	*GAMA*	MOC VTOL.2215 (b) and (c) - Flight load conditions	19, 20	Considering that flight controls of VTOL vehicles may be decoupled and different from those of traditional aircraft or helicopters, it is necessary to define the meaning of longitudinal control and the intent when it is mentioned at MOC VTOL.2215 (b) and (c). Similarly, it is necessary to consider that pitching upwards may not cause change in altitude on a VTOL, but deceleration. So it is necessary to define the intent of the maneuver.	To define the meaning of longitudinal control. To define the intent of pitch upward maneuver.	No	Yes	Accepted	See Explanatory Note 8.1.

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08-13	*Boeing*	VTOL.2215, 3rd paragraph	19	THE PROPOSED TEXT STATES: "Suddenly. For the purposes of this MOC, 'suddenly' is defined as the time interval for complete control input based on a rational analysis, supported by test." REQUESTED CHANGE: Definition: For the purposes of this MOC, 'suddenly' is defined as the time interval for complete control input based on a rational analysis, supported by test. The following time constants may be used without further substantiation with the exclusion of FbW systems, as noted below: (a)0.2 seconds of elapsed time between zero to maximum inceptor input for the critical case, for conventional or unaugmented systems. (b)For those systems with closed-loop augmentation (i.e. FbW, autopilot systems or supplemental actuator force systems), it must be shown, via rational analysis, that the system shall not permit a control surface input faster than (a) assuming an instantaneous inceptor input command for all critical flight conditions, including failure conditions, to a probability of not less than extremely remote.	JUSTIFICATION: These regulatory requirements are ported in part from AMC 23.423 (CS 23, Amendment 4), and the intent of that regulation (including any other regulations should be used for other control axes, such as roll and yaw). Further, the recommendation for a probability of extremely remote is for alignment with CS 29.337 Amdt 8 guidance and existing FAA Part 23 Non-commuter category requirements (Ref 23.1309) for catastrophic failure probabilities.		yes	Partially accepted.	0.2 seconds for conventional (pilot input) systems is accepted. MOC reworded.
08-14	*Boeing*	VTOL.2215 (a)	19	THE PROPOSED TEXT STATES: "(a) Symmetrical Flight Load Conditions: To produce these flight load conditions, the airspeeds should be set at VD_VTOL in forward, rearward and sideward flight and VD in forward flight, as applicable. The normal load factor should be unity." REQUESTED CHANGE: "(a) Symmetrical Flight Load Conditions: To produce these flight load conditions, critical airspeeds should be assessed for all airspeeds from Vmin to VD_VTOL in forward, rearward and sideward flight and Vmin to VD in forward flight, as applicable. The normal load factor should be evaluated from unity to those limits set in accordance to CS-VTOL.2200(c)(2)(f)."	JUSTIFICATION: Regulation appears to cover steady symmetrical maneuvers other than abrupt pitch (2215.(b)), which is the only logical proposed regulation to mirror the intent of CS23.333(b) [Amndmt 4]		yes	Not accepted	The symmetrical flight load conditions are intended to provide a baseline set of 1-g level flight up to the maximum design forward, rearward and sidewards speeds. The symmetrical manoeuvre case (pull-up and recovery) is defined in paragraph (b).

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08-15	*Boeing*	VTOL.2215 (a) and (b)	19	THE PROPOSED TEXT STATES: N/A – General comment REQUESTED CHANGE: The intent of these maneuvers appears rather misunderstood. These maneuvers should not be completed to the "maximum stops" of the control surfaces (current design standard do not require such maneuvers for either CS23 or CS25), but should be allowed to continued up to and including the maximum Nz envelope for open-loop response. If the intent of this regulation is to be applied only to FbW, then this should be clearly stated in the paragraph, and "maximum stops" should be changed to read "maximum inceptor input, with accurate flight control response included including explicit or inherent load limiting features" or equivalent wording to ensure appropriate application of intent, or utilizing existing language in CS23.395 ("The system limit loads need not exceed the higher of the loads that can be produced by the pilot and automatic devices operating the controls.") or just adopt the requirements of CS23.423.	JUSTIFICATION: Application of "maximum stops" language to a control surface at speed above VA (existing standard being CS23.423 or CS23.395) will greatly exceed existing airframe loads standards for both CS23 and CS25, at least considering open loop responses, which limits those conditions by pilot force, pilot response to published Nz limits or otherwise limited by the control system (open loop features or closed loop attenuation). If true, this applies a significant weight and economic burden without any corresponding increase in safety and should be reconsidered.		yes	Partially Accepted	See Explanatory Note 8.1.
08-16	*Boeing*	VTOL.2215 (e)	20	THE PROPOSED TEXT STATES: VH_VTOL or VNE_VTOL and VH or VNE REQUESTED CHANGE: We ask EASA to provide explanation or definition of these speeds.	JUSTIFICATION: The text doesn't define these speeds.			Accepted	V_{NE} and V_H definitions added to MOC VTOL.2200 Structural Design Envelope.
08-17	*Boeing*	VTOL.2215 (g)	21	THE PROPOSED TEXT STATES: N/A REQUESTED CHANGE: Add a subparagraph (4) to VTOL.2215 (g) to say: "Characterization of the lift/thrust failure may be considered using analysis in lieu of an instantaneous loss of lift/thrust if appropriate, but should be done in a rational and conservative manner, and appropriately verified by test"	JUSTIFICATION: How the lift/thrust system fails will be a critical part of the analysis per subparagraph (g), and thus the MoC should be more detailed and explicit on how to properly and rationally take these characteristics into account in the analysis.		yes	Accepted	MOC updated
08-18	*Boeing*	VTOL.2215	22	THE PROPOSED TEXT STATES: N/A - Various REQUESTED CHANGE: Akin to Comment 19 and 21 of this set, (d) and (e) requirements and language also should be revised to not require "maximum deflection" at VC, VD or VH conditions	JUSTIFICATION: Unless the interpretation of intent is incorrect, requirement for "maximum deflection" of the control surface (without further clarifying language) would greatly exceed the existing airframe strength standards, significantly increasing economic burden without any increase in the existing safety standard of performance.		yes	Not Accepted	See Explanatory Note 8.1. Maximum control inputs should be evaluated up to the defined critical speed for the manoeuvre. The flight control response may be taken into account.

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08-19	UK CAA	MOC VTOL.2215 Flight load conditions Paragraph (g)	21	CLARITY “Unsymmetrical loads due to lift/thrust unit failure: (1) The aircraft should be designed for unsymmetrical loads resulting from the failure of the critical lift/thrust unit, including blade release, at speeds up to VD_VTOL and VD, as applicable.”	Revise text as follows: “Unsymmetrical loads due to lift/thrust unit failure: The aircraft should be designed to take account of unsymmetrical loads resulting from the failure of the critical lift/thrust unit, including blade release, at speeds up to VD_VTOL and VD, as applicable.”	Yes	No	Not accepted.	Wording is aligned with the CS 23.367 requirement for unsymmetrical loads due to engine failure.

9. MOC VTOL.2220 GROUND AND WATER LOAD CONDITIONS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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09-01	*Leonardo Helicopters*	MOC VTOL.2220 5.	23	Should possible refer to CS27.235 (strictly speaking CS27.497 (i) is under tail wheel landing gear landing gear. Not clear how to comply with it.	Maybe include more specific ground handling rules, such as e.g. ANC-2.	YES		Partially accepted	Reference corrected to 27.235. The definition of specific ground handling cases from other specifications, such as ANC-2, may be too penalising for some VTOL aircraft considering their operations. As currently written, the Applicant has the flexibility to propose appropriate load cases for taxiing, including from ANC-2.
09-02	*Leonardo Helicopters*	4 (a) (3)	22	Ok to use the CS 27.501 with the following request: 27.501 (a)(2)declare “Structural yielding of elastic spring members under limit loads is acceptable”.	Considering the size of the aircraft and their power/controllability it is suggested to consider in addition to the elastic spring member also all the members installed below the elastic springs. This may save weight without any reduction in safety margin	YES		Not accepted	All structure, including landing gear, must withstand limit loads without detrimental or permanent deformation. Structural yielding of elastic spring members is not consistent with this requirement.
09-03	*Boeing*	VTOL.2220 (a)(2)	22	THE PROPOSED TEXT STATES: (2) “If significant, the structural dynamic response of the airframe should be taken into account; and” REQUESTED CHANGE: (2) “If significant, the structural dynamic response of the airframe should be taken into account considering any critical mass distributions for components sized by ground loads; and”	JUSTIFICATION: Additional guidance should be given to applicants to ensure that adverse mass distributions are included in any structural dynamic response analyzed, otherwise critical load cases and distributions may be inadvertently missed.	YES		Partially accepted	Agreed in principle. MOC reworded as follows: (2) “If significant, the structural dynamic response of the airframe should be taken into account considering all critical mass distributions; and”

10. MOC VTOL.2235 STRUCTURAL STRENGTH

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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10-01	UK CAA	MOC VTOL.2235 Structural strength	23	How is bearing strength and reliability addressed? As the engineering challenges of bearing design are unique, the VTOL requirements could provide an opportunity to develop requirements that specifically address bearing design, monitoring and substantiation. Mindful of G-VSKP, G-WNSR and Taiwan NA-107, this aspect of design has been shown to be a weak for CS-29 helicopter designs across the industry.	Either be clear that critical bearings are not an acceptable means of design architecture for both Enhanced and Basic Cat VTOL aircraft, or define specific bearing design and monitoring criteria for critical bearings.	Yes	Yes	Accepted	2250(c) requires that "For Category Enhanced, a single failure must not have a catastrophic effect upon the aircraft". This will prevent the use of critical parts, including critical bearings. For Category Basic, considerations for bearings, the failure of which could be catastrophic, will be addressed in a future MOC.
10-02	UK CAA	MOC VTOL.2235 Structural strength Para (c) Notes (1) & (2)	24	This section contains several pointers to guidance that read "(for further guidance see FAA AC 27.727(X)(X) in FAA AC 27-1B Change 7, which is the EASA AMC as per Book 2 of CS-27 Amdt. 6)", where X relates to the specific paragraph numbers referenced in the pointer. The intent of this is unclear because it appears to be stating that FAA AC material is the same as EASA AMC Book 2 material. If that is the case, would it be simpler to reference the EASA AMC?	Further clarity on the intent of these pointers may be helpful.	Yes	No	Noted	The EASA AMC to CS-27 Amendment 7 consists of FAA AC 27-1B Change 7 with the changes and additions given in CS-27 Book 2. The referenced FAA AC material is not modified by the EASA AMC and therefore is directly applicable.

11. MOC VTOL.2240(D) HIGH ENERGY FRAGMENTS – PARTICULAR RISK ANALYSIS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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11-01	*Airbus Helicopters (FXG)*	VTOL.2240(d) Introduction and § 1.	24	The statement for Category Basic "*… a lower safety objective…is accepted*" should be better clarified. Indeed, applying AMC 20-128A as suggested is acceptable under CS-25 if associated with engines certified under CS-E (so associated with a rotorburst risk classified as hazardous, and all relevant design, manufacture, support associated approaches – cf critical parts). Here the safety level for which a lift/thrust unit or rotating machinery rotorburst probability of occurrence should be developed is not mentioned, therefore considering the 5% probability limit of AC20-128 may not be appropriate. This should be clarified.	To modify the text as follows: § 1. For Category Basic: "*The methodology from existing AMC such as AMC20-128 is accepted,* ***provided the lift/thrust unit or rotating machinery rotorburst probability of occurrence is demonstrated to be compatible with an Hazardous classification ie minimum extremely remote***" NB : allowing lower levels according to AMC VTOL 2510 would be a regression.		X	Partially accepted	Wording is changed to: "The methodology from existing AMC such as AMC 20-128A is accepted for fragment size and trajectory. The lift/thrust unit or rotating-machinery probability of failure should be compatible with its severity, in accordance with VTOL.2510." and considerations have been added for cascading failures.
11-02	*Airbus Helicopters (MB)*	VTOL.2240(d)	24	"… no service experience …" might be true for an overall aircraft, but not for the components for which experience exists by other installation in other aircraft.	Benefit from experience in similar applications should be mentioned.	Suggestion		Partially accepted	In general, operations and architectures are anticipated to be significantly different from current applications. Particular considerations for in-service experience are included in MOC VTOL.2510. Clarification has been added in the text.
11-03	*Leonardo Helicopters*	MOC VTOL.2240(d) intro	24	"the corresponding risk should be assessed, in line with the objective of VTOL.2250(c)" 2250c requires "For Category Enhanced, a single failure must not have a catastrophic effect upon the aircraft " However, 2240(d) ask for a MINIMIZATION of the effects of a rotor burst. Unless a rotor fragment is fully contained, it is not possible to demonstrate compliance to 2250c. this is also stated in this MoC. "Due to no service experience, new technology and architectures is not possible to determine the likelihood and effects of failure". Is currently not possible to demonstrate that a rotor burst will not have catastrophic effects.	Remove sentence "the corresponding risk should be assessed, in line with the objective of VTOL.2250(c)"	YES	YES	Not accepted	The wording is: "the corresponding risk should be assessed, in line with the objective of VTOL.2250(c), with specific considerations for simultaneous or cascading effects" The minimization is taken into account by accepting that the analysis stops when cascading failures reach a probability of 10^{-9}. The consequences of a rotor burst can be demonstrated by test, analysis, or a combination of both.
11-04	*Leonardo Helicopters*	VTOL.2240	24	Even for Basic Category the high energy fragments can generate a catastrophic event to be adequately assessed. In addition the lift/thrust units have no in-service experience to be used to relax this requirement for basic category.	Align Basic category requirements with the Enanced ones	YES	NO	Partially accepted	Wording has been changed to: "The methodology from existing AMC such as AMC 20-128A is accepted for fragment size and trajectory. The lift/thrust unit or rotating-machinery probability of failure should be compatible with its severity, in accordance with VTOL.2510." and considerations have been added for cascading failures.

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11-05	*Boeing*	VTOL.2240(d)	24	THE PROPOSED TEXT STATES: N/A REQUESTED CHANGE: Add an additional requirement: "Applicants for either Basic or Enhanced category who wish to utilize means to shutdown or stop individual rotor systems to mitigate hazards considered under this risk analysis shall ensure that sufficient and reliable indications, control means and operational procedures are included in the design to allow for correct identification of a failed or hazardous lift/thrust unit and effective means to meet the analysis assumptions of imbalance exposure herein."	JUSTIFICATION: Regulatory language should be expanded to require applicants to show that any indication and/or control means for mitigating the hazards from uncontained rotor failures and imbalance conditions be shown to be reliable.			Accepted	Wording has been changed to: "Applicants for either Basic or Enhanced category who wish to utilize means to shut down or stop individual rotor systems to mitigate hazards considered under this risk analysis shall ensure that sufficient and reliable indications, control means and operational procedures are included in the design to allow for correct identification of a failed or hazardous lift/thrust unit and effective means to meet the analysis assumptions of imbalance exposure herein (see also MOC VTOL.2425 (b))."
11-06	*Rolls Royce (F. Musella*	MOC VTOL.2240(d)	24	***Requirement:*** *VTOL.2240(d) The aircraft must be designed to minimise hazards to the aircraft due to* ***structural damage caused by high-energy fragments*** *from an uncontained lift/thrust unit or rotating-machinery failure.* *For Category Enhanced the failure of a lift/thrust unit or other rotating-machinery should therefore be assumed and the corresponding risk should be assessed,* ***in line with the objective of VTOL.2250(c),*** *with specific considerations for simultaneous or cascading effects presented in this Particular Risk Analysis.* The VTOL.2250(c) states: [...] *For Category Enhanced, a single failure must not have a catastrophic effect upon the aircraft.* This MOC seems too conservative, the minimisation criteria can be met accepting residual risks for catastrophic effects as desctibed in the AMC 20.128A guidelines. Also the VTOL.2240(d) and CS 23.2240(d) are identical. CS 23 amdt 5 consider AMC to 23.2240 the ASTM F3115/F3115M-15 Standard Specification for Structural Durability for Small Aeroplanes or a list of CS 23 amdt. 4 requirements.	Remove the words **"in line with the objective of VTOL.2250(c)"** and define acceptable residual risks in line with the AMC 20.128A guidelines. Alternatively, acceptable AMC to 23.2240 could be used in line with CS 23 amdt 5.	yes		Not accepted	The wording is: "the corresponding risk should be assessed, in line with the objective of VTOL.2250(c), with specific considerations for simultaneous or cascading effects" The minimization is taken into account by accepting that the analysis stops when cascading failures reach a probability of 10^{-9}.
11-07	*Airbus Helicopters (FXG)*	VTOL.2240(d) Section 2 (a)	24	As far as fragments to be considered are concerned, "most damaging fragments" is unclear. Indeed one could understand that the effect of smaller fragments does not have to be considered, while – even if less energetic - they have to if they have a different spread angle.	Consider all fragments released with residual energy.		X	Accepted	Wording has been changed to: "The Safety Analysis should consider all fragments released with residual energy."

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11-08	*Airbus Helicopters (MB)*	VTOL.2240(d) 2.(a)	24	Additional information required to assess the maximum part.	e.g. a propeller designed, traced in production and service in quality and damage with a margin of safety of … can be assessed to generate fragments of attached parts like erosion protection but not a complete blade (critical parts)	Suggestion		Not accepted	The critical parts approach is not deemed sufficient to meet the objective of VTOL.2250(c) for Category Enhanced.
11-09	*Leonardo Helicopters*	MOC VTOL.2240(d)	24	"…uncontained compressor and turbine rotor failures, continue to occur…""…failure of a lift/thrust unit or other rotating-machinery should therefore be assumed…" Current helicopters blades has proved to be reliable with respect ot rotorburst. Design, manufacturing and maintenance processes should be accepted as a mean to comply with the rotorburst requirement, allowing demonstration that rotorbursts minimization has been accomplished by rotor design	"failure of a lift/thrust unit or other rotating-machinery should therefore be assumed, unless rotor elements failure can be demonstrated to be less than extremely improbable"	YES	YES	Not accepted	Manufacturing and maintenance process are not deemed sufficient to meet the objective of VTOL.2250(c) for Category Enhanced. The design must be such that a single failure does not have a catastrophic effect upon the aircraft. See particular considerations for cascading failures.
11-10	*Leonardo Helicopters (via ASD)*	MOC VTOL.2240(d)	24	"…uncontained compressor and turbine rotor failures, continue to occur…""…failure of a lift/thrust unit or other rotating-machinery should therefore be assumed…" Current helicopters blades has proved to be reliable with respect ot rotorburst. Design, manufacturing and maintenance processes should be accepted as a mean to comply with the rotorburst requirement, allowing demonstration that rotorbursts minimization has been accomplished by rotor design	"failure of a lift/thrust unit or other rotating-machinery should therefore be assumed, unless rotor elements failure can be demonstrated to be less than extremely improbable"	YES	YES	Not accepted	See comment 11-09

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11-11	*Boeing*	VTOL.2240(d)	25	THE PROPOSED TEXT STATES: (b) Hazards: …"Some further guidance material on engine imbalance, including windmilling considerations, can be found in AMC 25-24." REQUESTED CHANGE: …"Some further guidance material on engine imbalance, including windmilling considerations, can be found in AMC 25-24. Applicants may utilize design means of control and stoppage of those lift/thrust units, for which the probability of failure of those control means is shown to be extremely improbable, and must rationally consider the environment of operation under the expected imbalance conditions."	JUSTIFICATION: eVTOL configurations are unique in that lift rotors are not expected to windmill in most conditions after a blade liberation and imbalance where the motor is subsequently depowered, unlike a transport category high-bypass turbofan engine, the latter of which will continue to extract aerodynamic free-stream energy without pilot control, as significant CS25 certification history shows that such aircraft normally cannot tolerate the design impact (weight and cost) of a device with which to stop the rotor, as explicitly allowed per CS 25.903(c). Therefore, applicants should have clear guidance for those compliance paths that most probable, such as showing a reliable means of rotor stoppage in lieu of assessing continued windmilling for an extended period. The guidance in AMC 25-24 (and FAA AC 25-24) requires assessments of continued rotation, as this is normally expected for such turbofan aircraft, but provides no guidance on how to reliably ensure means of rotor stoppage. Thus, the proposed CS-VTOL regulation needs to expand on the AMC 25-24 guidance by the assumption that a large majority, if not all eVTOL applicants utilizing uncoupled distributed (discrete) lift units, will propose a mitigation means of shutting down of these hazardous motors or otherwise stopping the rotors in lieu of prolonged windmilling, and thus the proposed MoC should be more explicit on requiring that such control system and indication means be shown to be reliable, with sufficient Systems Integrity under the imbalance conditions and exposure window prior to shutdown.			Partially accepted	Wording is changed to: "Further guidance material on engine imbalance, including windmilling considerations, can be found in AMC 25-24. Applicants may utilize design means of control and stoppage of those lift/thrust units, for which the probability of failure of those control means is shown to be commensurate with the objectives of VTOL.2510, and must rationally consider the environment of operation under the expected imbalance conditions."

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11-12	*Boeing*	VTOL.2240(d) High Energy Fragments – Particular Risk Analysis (d) Safety Analysis	24	THE PROPOSED TEXT STATES: (d) Safety Analysis: It should be assessed that the failure of a lift/thrust unit or rotating-machinery does not have a catastrophic effect as defined in MOC VTOL.2510. The assessment should include aircraft systems, structures (including energy storage), occupants and other lift/thrust units. Due to the distributed propulsion, the failure of a lift/thrust unit may, for some architectures, potentially cause other lift/thrust failures in a chain reaction. Specifically, the assessment of simultaneous or cascading failures of lift/thrust units can use the following methodology: REQUESTED CHANGE: This section should be removed for Category Enhanced Aircraft	JUSTIFICATION: AMC 20-128 is applicable to CS-25, CS-23, CS-27 and CS-29 AMC 20-128 paragraph (10)(b)(2) states that "Damage to any other engines (the consequences of subsequent uncontained debris from the other engine(s), need not be considered)." In addition, AMC 20-128 (c)(3) defines for CS-25 large aeroplanes and CS-23 commuter category aeroplanes, the following hazard ratio guidelines have been achieved: (i) Single One-Third Disc Fragment. There is not more than a 1 in 20 chance of catastrophe resulting from the release of a single one-third disc fragment as defined in Paragraph 9a. (ii) Intermediate Fragment. There is not more than a 1 in 40 chance of catastrophe resulting from the release of a piece of debris as defined in Paragraph 9b. (iii) Multiple Disc Fragments. (Only applicable to any duplicated or multiplicated system when all of the system channels contributing to its functions have some part which is within a distance equal to the diameter of the largest bladed rotor, measured from the engine centerline). There is not more than 1 in 10 chance of catastrophe resulting from the release in three random directions of three one-third fragments of a disc each having a uniform probability of ejection over the 360° (assuming an angular spread of ±3° relative to the plane of the disc) causing coincidental damage to systems which are duplicated or multiplicated. Finally, AMC 20-128A paragraph (c)(4) states for newly designed non-commuter CS-23 aeroplanes the chance of catastrophe is not more than twice that of Paragraph 10(c)(3)(i), (ii) and (iii) for each of these fragment types. EASA is proposing higher level of safety than transport category aircraft, and commuter aircraft, which seems to be over prescriptive without providing a cost-benefit analysis and without showing the rationale explaining the perceived increase on safety compare with a CS-25 or commuter class aircraft.			Not accepted	Service experience of conventional aircraft has shown that damages due to high-energy fragments, for example following uncontained compressor and turbine rotor failures, continue to occur. VTOL aircraft have no service experience while the introduction of new technology and architectures means that VTOL aircraft cannot directly use conventional aircraft service experience to determine the likelihood and effects of failures. The specific risks introduced by the anticipated operations, such as low altitude overflight of congested area, and the wide spectrum of architectures possible warrant a different approach than AMC 20-128 for Category Enhanced.

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11-13	*Rolls Royce (F. Musella*	MOC VTOL.2240(d)	25	*(d) Safety Analysis:* *It should be assessed that the* ***failure of a lift/thrust unit or rotating-machinerydoes not have a catastrophic effect as defined in MOC VTOL.2510.*** *The assessment should include* ***aircraft systems****, structures (including energy storage), occupants* ***and other lift/thrust units****. Due to the distributed propulsion, the failure of a lift/thrust unit may, for some architectures, potentially cause other lift/thrust failures in a chain reaction. [...]* The VTOL.2240(d) requires to minimise hazards to the aircraft due to structural damage caused by high-energy fragments from an uncontained lift/thrust unit or rotating-machinery failure. The wording above refers to a generic failure of a lift/thrust unit and its effect on aircraft systems and structure. It should be limited to uncontained high energy debris effect on structures in line with the VTOL.2240(d) requirement. Also the methodology proposed is focused on lift/thrust unit (part of the lift/thrust system) failure caused by high-energy fragments from an uncontained lift/thrust unit (coming from another unit). The wording above is true in general but it should not be applicable to High Energy Debris where the requirement is for effect minimisation. Traditionally the uncontained engine rotor failure events are not required to be assessed following the 25.1309 criteria (equivalent to VTOL.2510). CS 25.901 (c) The powerplant installation must comply with CS 25.1309, except that the effects of the following need not comply with CS 25.1309(b): (1) Engine case burn through or rupture; (2) Uncontained engine rotor failure; and (3) Propeller debris release.	The propulsion failure should be limited to high-energy fragments and the effects to the structural elements. The criteria of VTOL.2510 should not be applicable to failures due to high-energy fragments from an uncontained lift/thrust unit or rotating-machinery failure Suggested resolution as above	yes		Not accepted	Service experience of conventional aircraft has shown that damages due to high-energy fragments, for example following uncontained compressor and turbine rotor failures, continue to occur. VTOL aircraft have no service experience while the introduction of new technology and architectures means that VTOL aircraft cannot directly use conventional aircraft service experience to determine the likelihood and effects of failures. The specific risks introduced by the anticipated operations, such as low altitude overflight of congested area, and the wide spectrum of architectures possible warrant a different approach than CS 25.901(c) for Category Enhanced.
11-14	*Embraer*	MOC VTOL.2240(d) High Energy Fragments – Particular Risk Analysis, item 2 (d) Safety Analysis.	25	The text on item 2 (d) is interrupted by a comment, which makes difficult to understand the paragraph which begins with "If the first failure can cause a second failure of a lift/thrust unit". The methodology for the lift/thrust unit cascading failure evaluation at figure 1 lets clear that the intent is to ensure that the failure condition overall probability is less than 1 x 10-9 per flight hour. So it is proposed to rewrite that paragraph for clarification.	If the first failure can cause a second failure of a lift/thrust unit, the probability of the second failure should be evaluated. In the determination of this probability, consideration can be given to the probability of occurrence of the first failure. If the overall probability of the combination of the first and second failures is less than 10-9 per flight hour, the hazards can be considered to have been minimised and the analysis can stop there ...	Yes	No	Partially accepted	Wording has been changed to: “In the determination of this probability, consideration can be given to the probability of occurrence of the first failure (e.g. structural failure rates) and the probability of chain reaction (incl. hazardous trajectory probability and associated second failure probability)”.

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11-15	*GAMA*	MOC VTOL.2240(d) High Energy Fragments – Particular Risk Analysis, item 2 (d) Safety Analysis.	25	The text on item 2 (d) is interrupted by a comment, which makes difficult to understand the paragraph which begins with "If the first failure can cause a second failure of a lift/thrust unit". The methodology for the lift/thrust unit cascading failure evaluation at figure 1 lets clear that the intent is to ensure that the failure condition overall probability is less than 1 x 10-9 per flight hour. So it is proposed to rewrite that paragraph for clarification.	If the first failure can cause a second failure of a lift/thrust unit, the probability of the second failure should be evaluated. In the determination of this probability, consideration can be given to the probability of occurrence of the first failure. If the overall probability of the combination of the first and second failures is less than 10-9 per flight hour, the hazards can be considered to have been minimised and the analysis can stop there ...	Yes	No	Partially accepted	See comment 11-14
11-16	*Rolls Royce (F. Musella*	MOC VTOL.2240(d)	25	The CS 23 amdt 5 requirement 23.2410 "Powerplant installation hazard assessment" requires the applicant to assess each powerplant installation separately and in relation to other aeroplane systems and installations to show that any hazard resulting from the likely failure of any system component or accessory will not prevent continued safe flight and landing or, if continued safe flight and landing cannot be ensured, the hazards have been minimised. The SC VTOL does not include a similar requirement. the VTOL.2410 is (reserved). The wording from the MOC VTOL.2240(d) considering an uncontained high-energy fragments from lift/thrust unit causing a second failure of a lift/thrust unit seem more appropriate for such requirement. How this is covered in the SC VTOL regulation? Does the term structural damage include equipment/unit damage that traditionally are considered as part of systems?	Clarify if the term structural damage includes equipment/unit damage	Yes	No	Noted	This is deemed to be covered by the sentence “The assessment should include aircraft systems, structures (including energy storage), occupants and other lift/thrust units.”
11-17	*Rolls Royce (C Ludena)*	MOC VTOL.2240(d)	25	If the requirement for the enhanced category is that no primary single failures leading to Catastrophic are allowed. In this case the sentence should be "*the first failure shall not be catastrophic*"	change should with shall in the sentence "*the first failure should not be catastrophic*"	yes	no	Accepted	MoC constitute advisory material thus “should” is typically used instead of “shall”. This sentence is however a reformulation of a requirement from SC-VTOL, therefore “shall” is appropriate.
11-18	*Rolls Royce (Adam Newman)*	MOC VTOL2240(d) sub-part (d)	25	“…for some architectures, potentially cause other lift/thrust failures…”	Consider if the MoCs should enforce the definition of rotor burst zones for which Zonal Safety Analysis is completed as per ARP4761 and the introduction of installation requirements and rules by zone (for example on wiring, fuel or flammable fluid lines etc) and precautions taken to minimize the hazard from such events Should it be commented that efforts should be made to minimise the risk and / or hazard of cross-engine (thrust / lift) debris?	No	Yes	Noted	EUROCAE WG-112 is currently developing guidance covering these aspects and the corresponding material may be adopted as MOC.

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11-19	*Airbus Helicopters (SB/MB)*	2240(d), §2. (d)	25	Misleading wording with "*second failure, third failure*". Consistency with 2510(7) page 56 is necessary: "*A single failure includes any set of failures which cannot be shown to be independent from each other*" **Failure are usually random failures with an associated failure rate**. The first failure belongs to this category. What is called 2nd and 3rd failures are just **cascading effects** resulting from the first failure. This has been correctly reflected on the schematic but not in the text.	It would be better to say that "**no single failure criteria" is applicable with the following exception: Cascading effects leading to catastrophic situation are acceptable providing that the root cause failure probability combined with the probability to generate a catastrophic cascaded effect is extremely improbable.**" Or " **The first failure should not be catastrophic" → "The initial failure should not have an immediate catastrophic failure effect, but may have an catastrophic effect by cascading events**." And adaptation of the following test to this wording structure.	yes	no	Partially accepted	Wording has been changed to: "The first failure shall not have an immediate catastrophic effect. It may however have a catastrophic effect by cascading events if extremely improbable. This is determined as follows:"
11-20	Airbus Helicopters (IE)	VTOL.2240 (d) §2 d	25	In the probability of the second failure, probability of trajectories causing the chain reaction is not explicitly mentioned for the overall probability.	It is suggested to add "In the determination of this probability, consideration can be given to the probability of occurrence of the first failure and the probability of chain reaction (incl. hazardous trajectory probability and associated second failure probability)"	Suggestion	Substantive	Accepted	Wording has been changed accordingly.
11-21	*Vertical Aerospace*	MOC VTOL 2240(d)	25	Some failure modes may be impossible to quantify. A blade designed to CS-P, meet bird strike requirements and maintained to the maintenance manual will not fail or will not have a numerical probability that can be linked to failure. Events that could lead to failure i.e. hitting a bird beyond certification limits is, by definition, out of scope of safety analysis.	Introduction of residual risk allowance that recognises a potential catastrophic outcome from a very rare event, in certain scenarios, might not be avoidable by design.	Yes	Yes	Noted	This methodology requires to consider generically the initial failure, regardless of probability for Category Enhanced. Bird strikes in particular have dedicated MOC under VTOL.2250(f).
11-22	*Leonardo Helicopters*	MOC VTOL.2240(d)	25	A clarification of the point (d) Safety Assessment is requested. The statement "The first failure should not be catastrophic" refers to the first high energy fragment or to the first impact? E.g. blade detachment. The first failure is the detachment of the blade and shall not be Catastrophic ?	Clarify that: "The first detachment of high energy fragment shall not be catastrophic independently by the fact that can hit other equipment."	YES	NO	Partially accepted	Wording has been changed to: "The first failure shall not have an immediate catastrophic effect. It may however have a catastrophic effect by cascading events if extremely improbable. This is determined as follows:"
11-23	*Leonardo Helicopters*	MOC VTOL.2240(d)	25	Please clarify if the method of cascading failure is applicable for the lift/thrust unit only.	/	YES	NO	Noted	This Particular Risk Analysis has been triggered by the specific need related to distributed propulsion and thus considers lift/thrust units. If other equipment justifies a specific approach for cascading effects, specific material will be developed.
11-24	*Leonardo Helicopters*	MOC VTOL.2240(d)	25	Please clarify "the probability of the second failure should be evaluated". Is the second failure due to the impact of the first failure with a general equipment. If this is the scenario the overall probability is the probability of the first detachment of high energy fragment combined the impact angle?	To include an example of calculation of the overall probability	YES	NO	Accepted	Wording has been changed to: "In the determination of this probability, consideration can be given to the probability of occurrence of the first failure (e.g. structural failure rates) and the probability of chain reaction (incl. hazardous trajectory probability and associated second failure probability). If this overall probability is less than 10^{-9} per flight hour, the hazards can be considered to have been minimised and the analysis can stop there."

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11-25	*Leonardo Helicopters*	MOC VTOL.2240(d)	25	Please clarify "The probability of the third failure should then be evaluated". After the impact of a blade (first failure) with a lift/thrust unit (second failure) how could be possible to evaluate the trajectory and energy of the debris that will be generated by the impact?	To consider to stop the methodology in Figure 1 to the second cascading failure.	NOT	YES	Not accepted	Some proposed architectures have a large number of lift/thrust units and all units should be considered until the overall probability is extremely improbable. Trajectory and energy of the debris can be demonstrated by test, analysis, or a combination of both.
11-26	*Volocopter*	2240(d) Section (d)	25/26	On page 25, MOC VTOL.2240 (d) it is described that "The first failure should not be catastrophic". In the figure on page 26, this is already depicted as the "First cascading failure", which would already be the second failure, induced by the first one. It is therefore not clear, if a safety analysis can be stopped after the first cascade, meaning the second failure, or if as depicted in figure 1, the analysis can only be ended after a second cascading failure which would already be a third failure.	EASA is asked to clarify the addressed comment. Proposal to adapt figure 1 in a way, replacing the wording "First cascading failure" by "First failure" and to adapt the following boxes to either "first and second cascading failure" or alternatively stay with a neutral "second and third failure", which by context of the MOC are cascaded.	yes	yes	Accepted	Wording has been changed to first, second and third failure
11-27	UK CAA	MOC VTOL.2240(d) High Energy Fragments – Particular Risk Analysis Para 2(d) Safety Analysis	25	it is not clear whether the effect of the second failure should be assessed in isolation or by considering the probability of previous events?	Please add clarification regarding whether the subsequent failures are to be assessed in isolation or by considering the probability of previous failures?	Yes	No	Accepted	Wording has been changed to: "In the determination of this probability, consideration can be given to the probability of occurrence of the first failure (e.g. structural failure rates) and the probability of chain reaction (incl. hazardous trajectory probability and associated second failure probability). If this overall probability is less than 10^{-9} per flight hour, the hazards can be considered to have been minimised and the analysis can stop there."
11-28	UK CAA	MOC VTOL.2240(d) High Energy Fragments – Particular Risk Analysis	24	SC VTOL.2240(e) states "For Category Enhanced, provisions for in-service monitoring of parts having an important bearing on safety in operations must be established." Does in-service monitoring mean continuous real-time condition monitoring, condition monitoring with periodic downloads, feedback from operators when parts fail, inspection of parts on removal or other means of monitoring?	MoC should state what is meant by the term "in-service monitoring".	Yes	Yes	Noted	Specific MOC will be developed integrating material from EASA CM-S-007 (https://www.easa.europa.eu/document-library/product-certification-consultations/easa-cm-s-007)

12. MOC VTOL.2250 (C) NO CATASTROPHIC EFFECT FROM SINGLE FAILURES IN THE CATEGORY ENHANCED

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12-01	*Geely Terrafugia*	MOC VTOL.2250(c) No catastrophic effect from single failures in the Category Enhanced	26	'The following method is accepted for compliance with VTOL.2250(c) in the Category Enhanced: (a) To demonstrate that no single failure has catastrophic consequences per design, a Safety Assessment should be performed that includes the following steps: a complete and comprehensive list of structural elements or parts and their interfaces should be provided;' Is principal structural elements (PSE) list an acceptable method to define the 'comprehensive list of structural elements or parts' ?	EASA could give some reference to define a 'comprehensive list of structural elements or parts' Such as FAA AC 23-13A 3-5	YES	YES	Not accepted	PSE has been specifically developed for fatigue evaluation under CS 23, 27, 29 and is associated to "catastrophic" failure. The traditional PSE selection is not sufficient to cover compliance with VTOL.2250 (c). All structural elements or parts must be considered. Due to the various configuration of VTOL, it is not possible to provide a comprehensive list of structural elements. However, the applicant is requested to provide a comprehensive list of structural elements or parts, and a safety assessment must be performed.
12-02	Collins Aerospace	MOC VTOL.2250(c) (a) (3) (ii)	26	Confused why one of many potential analyses (FMEA) is picked in particular here. System Safety Analysis is a process, FMEA is just a particular analysis in the process.	Delete this subsection.	Yes	No	Accepted	Correct: Safety Analysis or Safety Assessment should be performed. FMEA is one acceptable process. MOC has been reworded to not specify which particular Safety analysis should be performed. The applicant can select the preferred approach.
12-03	*Rolls Royce (C Ludena)*	MOC VTOL.2250(c)	26	this MOC VTOL.2250(c) is limited only to structural elements or parts. Systems and equipments are not included. The demonstration that no single failure has Catastrophic consequences should be derived from the overall safety assessment process (FHA, FMEA, FTA) as defined in MOC VTOL.2510.	either clarify in the title of the MOC VTOL.2250 (c) that it is only for structural parts: "*No catastrophic effect from structural single failures in the Category Enhanced*" Or if the single failure requirement is in general then refer to the overall safety process as defined in MOC VTOL.2510.	yes	no	Accepted	Title modified for clarification: "No catastrophic effect from structural single failures in the Category Enhanced"

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12-04	*Rolls Royce (M.Kimmerle (RRE))*	MOC VTOL.2250(c)	26	*a)(5)(ii) : "For simply loaded static elements that are not involved in a system function, if redesign or reconfiguration is impractical or adds excessive design complexity that would impair the overall safety objective, it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b) "* "simply loaded static elements" is not defined and needs clarification. rt After the loss of one propeller, the cascading event of damaging a neighbouring propeller cannot be excluded for most designs. This can result in a catastrophic failure condition after a single failure. Therefore the propeller and shaft will most likely have to be considered as "critical parts". The § is understood that the "extremely improbable" demonstration is an option (after demonstration that it is impractical to do differently) applicable only to parts not significantly loaded (with fatigue). This is contradictory to (b)(2) where fatigue tolerance is evaluated and allowed as compensating provisions. If simply loaded static elements is understood as non-rotating parts then it needs to be explained why they should be treated differently	Suggested wording: *For any part, where any single failure is identified that can lead to a catastrophic consequence, if redesign or reconfiguration is impractical or adds excessive design complexity that would impair the overall safety objective, it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b).*	Yes	No	Not accepted	Complex loaded parts which include rotating elements must comply directly with no single failure leading to catastrophic consequences. Simply loaded elements for all applications have demonstrated a more reliable in-service history. For this reason, compensating provisions may be accepted to show compliance with 2250 (c) for these parts only.
12-05	*Rolls Royce (Adam Newman)*	MOC VTOL.2250(c)	26	An FHA and FMEA are required, but not explicitly a Fault Tree – is this assumed as a pre-cursor to a FMEA as ARP4761 describes or an omission? Why are a Common Mode Analysis (CMA) and / or a Common Cause Analysis (CCA) not expected?	Consider if all acceptable system safety analysis is required as part of the MoC. Has cross-reference to MOC VTOL.2510 section 8 considered?	No	No	Accepted	MOC has been reworded to not specify which particular Safety analysis should be performed. The applicant can select the preferred approach. Nonetheless, Common Mode Analysis (CMA) and / or a Common Cause analysis (CCA) approach should be included.
12-06	*Airbus Helicopters (SB)*	2250(c)	26	FHA and FMEA are weak methods to identify single failures with catastrophic effects in complex systems	A full process encompassing the whole aircraft should be deployed. As an example, A/C FHA and PASA (Preliminary Aircraft Safety Assessment) as described in ARP4754A are efficient complementary methods to capture interactions between systems.	x		Accepted	MOC has been reworded to not specify which particular Safety analysis should be performed. The applicant can select the preferred approach.

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12-07	*Airbus Helicopters* *(FXG)*	VTOL.2250(c) Section (a)(5)	P 26, 27	(a)(5)(ii) : "*For simply loaded static elements that are not involved in a system function, if redesign or reconfiguration is impractical or adds excessive design complexity that would impair the overall safety objective, it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)* " (a)(5)(ii) is understood as contradictory to (b)(2). "*simply loaded static elements*" wording would need to be clarified, especially with regards to (b)(2) P27 where compensating provisions could be a "*fatigue tolerance evaluation*". Either it is understood that the "*extremely improbable*" demonstration is an option (after demonstration that it is impractical to do differently) applicable only to parts not significantly loaded in fatigue : but then, why using a fatigue tolerance evaluation as a compensating factor is not appropriate?, Or it is understood that this option is limited to "non-rotating parts", but then the rationale is questionable (rotating or non-rotating single load parts leading to catastrophic consequences in terms of failures should not be addressed differently).	Proposal : To reword (a)(5)(ii) as follows: *"~~**For simply loaded static elements that are not involved in a system function,**~~ If redesign or reconfiguration is impractical or adds excessive design complexity that would impair the overall safety objective, it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)."*		X	Not accepted	Complex loaded parts which include rotating elements must comply directly with no single failure leading to catastrophic consequences. Simply loaded elements for all applications have demonstrated a more reliable in-service history. For this reason, compensating provisions may be accepted to show compliance with 2250 (c) for these parts only. The extremely improbable demonstration is acceptable for simply loaded parts only. The classification/selection of the simply loaded static elements must be performed by the applicant. It is not possible for EASA to identify in advance a list of simply loaded elements For the Simply loaded elements, the compensating provision will be addressed in the MOC VTOL 2250 (c) (b). Presentation from the EASA symposium 2019 https://www.youtube.com/watch?v=uOZGofciHdk
12-08	THALES Avionics	MOC VTOL.2250(c)	26	"a Functional Hazard Assessment (FHA) to identify the reasonably anticipated and conceivable failure conditions that have Hazardous or Catastrophic consequences considering all the stages of flight and operating conditions;" The intent is to reach "No catastrophic effect from single failures in the Category Enhanced" and not hazardous effect.	Remove the word "Hazardous"	Suggestion	Objection	Accepted	Hazardous consequence has been removed.
12-09	*Leonardo Helicopters*	MOC VTOL.2250(c)	26	Point (a) (3) (i) The requirement clearly refers to Catastrophic failure conditions. The use of Hazardous can create confusion.	To update the statement removing Hazardous	NOT	YES	Accepted	Hazardous consequence has been removed.
12-10	*Leonardo Helicopters*	MOC VTOL.2250(c)	27	Point (b) (1) redundancies Please clarify the word redundancies. If the design contains a redundancy configuration then the failure of one can not lead to a catastrophic effect because the remaining one is able to perform the function	Remove the word "redundancies"	NOT	YES	Accepted	The word "redundancies" is removed

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12-11	*Leonardo Helicopters*	MOC VTOL.2250(c)	27	Point (b) (7) Other Safety Devices Please specify if the possibility to calculate a quantitative probability of occurrence of the structural failure (to meet the extremely improbable) should be an acceptable compensating provision or not.	/	YES	NOT	Noted	Structure failure rate MOC will be developed to provide additional guidance in order to demonstrate extremely improbable.
12-12	*Leonardo Helicopters*	MOC VTOL.2250(c)	27	"for simply loaded static elements"	Add a definition of "simply loaded"	YES	YES	Accepted	The following note is added in the MOC 2250 (c) (a)(5)(ii) *"Note: Simply loaded static elements are typically airframe components. They are not high cycle fatigue loaded, non-rotating and not complexly loaded such as control surfaces or blades."*
12-13	*Leonardo Helicopters*	MOC VTOL.2250(c) Para (a)(5)	27	"for simply loaded static elements" This approach is too restrictive with respect to rotating elements of the LTS (shafts, blades, etc.) and does not allow many aircraft configuration otherwise acceptable for the SC.VTOL (which is applicable for VTOL with more than two LTU). Simplicity in the VTOL rotors strongly reduces number and complexity of the rotating elements compared to current helicopters. Design methodology, technology and quality of VTOL rotors can demonstrate to satisfactorily match the overall safety objective for CAT events if current critical parts process is introduced beside the compensating provisions listed.	Current critical parts process together with the listed compensating provisions should be accepted to demonstrate compliance with the SC.VTOL safety objective, not only for simply loaded static elements but for rotating elements of the LTU also.	YES	YES	Not accepted	Only simply loaded elements should be considered for MOC 2250 (c) (b). The critical parts process has not been demonstrated fully reliable to prevent failure (catastrophic) and has consequently not be considered for VTOL.
12-14	*GAMA*	MOC VTOL.2250(c) No catastrophic effect from single failures in the Category Enhanced	26	Confusing text: (b) For structural elements or parts and failure modes identified in (a)(5)(ii), **an acceptable of compensating provisions acceptable** to EASA may be selected from the non-exhaustive list below:	Suggest rewording the bolded text.	Yes	No	Accepted	MOC updated.

12-15	Boeing	MOC VTOL.2250(c)	26	THE PROPOSED TEXT STATES: Paragraph VTOL.2250(c)(a)(3)(i)&(ii) states (i) a Functional Hazard Assessment (FHA) to identify the reasonably anticipated and conceivable failure conditions that have Hazardous or Catastrophic consequences considering all the stages of flight and operating conditions; and (ii) a Failure Modes and Effects Analysis (FMEA). This qualitative design assessment should evaluate the failure effects for all reasonably anticipated and conceivable failure modes at structure elements or parts level. REQUESTED CHANGE: We ask EASA to remove MOC VTOL.2250(c)(a)(3)(4)(ii), (5) & (b)	JUSTIFICATION: Given the wording in 2250(a), this comment is noting that it may be interpreted that EASA is proposing to apply FMEA and FHA SSA methods to the structural mechanics of PSE structural elements, which are not considered or required for CS 25 & CS 29 transport category aircraft structures. However, without the benefit of clarifying dialogue with EASA, the intent may not actually be to apply these SSA methods to the structural mechanics of structural elements per se, but rather to those certification artifacts and requirements that define the performance basis of those PSEs, such as loads, aeroelastic stability and damage tolerance. Therefore, if the latter is the case, then this comment should therefore be interpreted to request a significant and fundamental re-write of the 2250 language to clarify that SSA methods are not intended for an assessment of reliability of the structural mechanics of PSEs, etc per se, but rather their ability to carry the initial and subsequent effects from any know or latent failure not shown to be extremely improbable that may exceed the performance of such PSEs. We note that such new guidance related to IS&S and other system/structure interaction safety analyses may be prudent now given the increasing use of FbW systems, and thus, if this is the intent of the draft MOC, the language in the draft should be more clearly explained with revised language. Unfortunately, 2250(b)(4) and (5) imply SSA practices should be utilized regarding “failure modes” of the PSEs to determine probabilities, which could imply a quantification of reliabilities of structural mechanics. With respect to any intent regarding assessment of the reliability of structural mechanics methods, CS-23 amendment 5 establishes that CS 23.2250 replaces partially or completely the following sections of CS-23 amendment 4, namely CS 23.601, CS 23.603, CS 23.607, CS 23.683, CS 23.687, CS 23.689, CS 23.691, CS 23.723, CS 23.727, CS 23.731, CS 23.733, CS 23.735, CS 23.775, CS 23.783, CS 23.807, CS 23.859, CS 23.1301, CS 23.1323, CS 23.1325, CS 23.1435, and CS 23.1445. These regulations establish a known, fully functional and highly reliable safety system (also used in CS 25) that inherently, and extremely rigorously, addresses reliabilities of structural mechanics, and this system has an extremely high performance without the need for additional certification burden, nor any accompanying obvious safety improvement, with regard to such structural mechanics aspects. This existing guidance and regulations already fully address the risks of any know or latent failures of structural PSEs without any FMEA/FHA engineering analysis methods added to this (including loads regulations and existing guidance that require applicants to consider any such failures that may affect loads that are not shown to be improbable),		yes	Partially accepted	MOC has been reworded to not specify which particular Safety analysis should be performed. The applicant can select the preferred approach. VTOL Special condition 2250 (c) is a completely new requirement that is in addition to the well-established CS 27, 29 requirements and does not remove the need to show compliance also to them, such as material, durability, interaction system and structure, aeroelasticity… 2250 (c) is a design requirement to avoid the presence of single failure with catastrophic effects. This objective is found achievable thanks to the VTOL configuration. MOC VTOL.2245 Durability will provide additional information for compliance demonstration.

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					comprised primarily of requirements fordemonstration of residual strength capability assessments of complete or partial PSE failure requirements of 23.571/572/573, and test validation of those PSEs. Further, when identifying PSEs for consideration under this proposed rule, consideration should be given to the effect caused by partial or complete loss or failure of structure with respect to continued safe flight and landing, considering all flight phases including stability, control and aero elasticity, which is already required by CS 2X.571 or its equivalent CS 23.2240 Structural Durability. Although likely obvious, it should perhaps be considered for more explicitly language along these lines. As fundamental to any CS 23 or CS25 safety system, all parts of these existing guidelines and regulations are normally verified with exhaustive certification test bases related to materials and manufacturing variability along with a very high level of safety performance demonstrated over several decades without any need for such subjective analyses. Therefore, there appears to be no clear or obvious safety benefit from such potentially subjective FMEA and FHA analyses being applied to Structural Mechanics aspects of PSEs, given the additional artifacts and economic burden to both applicant and regulator, in addition to significantly exceeding existing established Transport Category requirements with an impeccable safety record using existing guidance as noted above.				
12-16	*Volocopter*	2250(c) Section (b)	27	"For structural elements or parts and failure modes identified in (a)(5)(ii), an acceptable <> of compensating provisions acceptable to EASA may be selected from the non-exhaustive list below: " There seems to be a missing <> part of text in order to form the sentence.	EASA is asked to reconfirm on the intended meaning.	yes	no	Accepted	New text: *"For structural elements or parts and failure modes identified in (a)(5)(ii), compensating provisions acceptable to EASA may be selected from the non-exhaustive list below"*
12-17	UK CAA	MOC VTOL.2250(c) No catastrophic effect from single failures in the Category Enhanced Para (a)(3)(i)	26	Emphasis should be placed on the generation of an Aircraft-level Functional Hazard Assessment (AFHA) as the top level process that allows the identification and evaluation of potential hazards related to an aircraft regardless of the details of its design.	Suggest revising the paragraph with Aircraft(-level) Functional Hazard Assessment (AFHA).	Yes	No	Not accepted	In the reply to comment 12-02 it has been agreed that Safety Analysis or Safety Assessment should be performed. FMEA or AFHA are only some acceptable processes. MOC has been reworded to not specify which particular Safety analysis should be performed. The applicant can select the preferred approach.

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12-18	UK CAA	MOC VTOL.2250(c) No catastrophic effect from single failures in the Category Enhanced Para (a)(5)(ii)	26	This states that "for simply loaded static elements that are not involved in a system function, …. it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)." Does "static elements that are not involved in a system function" mean airframe structure or other mission equipment?	If the correct interpretation is airframe structure, then replace text with: "for simply loaded static elements that are part of the airframe structure, it should be demonstrated that catastrophic …".	Yes	No	Noted	The correct interpretation is different. The following clarification note has been included in the MOC: *"Note: Simply loaded static elements are typically airframe components. They are not high cycle fatigue loaded, non-rotating and not complexly loaded such as control surfaces or blades."* EASA does not want to be too restrictive on the simply loaded elements, as the following proposed text is: "for simply loaded static elements that are part of the airframe structure, it should be demonstrated that catastrophic …". See also comment 12-12
12-19	UK CAA	MOC VTOL.2250(c) No catastrophic effect from single failures in the Category Enhanced Para (a)(5)(ii)	26	This states that "for simply loaded static elements that are not involved in a system function, …..it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)." VTOL.2250 states "For category Enhanced, a single failure must not have a catastrophic effect upon the aircraft". This MoC is not consistant with VTOL.2250	Decide whether a single failure Catastrophic effect is allowed at a rate of extremely improbable or is unacceptable for VTOL aircraft, and then ensure that SC and MOC are consistant on this aspect.	Yes	Yes	Not accepted	All the efforts should be developed by the applicant to design with no single failure catastrophic. However, in the impossibility (demonstrated) to meet this objective an Acceptable Means of Compliance to show extremely improbable single failure is an option. This has been presented at the 2019 Rotorcraft symposium: https://www.youtube.com/watch?v=uOZGofciHdk
12-20	UK CAA	MOC VTOL.2250(c) Para (a)(5)(ii)	26	This states that "for simply loaded static elements that are not involved in a system function, …..it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)." The MoC is not consistant with MOC VTOL.2510(7)(b) which states "While single failures should normally be assumed to occur, experienced engineering judgment and relevant service history may show that a catastrophic failure condition by a single failure mode is not a practical possibility."	If a single failure with catastrophic effect is a theoretical possibility but not considered to be a practical possibility then the requirement to be extremely impobable would be redundant. Decide whether a single failure Catastrophic effect is allowed at a rate of extremely improbable, can be allowed if considered to be not a practical possibility or is simply unacceptable for VTOL aircraft. Then ensure that SC and MOC are consistant on this aspect.	Yes	Yes	Not accepted	All the efforts should be developed by the applicant to design with no single failure catastrophic. However, in the impossibility (demonstrated) to meet this objective an Acceptable Means of Compliance to show extremely improbable single failure is an option for simply static loaded elements. This has been presented at the 2019 Rotorcraft symposium: https://www.youtube.com/watch?v=uOZGofciHdk
12-21	UK CAA	MOC VTOL.2250(c) Para (a)(5)(ii)	26	This states that "for simply loaded static elements that are not involved in a system function, …..it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)."	This MoC should be clear that this requirement is supplemental to VTOL.2510.	Yes	Yes	Partially accepted	System failure is addressed under VTOL.2510 See also reply to comment 12.03

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
12-22	UK CAA	MOC VTOL.2250(c) Para (a)(5)(ii)	26	SC VTOL.2250 states "For category Enhanced, a single failure must not have a catastrophic effect upon the aircraft". For single failures with catastrophic effect for Basic Category VTOL aircraft, should parts be defined as Critical Parts for which a separate new requirement would be needed?	If considered necessary, add new requirements and/or MoC to define and address VTOL Critical Parts.	Yes	Yes	Not accepted	For both Category Basic and Enhanced "The suitability of each design detail and part having an important bearing on safety in operations must be determined". Additional MOC will be developed to address this part of the requirement, for both Basic and Enhanced.
12-23	UK CAA	MOC VTOL.2250(c) Para (a)(5)(ii)	26	Following EASA review of Comment 46 above re: *Decide whether a single failure Catastrophic effect is allowed at a rate of extremely improbable or is unacceptable for VTOL aircraft, and then ensure that SC and MOC are consistant on this aspect.* If it is determined that catastrophic effect from single failures in the Category Enhanced <u>is</u> allowable, at a rate of extremely improbable, then; For catastrophic effect single failures for Enhanced Category, should parts be defined as Critical Parts for which a separate new requirement would be needed?	If considered necessary, add new requirements and/or MoC to define and address VTOL Critical Parts.	Yes	Yes	Not accepted	The critical parts process has not been demonstrated fully reliable to prevent failure (catastrophic) and has consequently not be considered for VTOL
12-24	*Airbus Helicopters* (via ASD)	VTOL.2250(c) Section (a)(5)	P 26, 27	(a)(5)(ii) : "*For simply loaded static elements that are not involved in a system function, if redesign or reconfiguration is impractical or adds excessive design complexity that would impair the overall safety objective, it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)* " (a)(5)(ii) is understood as contradictory to (b)(2). "*simply loaded static elements*" wording would need to be clarified, especially with regards to (b)(2) P27 where compensating provisions could be a "*fatigue tolerance evaluation*". Either it is understood that the "*extremely improbable*" demonstration is an option (after demonstration that it is impractical to do differently) applicable only to parts not significantly loaded in fatigue : but then, why using a fatigue tolerance evaluation as a compensating factor is not appropriate?, Or it is understood that this option is limited to "non-rotating parts", but then the rationale is questionable (rotating or non-rotating single load parts leading to catastrophic consequences in terms of failures should not be addressed differently).	Proposal : To reword (a)(5)(ii) as follows: *"~~**For simply loaded static elements that are not involved in a system function**~~, If redesign or reconfiguration is impractical or adds excessive design complexity that would impair the overall safety objective, it should be demonstrated that catastrophic consequences from any single failure are extremely improbable applying a combination of the compensating provisions in accordance with paragraph (b)."*	no	yes	Not accepted	See comment 12-07

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
12-25	*Leonardo Helicopters (via ASD)*	MOC VTOL.2250(c) Para (a)(5)	27	"for simply loaded static elements" This approach is too restrictive with respect to rotating elements of the LTS (shafts, blades, etc.) and does not allow many aircraft configuration otherwise acceptable for the SC.VTOL (which is applicable for VTOL with more than two LTU). Simplicity in the VTOL rotors strongly reduces number and complexity of the rotating elements compared to current helicopters. design methodology, technology and quality of VTOL rotors can be demonstrated to satisfy the overall safety objective for CAT events if current critical parts process is introduced beside the compensating provisions listed.	Current critical parts process together with the listed compensating provisions should be accepted to demonstrate compliance with the SC.VTOL safety objective, not only for simply loaded static elements but for rotating elements of the LTU also.	YES	YES	Not accepted	See comment 12-13
12-26	*(Rolls-Royce) (via ASD)*	MOC VTOL.2250(c)	26	After the loss of one propeller, the cascading event of damaging a neighbouring propeller cannot be excluded for most designs. This can result in a catastrophic failure condition after a single failure. Therefore the propeller and shaft will most likely have to be considered as a "critical part". With the allowed compensating provisions listed in (b) the means to allow a critical part would be given again. Is this understanding correctly?		Yes	No	Noted	See comment 12-04 and 12-23. MOC VTOL.2240(d), regarding high energy fragments, is updated to clarify the approach for cascading events. Additional guidance regarding the acceptable combination of compensating provisions will be published in a future revision of MOC VTOL.2250(c).

13. MOC VTOL.2250 (F) AIRCRAFT CAPABILITY AFTER BIRD IMPACT

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
13-01	*Alex Scerri*	MOC VTOL.2250 (f) 1	27	Use of “maximum speed” and only non-SI units for altitude.	A more formal definition of “maximum speed” as a defined V speed and inclusion of S.I. unit for altitude (2438 m) as for CS-25.	YES	NO	Partially accepted	The “maximum speed” corresponds to the critical speed for the bird impact. It will depend on the aicraft speed but also on rotating parts speeds. It has to be assessed on a case by case basis. SI units are added.
13-02	*Alex Scerri*	MOC VTOL.2250 (f) 1	27	https://www.linkedin.com/pulse/evtol-case-bigger-bird-alex-scerri As outlined in the linked article above; • These aircraft will be operasting mostly below 3,000 ft, where most bird strikes occur. • They will be extensively used as airport to city shuttle and therefore frequently share airspace as CS-25 aircraft hence be subject to encountering the same bird species (size, mass). • Operating in attractant-rich urban environment. • EASA commissioned ATKINS report (https://www.easa.europa.eu/sites/default/files/dfu/Final%20report%20Bird%20Strike%20Study.pdf) states “The certification requirements for CS-23 Commuter Aircraft (2 lb, windshield only) and CS-29 Transport Helicopters (1 kg) result in an undesirably large proportion of bird strikes (5 to 11%) above the certification value. • A higher certified bird mass will allow more flexibilitiy for mitigation by decreasing allowed operating speed during migration/reports/observation of birds larger than certified mass in the operating area.	Increase bird mass to 4 lb, as for CS-25.	NO	YES	Not accepted	Commonality with helicopters and CS-23 commuter aircraft is ensured. After ATKINS study (see Report), the ARAC Rotorcraft bird strike working group (see report) performed a larger study which confirmed that the 1kg bird is representative of the threat.
13-03	*Alex Scerri*	MOC VTOL.2250 (f) 2	28	Multiple bird strike capability should not be less than prescribed in the associated section of CS-E	Enusre correlation of Multiple bird strike capability with CS-E.	YES	NO	Accepted	Multiple bird strike capability will be addressed in the frame of the SC E-19 EHPS.
13-04	*Rolls Royce (Jonathan Holt)*	MOC VTOL.2250(f)	27	Wording around ‘respectively’ needs clarifying.	Suggest splitting the first sentence into two: one for Category Basic, one for Category enhanced	Yes		Accepted	Wording is improved. New text: *“In accordance with VTOL.2250(f), VTOL aircraft must be designed to ensure the capability of a controlled emergency landing in the Category Basic with a maximum of 7 or more seats, or of a continued safe flight and landing in the Category Enhanced, after impact of a 1.0-kg (2.2-lb) bird.”*

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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13-05	*Rolls Royce (F. Musella)*	MOC VTOL.2250(f)	27	The ARAC Rotorcraft Bird Strike Working Group work have shown an increase in the number of bird strikes event limited to small and large category rotorcraft. Therefore the MOC VTOL.2250(f) guidelines for structures, other than windshield, systems and equipment should be limited to the A/C configurations and relative speed in VTOL flight phases similar to rotorcraft. If the VTOL has the capability to fly and land as a conventional CS 23 aircraft, CTOL configurations and speeds need only be considered for the bird impact on windshield panels. The "General considerations" section states that "*the mode of operation as conventional aeroplanes (CTOL) is also specifically addressed, when relevant, in the Means of Compliance described in this document*". The Bird strike should be one of those cases.	If the VTOL has also CTOL configuration, the bird impact for this mode of operation and the related speeds should be limited to windshield panels in line with CS 23 requirements.	Yes	No	Not accepted	MOC VTOL.2250(f) is focussed on a risk assessment to evaluate the VTOL configurations and architectures for which bird impact can be more often critical.
13-06	*Leonardo Helicopters*	2250(f) Para.2(a)	28	What is intended with "Multiple bird strike"? which number of birds?	Please clarify	YES	NOT	Noted	This subject will be addressed in the frame of SC E-19 EHPS. The number and the size of the birds will, like described in CS-E, be depending on the air intake area or impact surface area. EASA presented the approach during the rotorcraft symposium in 2019. Please refer to the presentation (slide 10). https://www.youtube.com/watch?v=zWge3lS6J_8
13-07	*Leonardo Helicopters*	2250(f) Para.2(c)	28	Does "no loss of function" mean that the element should preserve its full functionality in service without any inspection, maintenance, etc. after the first continued safe flight and landing after the impact?	Please clarify	YES	NOT	Noted	The objective in VTOL.2250 (f) is to ensure a continued safe flight and landing for category Enhanced and a safe landing for basic category. Maintenance can be made after the end of the flight, before next flight.
13-08	*Leonardo Helicopters*	2250(f) Para.2(c)	28	Specify "small birds" size	/	YES	NOT	Noted	This subject will be addressed in the frame of SC E-19 EHPS, taking into consideration the bird size indicated in CS-E 800.
13-09	*Leonardo Helicopters*	2250(f) Figure 1	28	How many medium and small birds should be considered?	Please clarify	YES	NOT	Noted	Refer to answers provided to questions 13-06 and 13-08.
13-10	*Leonardo Helicopters*	2250(f) Para.2(c)	28	MOC VTOL 2400 (b) does not concern birdstrike.	Explain reference to the mentioned requirement or remove it	YES	NOT	Noted	VTOL.2400 (b) request the engine or the propulsion system to be type certified or meet accepted specifications. EASA is defining these “accepted specifications” via the SC E-19 EHPS. The objective of the schematic was to provide a global picture and the link between the different requirements.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
13-11	*Leonardo Helicopters*	MOC VTOL 2250(f) Par.2	28	It is not defined aircraft speed for multiple bird strike evaluation	Add aircraft speed at which multiple bird strike capability shall be demonstrated	YES	NO	Accepted	The speed to be considered corresponds to the critical speed for the bird impact. It will depend on A/C speed but also on rotating parts speeds. It has to be assessed on a case by case basis. That is why the notion of "most critical configurations" is used. Same wording as for the single bird (§ 1 (a)) added.
13-12	*FLUTR*	MOC 2250(f)		For cruise configuration case, the MOC doesn't consider use of bird detection and avoidance as a mitigation strategy using camera based systems. For hover case, bird impact will be with rotors only. No airframe/windscreen effects are safety applicable. Normal propeller or thrust unit failure criteria apply.	Include reference to a functional bird detection/warning/ and/or auto-avoidance system. If such a system can provide an equivalent level of safety by avoding birds compared to colliding with birds, then strengthened cockpit shields etc do not apply.	suggestion	substantive	Not accepted	Bird avoidance systems are not considered as a valid option in the absence of sufficient data demonstrating their efficiency (Refer to ARAC working group report https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/ARAC%20RBSWG%20Final%20Report.pdf). Once more robust data will be available, different MOC could be proposed by applicant providing they meet equivalent safety standard.
13-13	UK CAA	MOC VTOL.2250(f) 1. Single bird strike evaluation:	27	"This should be ensured in the most critical configuration for the corresponding velocity of the VTOL (relative to the bird along the flight path of the vehicle) up to the maximum speed in level flight with maximum continuous power, at maximum operating altitude up to 8,000 feet **whichever is lower**." This is not clear – please clarify- what does this mean? Is this about using the maximum velocity for the test at level fight or at 8000 fleet? Whichever is lower? Clarification is required.	Clarification is required to avoid questions after publication.	Yes	No	Accepted	The wording is similar to CS 29.631 requirement considering that the substantiation of bird strike capability will not be requested at an altitude higher than 8000ft. Wording changed. New text: "This should be ensured in the most critical configuration for the corresponding velocity of the VTOL (relative to the bird along the flight path of the vehicle) up to the maximum speed in level flight with maximum continuous power, at operating altitude up to 2438 m (8,000 ft.)."
13-14	UK CAA	MOC VTOL.2250(f) 2. Multiple bird strike evaluation: Para 2(c)	28	"Multiple bird strike evaluation is not required for the windshield." How is this justified?	Please add a rationale behind this i.e. why it is acceptable.	Yes	No	Noted	The ARAC working group has shown that multiple bird strike on the airframe is representing 1 to 2% of the bird strikes. The large bird impact is the most frequent case and provide good design provisions to sustain a multiple bird impact.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
13-15	UK CAA	MOC VTOL.2250(f) 2. Multiple bird strike evaluation: Para 2(c)	28	Why does the multiple bird strike evaluation allow a bird size of 0.45 kg while for single bird strike it is 1.0 kg? What is the rationale behind this? Couldn't more than one 1.0 kg bird impact this VOTL aircraft?	The bird sizes would differ from region to region and so it would be better for the applicant to provide justification in using the most appropriate bird size for both single and multiple bird strike evaluation (to be submitted to the authority for acceptance prior to the test) rather than using a standard 1 kg and 0.45 kg bird.	Yes	No	Not accepted	Harmonization of safety levels has to be ensured during the certification process. The 1kg bird comes from the ARAC report. https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/ARAC%20RBSWG%20Final%20Report.pdf The 0.45kg bird has been extracted from CS-E requirements and is representative of the average weight of a city dove. However, for the multiple bird impact, the applicant can either chose to consider a 0.45kg bird impact on each redundant system or consider the approach proposed in the SC E-19 EHPS that was presented at the rotorcraft symposium in 2019 (refer to slide 10): https://www.youtube.com/watch?v=zWge3lS6J_8
13-16	Boeing	VTOL.2250 (f)(c)(1)	27	THE PROPOSED TEXT STATES: ""Direct Effects": to ensure the integrity of the structure and functionality of systems or equipment (including consideration of shock loads) which are critical for continued safe flight and landing (for Category Enhanced) or controlled emergency landing (for Category Basic)." REQUESTED CHANGE: ""Direct Effects": to ensure the integrity of the structure and functionality of systems or equipment (including consideration of shock loads) which are critical for continued safe flight and landing (for Category Enhanced) or controlled emergency landing (for Category Basic). For any rotor structure that may result in blade fragment liberation, the methods of 2240(d) shall be used for demonstration of compliance to (a) of this section.	JUSTIFICATION: Regulation and/or guidance should address and allow potential conditions where rotor structure may liberate from a critical bird impact and what is necessary to demonstrate safe CSF&L (using 2240 guidance), in lieu of CRI adjudication.		yes	Partially accepted	The consideration is addressed in Section 1 (d)(2) of MOC VTOL.2250 (f) "induced effects". The MOC.VTOL 2240 (d) scenario is not necessarily representative for the bird strike, however the text is completed as follows: *"(2)"Induced Effects": to examine the possible consequences of the ejection of pieces from structures, systems or equipment which are struck by a bird on other structures and systems.* *For a bird impact on the lift/thrust system, the guidance in MOC VTOL.2240(d) can be followed, when relevant, in the demonstration of compliance mentioned in paragraph (a) of this section."*
13-17	Boeing	VTOL.2250 (f)1.(a)	27	THE PROPOSED TEXT STATES: "..up to the maximum speed in level flight with maximum continuous power.." REQUESTED CHANGE: "..up to the maximum speed in level flight (VH_VTOL) with maximum continuous power and rotors turning at maximum permissible rpm for VTOL Mode, or up to VC with maximum continuous power for Aeroplane Mode…"	JUSTIFICATION: The "maximum speed in level flight" should be clarified to mean the maximum speed where the rotors are turning for strikes on the rotors with this being done at VH_VTOL, and Vc for Aeroplane (wing-borne) flight mode.		yes	Not accepted	This evaluation must be performed for the most critical condition along the flight track. The maximum rotor RPM is not necessarily associated to maximum forward speed.

14. MOC VTOL.2270(A) AND (C) EMERGENCY LANDING CONDITIONS: GENERAL CONSIDERATIONS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
14-01	UK CAA	MOC VTOL.2270(a) and (c) Emergency landing conditions: General considerations Para (c)	28	This specifies replacements for "*engines*" and "*rotors*". i) Some VTOL aircraft may use a hybrid electricity generation system, which may include an internal combustion engine, as such, it may be unwise to remove the reference to engines. ii) This MoC allows for CTOL flight and previous sections of the MoC (e.g. MOC VTOL.2240(d)) make specific reference to *"... propellers, rotors that provide lift, compressor and turbine rotors of turbine engines and APUs and, electric motor rotor and cooling fans".* Does the replacement of the terms "engines" and "rotors" in this section conflict with other requirements within this MOC? This section states that the term "*engine*" should be replaced with "*energy storage system*". This appears to conflict with both MOC VTOL.2000 and MOC VTOL.2270(d) which state that the term "*fuel tank*" should be replaced by the term "*energy storage system*".	Additional clarification is required.	Yes	Yes	Accepted	With the introduced replacements, the items of mass considered (as a minimum) are "lift/thrust units, transmissions and energy storage systems" instead of "rotors, transmissions and engines". Since this paragraph only contains some examples of large items of mass in a typical VTOL, it does not conflict with other MOCs. In accordance with the definitions provided in MOC VTOL.2000, "a lift/thrust unit is considered to be any engine that directly contributes to providing lift or thrust and includes its controller, the connected effector (e.g. rotor, propeller, fan) and any related actuators (e.g. pitch change, tilting, vectoring)". Engines are thus included under this term. The text has been modified to enhance the clarity in the intended purpose. New text: *"CS 27.561(c) Amdt. 6 is accepted as a means of compliance replacing "rotors, transmissions and engines" by "lift/thrust units, transmissions and energy storage systems"*
14-02	UK CAA	MOC VTOL.2270(a) and (c) Emergency landing conditions: General considerations Para (d)	28	This appears to conflict with the previous list item (c), which states that the term "*engines*" should be replaced with "*energy storage system*".	Some further clarification is required.	Yes	Yes	Accepted	Refer to comment 14-01.

15. MOC VTOL.2270(B)(1) EMERGENCY LANDING DYNAMIC CONDITIONS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
15-01	*Leonardo Helicopters*	*2270(b)(1)*	29	Therefore the 30 g is only valid if the structure underneath the seats has equal or better damping characteristics than a conventional rotorcraft.	OEM's may not be aware of the damping characteristics of the conventional rotorcraft	YES	NO	Noted	The typical structure of a rotorcraft below the seat attachment can be assessed through available sources such as maintenance manuals. Therefore it is possible to assess the dampening characteristic taking into account that a qualitative, not a quantitative analysis is expected.

16. MOC 1 VTOL.2300 FLY-BY-WIRE CONTROL SYSTEMS: DEFINITION AND SCOPE

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
16-01	*Rolls Royce (Adam Newman)*	MOC 1 VTOL.2300	30	*"The lift-thrust units, inverters and controllers…are typically part of the flight control system…"* I would not agree, they could also be reasonably be considered part of an engine control system operating to a series of power-setting commands sent by the aircraft flight control system.	The MoC is pre-assuming an architecture	No	Yes	Partially accepted	The definition has now been moved to section 8 in MOC VTOL.2000 and modified to: *"The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function."*
16-02	FAA RSB HF	2300	30	The lift/thrust units, inverters and lift/thrust unit controllers can be considered to be actuators and are typically part of the flight control system, both in terms of magnitude and direction of thrust. COMMENT The statement infers that lift/thrust units are used to control attitude, flight path in all eVTOL aircraft. They may not depending on design (to date they are though).	The lift/thrust units, inverters and lift/thrust unit controllers can be considered to be actuators *if they are used to control the aircraft's attitude or flight path. If they are used to control the aircraft's attitude or flight path, then they* are typically part of the flight control system, both in terms of magnitude and direction of thrust	Yes		Partially accepted	The definition has now been moved to section 8 in MOC VTOL.2000 and modified to: *"The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function."*
16-03	THALES Avionics	MOC 1 VTOL.2300	30	Definition does not use the same wording as in section MOC VTOL.2000 8). The definition of flight control computers use the term "flight control computer" and crew inceptors. Also, it is unclear what "all those elements necessary to control the attitude, flight" mean. Does inertial sensor, for example, is included in the Fly-By-Wire control system scope? If so, does section MOC 4 VTOL.2300 is also applicable to those sensors and controller that came with them?	Use the same wording (as for MOC VTOL.2000 8.) and highlight the difference if any. Please refine or clarify the scope of the FBW flight control system.	Suggestion	Objection	Accepted	The definition has now been moved to section 8 in MOC VTOL.2000 and modified to: *"The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function."* The sensors are explicitly included.
16-04	Lilium GmbH	MOC 1 VTOL.2300	30	The flight control system definition here conflicts with definition number 8 in the MOC VTOL.2000. Definition number 8 does not include the actuators, whereas the MOC 1 VTOL.2300 says that "*actuators are typically part of the flight control system*".	Please, clarify the difference in the FCS definition (page 7) and FBW definition (page 30).	no	yes	Accepted	The definition has now been moved to section 8 in MOC VTOL.2000 and modified to: *"The flight control system is composed of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, speed and flight path (trajectory) of the aircraft. The lift/thrust units can be functionally considered to be actuators of the flight control system and therefore part of the flight control function."*
16-05	*Volocopter*	MOC 1 2300	30	With the definition provided under MOC 1 to VTOL.2300, the LTU becomes part of the Flight Control System. Despite being actuators to control the attitude and trajectory, this separation is is not shared by Volocopter and not in line with SC-EHPS EHPS.15 definition of EHPS, where the engines or motors form a system with the energy storage and electrical wiring.	EASA is asked to clarify the intended separation between systems for VTOL in accordance between SC-VTOL and SC-EHPS.	yes	yes	Accepted	The following clarification has been included in the definition provided now in section 8 of MOC VTOL.2000: "In reference to the lift/thrust unit definition provided in Section 6 of this MOC, any engine directly contributing to providing lift or thrust, its controller, and fans shall comply with the applicable engine certification provisions while the other elements (rotors, propellers, and related actuators) shall comply with SC VTOL."

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
16-6	UK CAA	MOC 1 VTOL.2300 Fly-by-Wire control systems: Definition and Scope	30	CLARITY "The Fly-by-Wire (FbW) Flight Control System is comprised of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, flight path (trajectory) and speed of the aircraft.	Revise text as follows: "The Fly-by-Wire (FbW) Flight Control System is comprised of the pilot controls, computers, wiring, actuators, sensors, and all those elements necessary to control the attitude, flight path (trajectory), position and speed of the aircraft."	Yes	No	Not accepted	No argument is given for the proposed change. It could also cause a blurring of the boundary with the onboard navigation system as written.

17. MOC 2 VTOL.2300 ACCEPTABILITY OF ASTM STANDARD F3232-F3232M-17 FOR FLY-BY-WIRE FLIGHT CONTROL SYSTEMS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
17-01	*Pipistrel*	MOC 2 VTOL.2300(1)	30	The table includes two rows for Section 5.2 from ASTM F3232-F3232M-17. They appear to be duplicates.	Remove the first row where “5.2” shows up in the table.	Yes	No	Accepted	First instance of §5.2 removed.
17-02	FAA RSB AdFC	MOC 2 VTOL.2300 section 1	30	The first sentence incorrectly identifies F3232-17 as “Standard Specification for Systems and Equipment in Small Aircraft.” The title of F3232 is “Standard Specification for Flight Controls in Small Aircraft”.	Update to the correct document.		Objection	Accepted	Changed as suggested
17-03	FAA RSB AdFC	MOC 2 VTOL.2300 section 1	30	The applicability of ASTM F3232 seems to be incomplete, only defining as described in the text “prepared with the assumption of traditional (i.e. mechanical) primary flight controls.” One example of is in the included table, section 4.2 states ”This ASTM standard paragraph is an accepted means of compliance. Nevertheless, additional means of compliance are required for FbW, as proposed in this MOC.” but no other compliance is proposed. There is a working group defining a standard for Indirect Control Systems (ICS) that is a more appropriate MOC.	ASTM F3232 is not a complete solution. The addition of the draft ASTM standard WK61549 should be considered in the showing of compliance for advanced flight control designs once its mature.	Suggestion		Noted	EASA recognises that the ASTM standard is not a complete solution, hence much of the MOC content. EASA cannot add a reference to a draft standard, however, should the draft become formally issued, the MOC VTOL could be updated to include such a reference.
17-04	FAA Systems	MOC 2 VTOL.2300	31	F3232-19aE1 corrected the typo in section 4.9. Thank you for pointing this error out!	Consider referencing the current version of F3232 when the final MOC is published. Hopefully, a new revision will be published this year.	Suggestion		Accepted	**References to “ASTM F3232/F3232M-17” are replaced by “ASTM F3232/F3232M-20”.** The following sentence has been also included in the CRD to consider future revisions of the standard as well as alternative standards: *“Later revisions of ASTM F3232/F3232M or alternative standards may also be proposed by the applicant and agreed with EASA as acceptable means of compliance in a particular certification project”*
17-05	THALES Avionics	MOC 2 VTOL.2300	30	« This ASTM § was developed for traditional flight control systems. It is accepted as with some additions, see Section 0 . » Bad reference	Correct the reference	Suggestion	Substantive	Accepted	Corrected to “see Section 2, below”
17-06	*GAMA*	MOC 2 VTOL.2300(1)	30	The table includes two rows for Section 5.2 from ASTM F3232-F3232M-17. They appear to be duplicates.	Remove the first row where “5.2” shows up in the table.	Yes	No	Accepted	See comment 17-01
17-07	Lilium GmbH	MOC 2 VTOL.2300	30	ASTM table, line §4.7, shows a reference to a “Section 0”, which does not exist.	Double check the cross-reference section.	yes	no	Accepted	See comment 17-05
17-08	Lilium GmbH	MOC 2 VTOL.2300	30	ASTM table, line §4.10. The §4.10 of ASTM was declared here as “Accepted”, however this paragraph in the ASTM document talks about cable systems. Why was this accepted for an FBW system?	Please, clarify or remove §4.10	no	yes	Not accepted	The ASTM paragraph is appropriate if there is a cable element to the FCS.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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17-09	Lilium GmbH	MOC 2 VTOL.2300	30	In section (a) (2) it is requested that the test should be based using the pilot controls as input. Nevertheless, most modern closed-loop control laws do not provide a static relation between pilot input and effector displacement, with the relation being dependent on the overall aircraft state.	It is suggested to remove the references to the pilot controls or to include a note stating that the maximum pilot control deflection and maximum surface/effector travel can be tested independently when applicable to the design.	no	yes	Not accepted	This para is specifically concerned with adapting the ASTM F3232-F3232M standard, and it states that this is "One method, but not the only one," which leaves the applicant free to propose a more relevant test to suit their particular control system.
17-10	Lilium GmbH	MOC 2 VTOL.2300	30	MOC references revision 17 of ASTM standard F3232/F3232M, but the most current revision is 19a. No significant changes were done between these two revisions except for the addition of a section dedicated to Enhanced Envelope Awareness System and the correction of the typo mentioned in the MOC.	Please updating the reference to the ASTM standard or including a statement that the newer versions are also acceptable.	no	yes	Noted	EASA cannot add a reference to a draft standard. However, should the draft become formally issued, the MOC VTOL could be updated to include such a reference.
17-11	UK CAA	MOC 2 VTOL.2300 1. Status and comments Table: Entry §4.7	30	This refers to *"It is accepted as (?) with some additions,…Section 0"*. There is no immediately apparent Section 0. Is this a typo, should it point to Section 2 of MOC 2 VTOL.2300?	Typographical (?) error to be corrected.	No	No	Accepted	See comment 17-05

18. MOC 3 VTOL.2300 VALIDATION OF ELECTRONIC FLIGHT CONTROL LAWS (FCL) IN FLY-BY-WIRE FLIGHT CONTROL SYSTEMS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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18-01	*Rolls Royce (Jonathan Holt)*	MOC 3 VTOL.2300	33	Item c on p33 permits engineering judgment in determining when validation is adequate. Given the novel, complicated and highly safety critical nature of the FCL, the adequacy of this is questionable, although it is acknowledged that being more explicit at this point may be difficult.	Reconsider if using judgment here is acceptable	Yes		Noted	As the commenter states, it is difficult to be explicit on this point and the 9 points identified in part (c) are aspects intended to assist an acceptable engineering judgement to be made.
18-02	FAA RSB AdFC	MOC 3 VTOL.2300	32	Is the expectation that the applicant share their control laws with the certification authorities? Also, as previously stated, any requirement to MHQRM should be reconsidered.	This section needs to clarify what a detail validation activity requires vs the how other system requirements are validated. For example, will any new documentation be required for a plan and test?		Objection	Noted	It may not be necessary for the applicant to share the detail design of the control laws with the authority, but it will certainly be necessary to describe the functions and how they are accomplished as stated in (b)(1). The documentation necessary to plan the validation and test strategy should not be new, but should be reviewed to ensure alignment with this MOC as stated.
18-03	FAA RSB SW	MOC 3 VTOL 2300 Validation of Flight Control Laws	32	This section is too prescriptive as it establishes new requirements for strategies, validation, documents for validation, auditing activities, etc. The long-standing Industry Standards (ARP 4754A) already covers everything needed for this section.	Recommend removing everything in this section and simply reference the Industry Standard ARP4754A for guidance on Validation. Getting too prescriptive increases the possibility of getting out of sync with established practices and can cause confusion.. Note: ASTM does not address FBW; and thus, is not appropriate for highly integrated/complex systems utilizing FBW.		Objection	Not accepted	Many certification projects which have been developed using industry standards, have identified shortcomings in the validation of the flight control laws, and it has been necessary to add regulatory material (e.g. EASA CRIs) to address these shortcomings. This MOC is based on those CRIs. Comment regarding ASTM is noted, but there are parts of that material which are complimentary to the material written here.
18-04	THALES Avionics	MOC 3 VTOL.2300	32	" Compliance of the electronic flight control laws and logics with VTOL.2300, similarly to VTOL.2145, VTOL.2500, VTOL.2510 and the Handling Qualities in VTOL.2135 as per MOC VTOL.2135 and ARP 4754A/ED-79A, should be considered satisfactory when an adequate substantiation of validation activities is shown and formalised in the compliance documents." The word "logics" without some context is difficult to grasp. Are you referring to voting mechanism (for example) or the "operational mode"? Reference to VTOL.2300, similarly to VTOL.2145, VTOL.2500, … is already included in (a) (1) .	Proposed wording: Compliance of the electronic flight control laws should be considered satisfactory when an adequate substantiation of validation activities is shown and formalised in the compliance documents.	Suggestion	Substantive	Accepted	New text: "Compliance of the electronic flight control laws should be considered satisfactory when an adequate substantiation of validation activities is shown and formalised in the compliance documents."

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NR	Author	Section, table, figure	Page						
18-05	THALES Avionics	MOC 3 VTOL.2300	32	"Check proper integration of each function in FCL/FCS against objectives (e.g. rig-test, offline/piloted simulation, flight test, …)." Do you mean : Check proper integration of each FCL function in the eFCS against objectives (e.g. rig-test, offline/piloted simulation, flight test, …). FCS: the acronym is not defined Did your intend to use eFCS instead?	Porposed wording: Check proper integration of each FCL function in the eFCS against objectives (e.g. rig-test, offline/piloted simulation, flight test, …).	Suggestion	Substantive	Accepted	FCS changed for EFCS.
18-06	*Leonardo Helicopters*	MOC 3 VTOL.2300 c.1	33	FCL priorities seen as check state machine check could be obsolete. Looking forward to Autonomous vehicles could be difficult to resume priorities in a kind of state machine as it does today. Maybe other type of check could foreseen.	To be updated to allow new machine architectures	YES	NO	Not accepted	New machine architectures can be addressed as they occur, with project specific MOCs as necessary. If they become commonplace, this MOC SC VTOL can be updated.
18-07	*Leonardo Helicopters*	MOC 3 VTOL.2300 c.9	33	FCL entry/exit conditions could be obsolete. Looking forward to Autonomous vehicles could be difficult to define entry/exit conditions in a kind of state machine as it does today.	To be updated to allow new machine architectures	YES	NO	Not accepted	New machine architectures can be addressed as they occur, with project specific MOCs as necessary. If they become commonplace, this MOC SC VTOL can be updated. Autonomous flight is not being considered in this issue of MOC VTOL.
18-08	*Volocopter*	MOC 3 VTOL.2300 Section (a)(1)	32	(a)(1) should be named "specific validation strategy" instead of "specific test strategy". The item (a)(2) correctly refers to "validation strategy" with some examples that not neceseraly are tests (e.g.: analyses).	Change wording to "**validation strategy**" instead of "test strategy".	yes	no	Accepted	"test strategy" changed to "validation strategy".
18-09	*Volocopter*	MOC 3, 2300 Section (b)(3)	32	The section "Check compatibility of each function with other functions acting on the same control surface/actuator" focuses on the issue, when multiple control functions act on the same effector. For eVTOL aircraft (e.g., multicopter or transitioning aircraft), this is regularly the case as the actuators are not assigned to a single control axis but rather used in combination for all axis (e.g., total thrust and torques with multicopter). A particular challenge/potential problem with this are actuator limitations, as an excessive control demand in one axis also limits the control authority in the other axis. Volocopter recommends to supplement 2300(b)(3) with a third bullet point.	Add: **"(iii) Particular consideration shall be put on actuator limitations and the resulting coupling of the remaining control authority between different control functions**"	yes	no	Accepted	A third bullet is added as follows: "(iii) Particular consideration should be given to actuator limitations and the resulting coupling of the remaining control authority between different control functions"

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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18-10	*Volocopter*	MOC 3 VTOL.2300 Section (b)(4)	32, 33	FCL modes should be considered in the validation activities of FCL as one function can be applicable to more than one mode.	Proposal: (4) "Check compatibility of each function **in all applicable modes** with other functions at aircraft level:" or add a (iii) in (4): **"(iii) Consider the function in all applicable modes."**	yes	no	Accepted	Text is amended as follows: "(4) Check compatibility of each function in all applicable modes with other functions at aircraft level:"
18-11	*Volocopter*	2300(b)(5)	33	Coupling/dependencies between functions acting on the same actuator in case of failure are not explicitly covered so far.	Add: **"(iii) In case, functions are acting on the same control surface/actuators, particular consideration shall be put on coupling/dependency of failures in these functions (including control margin dependencies) as well as the overall redundancy management between these functions (including actuator limitations).**"	yes	no	Partially accepted	Third bullet is added as follows: "(iii) Where functions are acting on the same control surface/actuators, particular consideration shall be given to coupling of failures in these functions (including control margin dependencies) as well as the overall redundancy management between these functions (including actuator limitations)."
18-12	*Volocopter*	MOC 3, 2300 Section (c)	33	The meaning of "FCL changes" in the context of "The determination that an adequate level of validation of FCL changes has been achieved should be based on engineering judgment." is not understood.	Could EASA please provide some background, what kind of FCL changes are considered here?	yes	no	Accepted	Amend sentence as follows: The determination that an adequate level of validation of the FCL design has been achieved should be based on engineering judgment.

19. MOC VTOL.2300(A)(1) FUNCTION AND OPERATION OF FLY-BY-WIRE FLIGHT CONTROL SYSTEM

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
19-01	*Rolls Royce (Jonathan Holt)*	MoC VTOL.2300 (a)(1)	P34	Item a) typo: led should be lead at the end...	Correct	Yes		Accepted	New text: "Compliance should be shown in conjunction with VTOL.2445, as engine failures could lead to flight control mode degradation."
19-02	FAA RSB HF	2300 (a)(1)(3)	34	In case of several flight control modes, limitations should be clearly annunciated and the definition of a Training Area of Special Emphasis (TASE) in the Flight Crew Data (FCD) may be established during the certification of the Operational Suitability Data (OSD). COMMENT: Not clear. Indicates, regardless of design, that there are flight control modes that will require TASE, FCD, etc. Not sure that is what is intended. As written presumes design which should not be the intent.	Clarify	Yes		Partially accepted	"*In case of*" indicates that depending on the design choice there may be additional needs. We did not write that there are flight control modes but that in case there are, then… Item (3) has been improved as follows: (3) In case of several flight control modes, limitations should be clearly annunciated and the definition of a Training Area of Special Emphasis (TASE) in the Flight Crew Data (FCD) may **need to** be established during the certification of the Operational Suitability Data (OSD). This is to highlight that this will be evaluated during the OSD review.
19-03	THALES Avionics	MOC VTOL.2300(a)(1)	35	"The flight control system should be designed to continue to operate and not hinder aircraft recovery from any attitude. […] (4) The following conditions that might occur due to pilot action, system failures or external events should be considered: (i) Abnormal attitude (including the aircraft becoming inverted); […] (iii) Critical flight displays should continue to provide accurate attitude, airspeed and heading information and any other information that the pilot may require to execute recovery from the unusual attitude and/or arrest the higher than normal pitch, roll or yaw rates. If the aircraft goes beyond limit flight envelop how can the aircraft be able to recover? This seem to imply that there is not limit flight envelop.	Introduce the concept of limit flight envelop to limit the scope of the requirements.	Suggestion	Objection	Not accepted	This part is independent of the aircraft flight envelope. As written, the aircraft may be upset (e.g. become inverted) due to external conditions. In such a case, the flight control system should continue to operate and not prevent the pilot from recovering. The objective is not to demonstrate that the aircraft can be flown for instance inverted. Just that the system does not prevent the recovery from that abnormal attitude.
19-04	*Vertical Aerospace*	MOC VTOL.2300(a)(1)	34	Typo "Compliance should be shown in conjunction with VTOL.2445, as engine failures could led to flight control mode degradation."	Change 'led' to 'lead'	Yes	No	Accepted	See reply to comment 19-01.

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19-05	*Leonardo Helicopters*	MOC VTOL.2300(a)(1) b.2	34	Be more accurate in describing 'satisfactory change the flight path'. In a piloted aircraft the pilot modifies attitude and/or rates while in a operated aircraft should modifies only rates.	Please clarify	YES	NO	Not accepted	The text appears clear to us.
19-06	*Leonardo Helicopters*	MOC VTOL.2300(a)(1) c.1	35	'not hinder aircraft recovery from any attitude' seems too restrictive. Recovery from any attitude requires eccessive controls forces, and reaction time.	Change from any attitude into 'from any attitude in a safe operational scenario'. E.g 'recovery from any attitude within the LFE'	YES	YES	Not accepted	Same answer as for comment 19-03.
19-07	*Leonardo Helicopters*	MOC VTOL.2300(a)(1) c.3	35	Recover from any attitudes seems too restrictive	Change from any attitude into from any attitude in a bunch of safe operational scenario. E.g 'recovery from any attitude within the LFE'	YES	YES	Not accepted	Same as 19-03 and 19-06.
19-08	*Volocopter*	2300(a)(1) Section (a)(3)	34	Considering also system limitations of LTU or other actuators, reference to 2300(a)(3) should be given in addition to VTOL.2445.	Add reference to 2300(a)(3)	yes	no	Partially accepted	The purpose of the sentence is to highlight non obvious relations with other objectives in the SC VTOL not with other parts of the same objective. The text is modified as follows: *"Compliance should be shown in conjunction with other paragraphs (such as VTOL.2445), where failures could lead to flight control mode degradation"*
19-09	*Volocopter*	2300(a)(1) Section (b)(2)(viii)	34	The paragraph states, that FEP limitations should be compatible with "any other operation limitations for the aircraft and lift/thrust system installation.". For completeness, it should explicitly mention "tilt rotor angular deflection limits and tilt rotor angular rate limits" as well as "control surface deflection limitations".	Add: **"tilt rotor angular deflection limits**" and "**tilt rotor angular rate limits**" and "**control surface deflection limitations**".	yes	no	Noted	We concur, however the MoC will never cover all possible design solutions and a tilt rotor is design specific. We believe these three points are already covered by item (b)(2)(viii) "any other operation limitations for the aircraft and lift/thrust system installation"
19-10	*Volocopter*	2300(a)(1) Section (c)	35	All the described scenarios of (c))(1)/(2)/(3)/(4) should consider the modes (and degraded modes) in the flight control and critical displays at all attitudes as they are also addressed by section (a) of MOC VTOL.2300(a)(1)	EASA is asked to change the text to consider the flight control modes in section (c) as was done for section (a).	yes	no	Partially accepted	The Section (c) has been slightly reworded to clarify the intent. New text: *"(c) Flight control and critical displays* *The following apply at all attitudes and in all modes of operation:"*
19-11	*Volocopter*	2300 (a)(1) Section: (c)(5)(iii)	35	"Critical flight displays should continue to provide accurate attitude, airspeed and heading information..." MoC for the minimum required VTOL instrumentation is not published yet and this point indirectly prescribes to have a certain flight information as "critical". It is not intention of VTOL.2300 to define critical displays, so the proposal is to to reword this bullet point.	Proposal: "Critical flight displays should continue to provide accurate information..."	yes	yes	Accepted	New text: "Critical flight displays should continue to provide accurate **indications** and any other information that the pilot may require to execute recovery from the unusual attitude and/or arrest the higher than normal pitch, roll or yaw rates."

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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19-12	UK CAA	MOC VTOL.2300 (a)(1) Function and operation of Fly-by-Wire flight control system Para (a)(1)	33	Para (a)(1) states that "…a means should be provided to indicate to the crew any mode that significantly changes or degrades the handling or operational characteristics of the aircraft." This could be interpreted as being an entry in the AFM. If the intention is that the flight crew should be provided with a flight deck alert, it may be helpful to be more specific about the required means to indicate significant changes or degradations of handling or operational characteristics.	Further clarification would be helpful if this paragraph was intended to refer to a flight deck indication.	Yes	No	Not accepted	Comment is not understood as an AFM entry cannot provide an indication to the crew. Only the aircraft/system can. In addition, an alert is one option.
19-13	UK CAA	MOC VTOL.2300 – All Sections	34 to 42	Is there any link between the failure alerting mechanisms referenced in this section and CS-23/27 1322?	Question only, no proposed resolution.	Yes	No	Noted	Crew alerts (e.g. warning, caution, advisory) are indeed an important element. Please see VTOL.2605 Installation and operation information.
19-14	UK CAA	MOC VTOL.2300 (a)(1) Para (b)(4)	34	This states that "The FEP system and any failure condition not shown to be extremely improbable should be analysed per MOC VTOL.2135 MHQRM (including the effect on flight envelope probabilities) and VTOL 2510." Some items within MOC VTOL.2135 are still TBD.	Provide definitions of all items within MOC VTOL.2135 that are relevant to this version of MOC VTOL.2300.	Yes	Yes	Noted	Suggested resolution is too general, it is not clear what definitions ("all items") are being referred to. Nevertheless, EASA deems to have provided already the definitions within MOC VTOL.2135 relevant to MOC VTOL.2300, and in particular definition of probabilities that are available at the moment. When definitions of probabilities that are now "TBD" will be available, the MoC will be updated accordingly.
19-15	UK CAA	MOC VTOL.2300 (a)(1) Para (c)(4)	35	A relevant version of 25.1302 might provide some helpful additional considerations.	It might be helpful to consider adding a relevant version of 25.1302 in a future update.	Yes	Yes	Noted	Additional MOCs to address Human Factors aspects are under consideration.
19-16	*Leonardo Helicopters (via ASD)*	MOC VTOL.2300(a)(1) c.1	35	'not hinder aircraft recovery from any attitude' seems too restrictive. Recovery from any attitude requires eccessive controls forces, and reaction time.	Change from any attitude into 'from any attitude in a safe operational scenario'. E.g 'recovery from any attitude within the LFE'	YES	YES	Not accepted	See comment 19-06

20. MOC VTOL.2300(A)(2) PROTECTION AGAINST LIKELY HAZARDS FOR FLY-BY-WIRE FLIGHT CONTROL SYSTEMS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
20-01	*Pipistrel*	MOC VTOL.2300(a)(2)(4)(ii)	36	MOC VTOL.2300(a)(2)(4)(ii) should be clearer about what is expected to automatically recover. The recovery being discussed is at the aerodynamic loop level, not at the component level. For example, if a spoiler panel has a malfunction causing erroneous movement, the flight control system should detect and disable that spoiler panel prior to an unsafe level of motion occurring. It is ok for the panel to be disabled for the remainder of the flight until a maintenance action is performed – so automatic recovery of the spoiler panel is not expected. However, the flight control system must continue to support safe flight and landing following the spoiler panel being disabled.	Update to: Any system in the aerodynamic loop which has a malfunction should not produce an unsafe level of uncommanded motion and the aerodynamic loop should automatically recover its ability to perform critical functions upon removal of the effects of that malfunction.	No	Yes	Partially accepted	It is the system which has the malfunction which should automatically recover. New text: "Malfunctions of systems in the aerodynamic loop should not ~~be~~ adversely affect~~ed~~ the ability to perform a continued safe flight and landing."
20-02	*Pipistrel*	MOC VTOL.2300(a)(2)(5)	37	MOC VTOL.2300(a)(2)(5) is ambiguous and does not provide clear guidance. What type of additional laboratory testing is expected? Can EASA provide a better definition of what is expected?	EASA to define what is expected in MOC VTOL.2300(a)(2)(5). Suggest removing the statement regarding extra testing. If this is not appropriate, bound the expectation for additional testing.	No	Yes	Not accepted	Complex FCS will require testing in addition to the individual components (i.e. rig or Iron bird testing). System level testing is necessary to ensure the correct and safe functioning of the FCS, and to adequately explore failure consequences, degraded mode effects, and to evaluate failure condition severities. Too specific guidance would move the rule away from being performance based.
20-03	*Pipistrel*	MOC VTOL.2300(a)(2)(8)(ii)	38	It is unclear what is meant by "over the spectrum of operating frequencies" in MOC VTOL.2300(a)(2)(8)(ii). What spectrum of operating frequencies is being discussed? A spectrum of operating frequencies is not applicable to all components of a fly-by-wire system (e.g. an aerodynamic surface does not move at a specific frequency). The text "over the spectrum of operating frequencies" seems unnecessary and should be removed.	Update MOC VTOL.2300(a)(2)(8)(ii) to remove "over the spectrum of operating frequencies"	No	Yes	Accepted	(8)(ii) is amended as follows: "(ii) Laboratory or aircraft testing to demonstrate unwanted coupling of electronic command signals (over the spectrum of operating frequencies) and their effects on the mechanical actuators and interfacing structure."
20-04	Collins Aerospace	MOC VTOL.2300(a)(2)(d)(3)(iii)(A)	39	"This assumption should be supported by FMEA/SSA expected failure rates for jams." System Safety Analysis is a process, FMEA is just a particular analysis in the process, and therefore should not be mentioned in the same manner.	Remove "FMEA/" from the text.	No	Yes	Not accepted	Both FMEA and SSA are documented processes which provide failure rates, including failure rates for jams. In this context SSA and FMEA can be used for compliance demonstration
20-05	Collins Aerospace	MOC VTOL/2300(a)(2)	39	"then its failure probability should be less than 1 x 10-3". It's not clear if this is conditional probability given that jam has occurred, or if it's per hour.	Replace with "then the conditional probability of failure of the jam alleviation device, given that jam has occurred, should be less than 1 x 10-3"	Yes	No	Accepted	This probability is not per flight hour, but is a pure probability. Text changed as suggested for additional clarification.
20-06	*Rolls Royce (Jonathan Holt)*	MoC VTOL.2300 (a)(2)	P35	Item a (P35) states 'they can be categorised into two categories:' then goescon to apparently list nine.	Something needs adjusting editorially here.	Yes		Accepted	(a) Control Signal Integrity final sentence is amended as follows: "They can be categorised into ~~two~~ the following categories:

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20-07	*Rolls Royce (Jonathan Holt)*	MoC VTOL.2300 (a)(2)	P37	Item (6) (ii) Typo: EEnhanced.	Correct	Yes		Accepted	(6)(ii) is amended as follows: "EEnhanced" to "Enhanced"
20-08	*Rolls Royce (Adam Newman)*	MOC VTOL.2300(a)(2) subpart (2)	35	Considered here, but may reference better elsewhere in the MoC Reference to the potential effects of space weather, SIB2012-09 (for example Single Event Effects SIB2010-10) are not considered here	Consider if other external causes should be considered here – particularly considering future aircraft may include on-board high voltage, high power and switching frequency power electronics for which these phenomena are perhaps not yet well understood	No	Yes	Accepted	Item (2) (iv) added as follows: (iv) Single Event Effects (SEE)
20-09	FAA RSB AdFC	MOC VTOL.2300 (a)(2)	36	Section (a) Contorl Signal Integrity (1)(4)(iii) – what is considered in the term "aerodynamic loop"?	Define the term "aerodynamic loop".		Objection	Noted	Defined as the behaviour of an aerodynamic vehicle when subjected to control surface or effector input and controlled as a response to the effect of those input/s on the aerodynamic vehicle.
20-10	FAA RSB AdFC	MOC VTOL.2300 (a)(2)	36	Section (5) – what is expected in this requirement "The complexity and criticality of the FBW flight control system (if utilised) necessitates the additional laboratory testing beyond that required as part of individual equipment validation and software verifitcation?	Clarify this requirement.		Objection	Noted	See comment 20-02
20-11	FAA Systems	MOC VTOL.2300(a)(2) Protection against likely Hazards for Fly-by-Wire flight control systems	38	The MOC for jams is quite rigorous. It establishes a high level of safety, but may be excessive for small aircraft with a single pilot and a single inceptor. Existing Part 23 airplanes cannot meet this requirement, but accidents due to jammed flight controls are very rare. A design that cannot fully meet these criteria could be very safe.	No changes suggested. As the MOC is applied to VTOL projects, it may be found that some cases will be identified where it would be appropriate to modify this requirement.	Observation		Noted	Noted.
20-12	*Airbus Helicopters (FXG)*	MOC 2300 (a)(2) (b)	38	'*A means should be provided to allow a check of full range of movement to their commanded position of all primary lift/thrust controls (ie pilot controls, control surfaces) prior to the flight, or a means should be provided that allow the pilot to determine that full control authority is available prior to flight*' It is understood the last part of the sentence addresses also lift/thrust units where the thrust control is achieved by means of variable rotational speed (and for which full control authority prior to flight should be demonstrated as well)	To be clarified that the requirement is also applicable for thrust controls based on variable rotational speed.	x		Noted	The check of this type of control is covered by the following sentence "Some checks of the engine power and power control (e.g. engine RPM at least at idle thrust) should also be provided."
20-13	*Airbus Helicopters (FXG)*	MOC 2300 (a)(2) (d)	38	Definition of jam : a jam is a failure or event such that a control (eg a control surface), pilot control, or component is fixed in one position	It is proposed to amend by distinguishing: - A limitation or a restriction in flight control, versus - Jamming, versus - (un-commanded) Run-away and to set different levels of counter measures.	x		Not accepted	Runaway is addressed in (a)(3) This definition of jam is consistent with the definition in AMC 25.671

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20-14	*Airbus Helicopters (SB)*	2300(a)(2) (d)(3)(ii)	39	"*then its failure probability should be less than 1 x 10-3*" may be ambiguous considering that such failures are dormant.	Add per flight hour if it was the original intention, or say considering dormancy.	x		Noted	See comment 20-05 This probability is not per flight hour, but is a pure probability.
20-15	THALES Avionics	MOC VTOL.2300(a)(2)	36	MOC VTOL.2300(a)(4)(ii) "Any system in the aerodynamic loop which has a malfunction should not produce an unsafe level of uncommanded motion and should automatically recover its ability to perform critical functions upon removal of the effects of that malfunction. MOC VTOL.2215 " In the case of no corrective action being automatically performed, pilot corrective action, may be assumed to be initiated at the time maximum pitching, rolling or yawing velocity is reached, but not earlier than 2 seconds after the lift/thrust unit failure. " MOC VTOL.2515 " Fail/Pass Criteria; when submitted to the Lightning Environment, it could be acceptable that equipment is/are subject to adverse effect, provided that the Level A function is maintained at the aircraft level and all the Equipment/Systems that are required in normal operation, recover manually or automatically, in a timely manner, this function after the threat. " Does MOC VTOL.2300 have precedence over the other MOC?	Clarify the scope of each requirement.	Suggestion	Objection	Noted	No, MOC VTOL 2300 does not have precedence over any other MOC. The three MOCs quoted address different requirements in the SC VTOL and have different emphases. The first concerns the FbW, which should ideally recover automatically, however, if the automatic recovery doesn't work, the Flight Loads (the second MOC quoted) have to account for this. In addition, in 2300a2, the automatic recovery pertains to recovery of the system after malfunction. Not recovery of the vehicle itself.
20-16	THALES Avionics	MOC VTOL.2300(a)(2)	37	"landing in the Category EEnhanced " Typo.	Correct typo	Suggestion	Substantive	Accepted	See Comment 20-07 (6)(ii) is amended as follows: "EEnhanced" to "Enhanced"

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20-17	THALES Avionics	MOC VTOL.2300(a)(2)	38	"Analysis or inspection to substantiate that physical or mechanical separation and segregation of equipment or components are utilised to minimize any potential hazards" What does mechanical separation means?	Proposed wording : "Analysis or inspection to substantiate that separation/ segregation are utilised to minimize any potential hazards." Definition of separation/ segregation from APR4761: SEGREGATION: The maintenance of independence by means of a physical barrier between two hardware components. SEPARATION: The maintenance of independence by means of physical distance between two hardware components.	Suggestion	Substantive	Accepted	(a)(8)(iii) is amended as follows: "Analysis or inspection to substantiate that separation/ segregation are utilised to minimize any potential hazards."
20-18	*Vertical Aerospace*	MOC VTOL.2300(a)(6)(ii)	37	Typo: "EEnhanced"		Yes	No	Accepted	See Comment 20-07 (6)(ii) is amended as follows: "EEnhanced" to "Enhanced"
20-19	*Leonardo Helicopters*	MOC VTOL.2300(a)(2) a.2	36	Cybersecurity should be also taken into account	Add to the external causes the standard linked to cybersecurity.	YES	NO	Noted	Other external causes are included by the phrase "These include, but are not limited to:"
20-20	*GAMA*	MOC VTOL.2300(a)(2)(4)(ii)	36	MOC VTOL.2300(a)(2)(4)(ii) should be clearer about what is expected to automatically recover. The recovery being discussed is at the aerodynamic loop level, not at the component level. For example if a spoiler panel has a malfunction causing erroneous movement, the flight control system should detect and disable that spoiler panel prior to an unsafe level of motion occurring. It is ok for the panel to be disabled for the remainder of the flight until a maintenance action is performed – so automatic recovery of the spoiler panel is not expected. However the flight control system must continue to support safe flight and landing following the spoiler panel being disabled.	Update to: Any system in the aerodynamic loop which has a malfunction should not produce an unsafe level of uncommanded motion and *the aerodynamic loop* should automatically recover its ability to perform critical functions upon removal of the effects of that malfunction.	No	Yes	Partially accepted	See comment 20-01. New text: "Malfunctions of systems in the aerodynamic loop should not ~~be~~ adversely affect~~ed~~ the ability to perform a continued safe flight and landing."
20-21	*GAMA*	MOC VTOL.2300(a)(2)(5)	37	MOC VTOL.2300(a)(2)(5) is ambiguous and does not provide clear guidance. What type of additional laboratory testing is expected? Can EASA provide a better definition of what is expected?	EASA to define what is expected in MOC VTOL.2300(a)(2)(5). Suggest removing the statement regarding extra testing. If this is not appropriate, bound the expectation for additional testing.	No	Yes	Not accepted	See comment 20-02
20-22	*GAMA*	MOC VTOL.2300(a)(2)(8)(ii)	38	It is unclear what is meant by "over the spectrum of operating frequencies" in MOC VTOL.2300(a)(2)(8)(ii). What spectrum of operating frequencies is being discussed? A spectrum of operating frequencies is not applicable to all components of a fly-by-wire system (e.g. an aerodynamic surface does not move at a specific frequency). The text "over the spectrum of operating frequencies" seems unnecessary and should be removed.	Update MOC VTOL.2300(a)(2)(8)(ii) to remove "over the spectrum of operating frequencies"	No	Yes	Accepted	See comment 20-03

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20-23	Lilium GmbH	MOC VTOL.2300(a)(2)	36	In item (a) (4) (i), the phrase “regardless of any malfunction from sources in the integrated” seems more restrictive than the criteria used in MOC VTOL.2510.	It is suggested to complement the phrase referencing a safety analysis and application of the same criteria used for MOC VTOL.2510 or use a similar wording to the one used in item (a) (4) (vi).	yes	no	Accepted	(4)(i) is changed as follows: “(i) The flight control system should continue to perform its intended function (even in a degraded mode), regardless of any malfunction from sources in the integrated systems environment of the aircraft.”
20-24	Lilium GmbH	MOC VTOL.2300(a)(2)	36	In item (a) (4) (ii), the requisition to “automatically recover […] upon removal of the effects of that malfunction” may not result in a robust design, especially in the presence of intermittent failures.	It is suggested to complement the phrases with a similar wording to the one used in VTOL.2425: “*If the safety benefits outweigh the hazard per [Ref to Phase 2 GM on determining safety benefits vs hazards]*, it should automatically recover its ability […]”	yes	no	Not accepted	It is a general understanding that complying with any regulation or following any guidance should not make the aircraft less safe.
20-25	Lilium GmbH	MOC VTOL.2300(a)(2)	36	The overall intention of item (a) (4) (iii) is unclear. Its wording seems to be more restrictive than the goals of VTOL.2510, where some adverse effect can be expected depending on the probability of the malfunction. If that is not the case, a clearer guidance on the classification should be provided.	Please clarify or remove, as it seems to be covered in intention by item (a) (4) (vi).	yes	yes	Accepted	See comment 20-01. New text: “Malfunctions of systems in the aerodynamic loop should not ~~be~~ adversely affect~~ed~~ the ability to perform a continued safe flight and landing.”
20-26	Lilium GmbH	MOC VTOL.2300(a)(2)	37	“*necessitates the additional laboratory testing*”. Not clear what “additional” means here. Is there any specific extra test expected? “beyond that required as part of individual…”, what else? In general, the overall intention of item 5 for MOC VTOL.2300(a)(2) is not clear.	Re-word to specify what laboratory testing is expected.	yes	no	Not accepted	See comment 20-02 Complex FCS will require testing in addition to the individual components (i.e. rig or Iron bird testing)
20-27	Lilium GmbH	MOC VTOL.2300(a)(2)	37	In item (a) (6), it is not clear what the meaning of “FbW FCS signals cannot be altered unintentionally”. The subitems (i) to (iv) do not support clarification of the meaning.	Please clarify.	yes	no	Accepted	(6) is amended as follows: “It should be shown that either the FbW flight control system signals cannot be altered unintentionally (i.e. what is received by the effector/actuator is what was transmitted by the computer), or that altered signal characteristics meet the following criteria:”
20-28	Lilium GmbH	MOC VTOL.2300(a)(2)	37	Typo in item (a) (6) (ii) – “EEnhanced”	Fix typo.	yes	no	Accepted	See comment 20-07 (6)(ii) is amended as follows: “EEnhanced” to “Enhanced”
20-29	*Volocopter*	2300(a)(2) Section (a)(1)	35	Volocopter considers listing of “Numeric overflow” as being beneficial.	Add: “**Numeric overflow**” to the list.	yes	no	Not accepted	Covered by “(i) loss of data bits, frozen or erroneous values”
20-30	*Volocopter*	2300(a)(2) Section (a)(4)(vii)	37	EASA should consider coupling between flight control dynamics and actuator control dynamics.	Add: “**Interaction of flight control functions** and **actuator control loops**”	yes	no	Accepted	The following point is added: “(a)(4)(vii) Interaction of flight control functions and actuator control loops”
20-31	*Volocopter*	2300(a)(2) Section (a)(8)(i)	37/38	Definition of minmimum requirements of laboratory test environment should be provided.	EASA is asked to provide mimumum requirements of simulation environment (e.g., flight mechanical model quality).	yes	no	Noted	A dedicated MOC on Simulation and Rig Test is under development.

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20-32	*Volocopter*	2300(a)(2) Section (d)(3)(iii)(A)	39	Scope of determination of "normally encountered position" is unclear.	EASA is asked to clarify, if this only concerns control surface deflections or also pilot control deflections.	yes	yes	Not accepted	Defined in "(1) Definition of Jam: A Jam is a failure or event such that a control (e.g. control surface), **pilot control**, or component is fixed in one position."
20-33	UK CAA	MOC VTOL.2300 (a)(2) Para (d)(2) Determination of Control System Jam Positions	39	It is possible that an aircraft may be required to transition between horizontal and vertical flight during the flight phase. Is this included in the list of items to be addressed? If so, it may be helpful to specifically state this to avoid possible confusion.	If transitions between horizontal and vertical flight during the flight phase are covered by MOC VTOL.2300(a)(2)(d), it may be helpful to specifically state this.	Yes	Yes	Not accepted	Already addressed with "The aircraft, pilot controls **and its movable control system and/or surfaces** should be designed to prevent a jam from occurring"
20-34	*Boeing*	VTOL.2300 (a)(2) (a)(1)(xi)	35	THE PROPOSED TEXT STATES: "(xi) structural interactions (such as control actuator compliance or coupling of structural modes with control modes), that may adversely affect the system operation." REQUESTED CHANGE: "(xi) structural interactions (such as control actuator compliance or coupling of structural modes with control modes), that may adversely affect the system operation or structural stability and integrity."	JUSTIFICATION: No such requirement for SMI (Structural Modal Interaction) and aeroelastic stability checks (including ASE (Aeroservoelastic) checks) appears in the draft MoC, and thus, system design requirements should be tied to IS&S and structural dynamic stability from nominal system operation and including failures.		yes	Accepted	The proposed change is accepted: "(xi) structural interactions (such as control actuator compliance or coupling of structural modes with control modes), that may adversely affect the system operation or structural stability and integrity."

21. MOC VTOL.2300(A)(3) CONTROL MARGIN AWARENESS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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21-01	*Volocopter*	MOC VTOL.2300(a)(3) Section (b)	40	Volocopter supports the approach for providing feedback to the pilot concerning the remaining control of the aircraft, also taking into account the various different types of possible flight control laws. However, it might be worth reconsidering to clarify that: All different VTOL configurations have in common that in order to be controllable there is a need of a certain level of control torque that acts upon the aircraft. For conventional fixed-wing aircraft, this torque is provided by control surfaces. For VTOL-aircraft this torque can be provided by lift-thrust units, control surfaces or a combination of both. Therefore, it is considered helpful to specify this control margin in terms of "available/remaining torque provision capability" to provide controllability and agility of the aircraft.	Reconsider detailing of "remaining control available".	yes	no	Accepted	New text in (a)(3)(b): "(b) There should be a direct feedback of the control margin to the flight crew at any time in flight, in nominal and in a failure condition. This control margin is the remaining control available, related to the type of control laws (e.g. attitude command) and the means of control (e.g. torque provided by lift/thrust units). For systems that provide combined thrust and vector control, information should be provided to the crew about which amount of remaining control is available to allow them to take the required actions to fly the aircraft."
21-02	*Collins Aerospace*	MOC VTOL/2300(a)(3)	40	"approaching to their limits ". "to" is not needed	Replace with "approaching their limits"	Yes	No	Accepted	(a)(3)(a) is amended as follows: "approaching their limits ".

22. MOC 4 VTOL.2300 COMMON MODE FAILURES AND ERRORS IN FLY-BY WIRE FLIGHT CONTROL FUNCTIONS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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22-01	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC4 VTOL.2300 (a)	Pg41	The first part of this paragraph "Apply ED-79A/ARP4754A, ED-80 / DO-254, AMC 20-115…." is badly written as there is a mix of references, noting that AMC 20-152 covers acceptance of ED-80/DO-254 and AMC 20-115 covers acceptance of DO-178C suite but also omits a crucial reference. The emphasis should be on proper application of ED-79A/ARP4754A and, crucially, ARP4761. AMC 20-115 and AMC 20-152 could well be cited as further guidance which would then point the Applicant to not only the hardware, but software standards that could be applied after having used the ARPs. I note that MOC VTOL.2510 8.Safety assessment process covers this approach and perhaps this should be cross referenced.	Suggest the following text: "Apply ED-79A/ARP4754A and ARP4761 and associated guidance that can be found in AMC 20-115 and AMC 20-152 to limit the likelihood of development errors that could impact aircraft safety." Suggest cross refer to MOC VTOL.2510 8.Safety assessment process.	No	Yes	Partially accepted	There is already a cross-reference to the MOC VTOL.2510. Paragraph a) is reworded as a result of other comments.
22-02	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC4 VTOL.2300 (a)	Pg41	The second part of this paragraph pre-supposes the answer to the first part. It should not be assumed that there is a need for a back-up system. Proper use of ED-79A/ARP4754A & ARP4761 will give justification for the design and architecture. It is for the Applicant to make the appropriate safety claims on their system architecture, not for the MOC to declare what the architecture should be. Note: Over a number of decades, it has been widely accepted that designing a back-up system removes effort from designing the main system. In flight control systems, it is widely accepted that triplex (or quadruplex) systems gives the necessary integrity which removes the need for a back-up system.	Delete the second part of this paragraph ie " Back-up system: Typically a back-up system is included. The back-up FCS should have a high level of integrity, an appropriate reliability and availability, and be fully independent of the main System. Complexity in the back-up FCS and unintentional engagement should be avoided." The following text should be sufficient: "Apply ED-79A/ARP4754A and ARP4761 and associated guidance that can be found in AMC 20-115 and AMC 20-152 to limit the likelihood of development errors that could impact aircraft safety." Suggest cross refer to MOC VTOL.2510 8.Safety assessment process.	No	Yes	Partially accepted	There is already a cross-reference to the MOC VTOL.2510. Paragraph a) is reworded as a result of other comments.
22-03	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC4 VTOL.2300 (a)	Pg41	A back up system will necessarily result in different handling characteristics to a main system; this is acknowledged in the second part of this paragraph "Complexity in the back-up FCS and unintentional engagement should be avoided ". If a main system fails, there will be stress on the crew. By providing a back-up system with necessarily different handling characteristics will increase the crew workload in an already stressed situation. Furthermore, assurance of unintentional engagement implies that it has to be at least the integrity of the main system. The main system and back-up system therefore have to be of the same integrity and this does not make sense. Proper use of ED-79A/ARP4754A and ARP4761 by the Applicant should provide an appropriate, safe architecture.	Delete the second part of this paragraph ie " Back-up system: Typically a back-up system is included. The back-up FCS should have a high level of integrity, an appropriate reliability and availability, and be fully independent of the main System. Complexity in the back-up FCS and unintentional engagement should be avoided." The following text should be sufficient: "Apply ED-79A/ARP4754A and ARP4761 and associated guidance that can be found in AMC 20-115 and AMC 20-152 to limit the likelihood of development errors that could impact aircraft safety." Suggest cross refer to MOC VTOL.2510 8.Safety assessment process.	No	Yes	Partially accepted	There is already a cross-reference to the MOC VTOL.2510. Paragraph a) is reworded as a result of other comments.

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22-04	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC4 VTOL.2300 (b)	Pg41	This sub-paragraph presupposes the results of the analysis undertaken by application of ED-79A, etc and should be removed. "It is recognized that dissimilarity in the High-level specifications of Flight Control Laws may not be easy to implement. Monitoring of the Flight Control Laws may be a possible mitigation means against common mode errors in such case." If this remains, then the issue will be that having 2 different control laws for FCS will mean that the handling characteristics of the aircraft will be different. Presentation of different handling in an emergency situation when main FCS has failed to a pilot increases crew workload and this is generally unacceptable.	Delete Sub-para (b)	No	Yes	Partially accepted	What the commenter proposes is not clear. We cannot simply delete and would need an alternative proposal. Paragraph b) has been reworded as a result of other comments.
22-05	*Dewi Daniels, Callen-Lenz*	MOC 4 VTOL.2300 & MOC VTOL.2510 (8) (b)	41 & 57–58	ED-79A/ARP4754A never uses the term "common mode failure". It always uses the term "common mode error".	Change "common mode failures and errors" to "common mode errors". Change "common mode failure" to "common mode error". Change "common mode failure/error" to "common mode error".	yes	no	Not accepted	This is normal, the ED-79A / ARP 4754A focus on the development aspects, e.g. development assurance. The ED-135 / ARP 4761 do use the terms common mode failures and errors. Please see in particular the ED-135 / ARP 4761 Appendix K.
22-06	*Dewi Daniels, Callen-Lenz*	MOC 4 VTOL.2300 (a)	41	What does "Apply ED-79A/ARP4754A, ED-80/DO-254, AMC 20-115 and associated guidance to limit the likelihood of development errors that could impact aircraft safety" mean?	Change to "Develop the flight control system to an appropriate Development Assurance Level (DAL), hardware design assurance level and software level in accordance with ED-79A/ARP4754A, ED-80/DO-254 and ED-12C/DO-178C, respectively".	yes	no	Noted	The comment is understood; however, we do not see what improvement this provides. The paragraph a) is anyway reworded as a result of other comments.
22-07	*Dewi Daniels, Callen-Lenz*	MOC 4 VTOL.2300 (a)	41	It is inconsistent to refer to ED-80/DO-254 (but not AMC 20-152) and AMC 20-115 (but not ED-12C/DO-178C).	Change "ED-79A/ARP4754A, ED-80/DO-254, AMC 20-115 and associated guidance" to "ED-79A/ARP4754A, ED-80/DO-254, ED-12C/DO-178C and associated guidance, including AMC 20-152 and AMC 20-115".	yes	no	Accepted	AMC 20-152 should be used instead of ED-80/DO-254. Nevertheless, paragraph a) is anyway reworded due to other comments.
22-08	*Dewi Daniels, Callen-Lenz*	MOC 4 VTOL.2300 (a)	41	What does "Typically a back-up system is included" mean?". What does "The back-up system should have a high level of integrity mean"?	Change to "If a back-up system is included, and it can be shown that the back-up system is fully independent of the main system, the back-up system could be developed to a lower development assurance level, as described in ED-79A/ARP4754A section 5.2.1".	no	yes	Partially accepted	Paragraph a) has been reworded.
22-09	*Dewi Daniels, Callen-Lenz*	MOC 4 VTOL.2300 (a)	41	The use of a back-up system also introduces the possibility that the back-up system behaves differently to the main system, leading to pilot confusion, especially if the transition to the back-up system was unexpected. According to the BEA accident report, two of the causes of the loss of AF447 were "Poor management of the startle effect that generated a highly charged emotional factor for the two copilots" and "The difficulty in recognizing and understanding the implications of a reconfiguration in alternate law with no angle of attack protection".	Add "If a back-up system is included, safe transition between the main system and the back-up system under all failure conditions should be validated in accordance with MOC 3 VTOL.2300".	no	yes	Not accepted	The transition is already covered elsewhere. The paragraph is anyway reworded as a result of other comments.

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22-10	*Dewi Daniels, Callen-Lenz*	MOC 4 VTOL.2300 (b)	41	If the High-level specifications of the Control Laws contain common mode errors, how does monitoring of the Flight Control Laws provide a possible mitigation? Monitoring may be able to detect the error, but the Flight Control Laws will still contain the common mode errors.	Explain how monitoring of the Flight Control Laws may be a possible mitigation against common mode errors in the High-level specifications of Flight Control Laws.	no	yes	Partially accepted	Paragraph b) has been reworded to add clarification.
22-11	*Pipistrel*	MOC 4 VTOL.2300(a)	41	Page 1 this document indicated it would not prescribe specific implementations – however MOC 4 VTOL.2300(a) is directly violating that statement and prescribing the use of a backup system. Text from Page 1: "This approach, previously utilised for the development of CS-23 Amendment 5, is also used for VTOL designs in order not to limit technical innovation by describing prescriptive design solutions as certification standards." If a backup system is going to be prescribed by MOC 4 VTOL.2300(a) in violation of the approach from page 1, then MOC 4 VTOL.2300(a) should clarify the expectations for the backup (e.g. How good/reliable does it need to be?).	Update MOC 4 VTOL.2300(a) to not prescribe specific design solutions.	No	Yes	Partially accepted	Paragraph has been reworded as a result of this comment and other comments. The paragraph is not prescriptive but covers the EASA expectations, as driven by the CMA requirements.
22-12	*Pipistrel*	MOC 4 VTOL.2300(b)	41	The term "dissimilarity" is used in MOC 4 VTOL.2300(b) however that term is not defined in MOC VTOL.2000. EASA should define what they mean when they use the term "dissimilarity" in MOC VTOL.2000 so applicants and system designers understand the expectations.	Updated MOC VTOL.2000 to include a definition of the term "dissimilarity"	No	Yes	Not accepted	The term is known in flight controls, it means the quality of being distinct, unique, or unlike. The term is used extensively in ARP 4761 and ARP 4754 to describe a form of redundancy where the multiple means are of different types.
22-13	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 4 VTOL.2300, sub-para (a)	41	What is meant by "high level of integrity" for the back-up FCS?	Add a definition or relate it simply to a level of reliability (see following comment)	Yes	No	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-14	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 4 VTOL.2300, sub-para (a)	41	What is meant by "appropriate reliability and availability" for the back-up FCS? Can we clarify this?	Define failure probability requirements in relation to the main system, say no more than 1 order of magnitude below the main system	Yes	No	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-15	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 4 VTOL.2300, sub-para (a)	41	What is meant by "…fully independent from the main system"?	Add a definition of "fully independent", particularly with respect to the definition used in CMA & DAL. If it really has the same meaning as that typical used in CMA checklist then I don't think this would not be practical?	No	Yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-16	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 4 VTOL.2300, sub-para (a)	41	What is meant by "…unintentional engagement should be avoided"?	Avoiding will not be possible to show but we could derive a safety requirement that is commensurate with the severity classification of the relevant FC	No	Yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.

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22-17	*Pipistrel*	MOC 4 VTOL.2300	41	This discussion of common mode failures/errors does not sufficiently clarify what specific common mode failures/errors EASA expects to be addressed and what the acceptable MOC are for those concerns. The scope of MOC 4 VTOL.2300 is also poorly defined - the flight control system interfaces with and receives data from the majority of the systems on the aircraft. Does that make any system that provides inputs to support a DAL A flight control function subject to this section? Broadly speaking, design errors must be mitigated by DAL as specified in the current certification standards. There is no way to add dissimilarity to fully address system level design errors, since errors at the system level can easily flow into dissimilar items. Hardware dissimilarity can be added to mitigate potential common mode design and manufacturing failures/errors that cause: - loss of a specific component/part - erroneous operation of a specific component/part At a software level, it would be possible to introduce some level of dissimilarity at the platform level of a computer (e.g. a system that uses different processors and uses a different RTOS on each processor would be dissimilar). In redundant systems, like flight control systems, the application software cannot be truly dissimilar because at a system level the application software performs the same function in each redundant module. It is also important to put reasonable bounds in place with regard to hardware dissimilarity expectations. Simple components where their failure modes are known and can be detected by standard factory testing (e.g. a thorough ATP) should not require dissimilarity. Otherwise this standard is calling into question basic physics in a manner that isn't being equally applied to mechanical flight control systems.	This section does not provide a clear MOC. Either remove this section or clarify that common mode issues should be addressed through the application of ARP 4761.	No	Yes	Partially accepted	The paragraph has been reworded as a result of this comment and other comments. We believe it is important to clarify the EASA expectations regarding flight controls.
22-18	*Pipistrel*	MOC 4 VTOL.2300(b)	41	MOC 4 VTOL.2300(b) indicates it may be difficult/impossible to have dissimilarity in the high-level design of the Flight Control Laws. If the Flight Control Laws are not dissimilar (e.g. there is just one control law), it is unclear how monitoring the Flight Control Laws provides any mitigation – since there is not a reversionary/backup dissimilar control law available. What would a monitor do in the event it detected some problem with the control law if there isn't a dissimilar backup control law available? MOC 4 VTOL.2300(b) doesn't make sense.	Remove or clarify MOC 4 VTOL.2300(b)	No	Yes	Partially accepted	It was meant that dissimilarity in a COM/MON architecture to address a development error leading to an erroneous behaviour is not possible. This point has been clarified in the text.

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22-19	Collins Aerospace	MOC 4 VTOL.2300	41	It would be very helpful to include more details in this portion of the MOC. For example, at what point are COTS processors considered dissimilar? Can they both be ARM? Can they be manufactured in the same foundry? In particular, it would be good to know what entries in ARP4761 Appendix K need dissimilarity for two components/designs to be considered dissimilar.	Clarify what is considered dissimilar in a system that cannot depend on design assurance alone. Add two or more example FBW systems that would be compliant to SC-VTOL.	No	Yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-20	FAA RSB AdFC	MOC 4 VTOL.2300(a)	41	Why provide this requirement when 23.2510 already covers this type of guidance?	Remove this requirement.	Suggestion		Partially accepted	The MOC has been reworded as a result of this comment and other comments. We believe it is important to clarify the EASA expectations regarding flight controls.
22-21	FAA RSB SW	MOC 4 VTOL.2300 Common Mode Failures and Errors in FBW flight Controls	41	Current Industry Standards and the FAA do not require back-up systems for FBW flight controls; and they are not typical. The typical considerations listed are too vague and subjective requirements and uncessary. We have long-standing industry standards that have been successfully applied that have yielded safe FBW flight control systems. The proposed prse standards and approaches should be appropriate for The proposed prescriptive criteria will stifle innovation. As written, the wording in this section is a commentary that levys, or alludes to specific design requirements that the applicants must follow to address Common Mode Failures and Errors. Applicants will not know if they have to provide a backup system or not. Is this back-up system in-lieu of a development assurance process? By following a robust development assurance process (ARP 4754A, DO-178, DO-254), the applicant should be able to mitigate common mode failures and errors.	Everything in this section is already handled and covered in the Industry Standards already called out in earlier section for systems, hardware, and software. Recommend removal of this section.		Objection	Partially accepted	The paragraph has been reworded as a result of this comment and other comments. We believe it is important to clarify the EASA expectations regarding flight controls.
22-22	*Airbus Helicopters* *(MM/SB)*	2300 MOC 4	41	Notion of backup system It's not clear if the backup is necessary or if the door is opened to other solutions. The notion of backup is often limited to simple functions, which is in line with the wording used in this paragraph "*complexity should be avoided*". This goes beyond the spirit of ARP4754A/ED79A and usual practices for FBW systems.	Quite often an alternate control law is used. This alternate control law is independent and possibly complex. Modify the text to consider such possibility	x		Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-23	*Airbus Helicopters* *(MM/SB)*	2300 MOC 4	41	"*The back-up FCS should have a high level of integrity*" According to ARP4754A/ED79A, a backup FDAL C can be sufficient providing a FDAL A for the primary FCS. FDAL C does not correspond to the highest integrity level	To modify the text by considering the following: What is important is to monitor the backup in order to avoid dormant errors (in addition to random failures). This can be done by something which is not part of the backup.			Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.

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22-24	THALES Avionics	MOC 4 VTOL.2300	41	"The back-up FCS should have a high level of integrity, an appropriate reliability and availability, and be fully independent of the main System. " What does « fully independent» means in this context? FCS as defined includes inceptor and sensors. So the interpretation of the word « fully independent » can be problematic due to the scope of the FCS.	Please clarify the term "fully independent" and limit the scope of the requirement.	Suggestion	Objection	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-25	THALES Avionics	MOC 4 VTOL.2300	41	Common Mode Failures and Errors in Fly-by Wire Flight Control Functions -CMA and No Single failure: for Basic category and specifically Basic 1, 2, would the requirements (dissimilar back-up FCS, total equivalence of design errors and failures etc) be applicable in the same way as for Enhanced. No tailoring seems to be made. Would it be, as an example, acceptable to raise the level of FDAL from C to B but without functional and implementation design independence thanks to this extra design assurance on the unique design ?	Please confirm that the requirements are identically applicable to all VTOL sub categories, or propose acceptable tailoring for Basic 1, 2 ? ,3??	Suggestion	Substantive	Partially accepted	This will be driven by the VTOL.2510 top level safety objectives.
22-26	*GAMA*	MOC 4 VTOL.2300(a)	41	Page 1 this document indicated it would not prescribe specific implementations – however MOC 4 VTOL.2300(a) is directly violating that statement and prescribing the use of a backup system. Text from Page 1: "This approach, previously utilised for the development of CS-23 Amendment 5, is also used for VTOL designs in order not to limit technical innovation by describing prescriptive design solutions as certification standards." If a backup system is going to be prescribed by MOC 4 VTOL.2300(a) in violation of the approach from page 1, then MOC 4 VTOL.2300(a) should clarify the expectations for the backup (e.g. How good/reliable does it need to be?). Note: reference GAMA letter (GAMA19-19)	Update MOC 4 VTOL.2300(a) to not prescribe specific design solutions.	No	Yes	Partially accepted	See reply to comment 22-11
22-27	*GAMA*	MOC 4 VTOL.2300(b)	41	The term "dissimilarity" is used in MOC 4 VTOL.2300(b) however that term is not defined in MOC VTOL.2000. EASA should define what they mean when they use the term "dissimilarity" in MOC VTOL.2000 so applicants and system designers understand the expectations.	Updated MOC VTOL.2000 to include a definition of the term "dissimilarity"	No	Yes	Not accepted	See reply to comment 22-12

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
22-28	*GAMA*	MOC 4 VTOL.2300	41	This discussion of common mode failres/errors does not sufficiently clarify what specific common mode failures/errors EASA expects to be addressed and what the acceptable MOC are for those concerns. The scope of MOC 4 VTOL.2300 is also poorly defined - the flight control system interfaces with and receives data from the majority of the systems on the aircraft. Does that make any system that provides inputs to support a DAL A flight control function subject to this section? Broadly speaking, design errors must be mitigated by DAL as specified in the current certification standards. There is no way to add dissimilarity to fully address system level design errors, since errors at the system level can easily flow into dissimilar items. Hardware dissimilarity can be added to mitigate potential common mode design and manufacturing failures/errors that cause: - loss of a specific component/part - erroneous operation of a specific component/part At a software level, it would be possible to introduce some level of dissimilarity at the platform level of a computer (e.g. a system that uses different processors and uses a different RTOS on each processor would be dissimilar). In redundant systems, like flight control systems, the application software cannot be truly dissimilar because at a system level the application software performs the same function in each redundant module. It's also important to put reasonable bounds in place with regard to hardware dissimilarity expectations. Simple components where their failure modes are known and can be detected by standard factory testing (e.g. a thorough ATP) should not require dissimilarity. Otherwise this standard is calling into question basic physics in a manner that isn't being equally applied to mechanical flight control systems.	This section does not provide a clear MOC. Either remove this section or clarify that common mode issues should be addressed through the application of ARP 4761.	No	Yes	Partially accepted	See reply to comment 22-17
22-29	*GAMA*	MOC 4 VTOL.2300(b)	41	MOC 4 VTOL.2300(b) indicates it may be difficult/impossible to have dissimilarity in the high level design of the Flight Control Laws. If the Flight Control Laws are not dissimilar (e.g. there is just one control law), it is unclear how monitoring the Flight Control Laws provides any mitigation – since there is not a reversionary/backup dissimilar control law available. What would a monitor do in the event it detected some problem with the control law if there isn't a dissimilar backup control law available? MOC 4 VTOL.2300(b) doesn't make sense. Note: reference GAMA letter (GAMA19-19)	Remove or clarify MOC 4 VTOL.2300(b)	No	Yes	Partially accepted	See reply to comment 22-18

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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22-30	*Garmin (via GAMA)*	MOC 4 VTOL.2300	41	Fly-by-wire systems are singled out in this section as being “particularly important” and requiring “specific attention [to] be paid to common mode failures and errors.” However, there is no justification as to why fly-by-wire systems should be considered differently from any other aircraft system which may contain Catastrophic failure conditions. Additionally, industry has previously commented on the EASA Certification Review Item (CRI) “Consideration of Common Mode Failures and Errors in Flight Control Functions” questioning why the previously accepted AMC 2x.1309 and Development Assurance documents such as ARP 4754A, DO-178B/C, and DO-254 are no longer sufficient for the development of certain aircraft systems. Additionally, dissimilarity is implied as a design requirements for fly-by-wire systems, but neither a clear definition of the term “dissimilarity” nor justification for prescribing the design of the flight control system is provided.	Garmin recommends that the previously accepted means of compliance and Development Assurance documents be applied equally to all aircraft systems, including fly-by-wire. If a higher level of safety or unique development assurance processes are required for any aircraft systems, EASA should adequately justify the need for these changes and work with industry and other regulatory authorities to develop suitable development assurance processes for these systems.	No	Yes	Not accepted	Flight controls are safety-critical both from a loss of function and integrity viewpoint, and therefore deserve a specific attention.
22-31	Lilium GmbH	MOC 4 VTOL.2300	41	MOC 4 VTOL.2300 (a) says “The back-up FCS should have a high level of integrity”. What does “high level of integrity” mean in this context?	Please, clarify what “high level” means. What would be considered a low-level of integrity or an acceptable level of integrity? Please, provide a definition.	noes	yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-32	Lilium GmbH	MOC 4 VTOL.2300	41	MOC 4 VTOL.2300 (a) says “…be fully independent of the main System”. What does “fully” mean here? As per definition 8 the FCS “is composed of the crew inceptors, if applicable, flight control computers and network provisions to distribute the rotational speed and actuator commands to the lift/thrust units and to aerodynamic control surfaces if any”. It is clear that “fully” does not mean the full end-to-end system. So, what is expected?	Please, provide a definition, or remove the word “fully”.	no	yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-33	*Volocopter*	MOC 4 VTOL.2300	41	Volocopter would like to understand the reason behind the high integrity demand for the Back-up, and how it will lead to an increase in safety. By introducing a high integrity Back-up (command / monitor for example) failures of the monitor can lead to a loss of a healthy function and therefore increase the unavailability of the Back-up. With the Back-up being the system taking over in case of loss of the main FCS, a loss of the main FCS can in cases of loss of integrity (e.g monitor failures) not be compensated by the Back-up. This leads to the conclusion that unnecessary deactivation should be carefully avoided which are significantly increased by the use of high integrity channels.	High availability should consequently take precedence over high integrity. EASA is requested to update the wording accordingly.	yes	yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.

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22-34	*Volocopter*	MOC 4 VTOL.2300	41	The term "Fully independent" does not match any ARP definition and is not understood in the context of this MOC.	EASA is asked to clarify the difference between "independence" as described in ARP4761 and the term used in the MOC.	yes	no	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.
22-35	UK CAA	MOC 4 VTOL.2300 Common Mode Failures and Errors in Fly-by Wire Flight Control Functions Para (b)	41	The previous paragraph (a) specifically defines the need for the backup FCS to have a "…high level of integrity, an appropriate reliability and availability, and be fully independent of the main System". There is no similar wording for the flight control law monitors. This could lead to inconsistent interpretations of the requirement. If the intent is for similar integrity, reliability and availability requirements to be placed on any systems used to monitor flight control laws, it would be helpful to specifically state that fact.	If flight control law monitors are intended to be subject to integrity, reliability and availability requirements, amend paragraph (b) to add a final sentence that reads: "The Flight Control Law Monitor should have a high level of integrity and an appropriate level of reliability and availability "	Yes	Yes	Partially accepted	Paragraph a) has been reworded as a result of this comment and other comments.

23. MOC 5 VTOL.2300 HIDDEN FAILURES IN FLY-BY-WIRE FLIGHT CONTROL SYSTEMS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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23-01	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC5 VTOL.2300	Pg41	At a) the definition of 'latent ' is given as ='hidden'. This is inconsistent with the section above which states "Each significant latent failure should be highlighted in the system safety assessment and subject to review by EASA." How can a 'hidden failure' be notified to anyone? If a latent failure was known about (ie not 'hidden') then it can/should be dealt with.	Delete "Each significant latent failure should be highlighted in the system safety assessment and subject to review by EASA."	No	Yes	Not accepted	Hidden is used in the sense that it is hidden from the FCS detection, and therefore also the crew, see definition (2).
23-02	Collins Aerospace	MOC 5 VTOL.2300 (a) (3)	41	How long does a failure need to be hidden for it to count as latent? 5 minutes? One flight? One power cycle? Need clarification.	Suggest updating (1) to "Latent = dormant = hidden for more than one flight" OR Update (b) to: (b) The following approach should be followed: (1) Double failures, with either one latent for greater than one flight that can lead to a Catastrophic Failure Condition should be avoided in system design. (2) Latent failures greater than one flight that contribute to Hazardous or Catastrophic effects at aircraft level should be avoided in system design. (3) The use of periodic maintenance or flight crew checks to detect significant latent failures greater than one flight is undesirable and should not be used in lieu of practical and reliable failure monitoring and indications.	No	Yes	Accepted	Definition (1) is updated to "**Latent = dormant = hidden for more than one flight**". It is however to be noted that the nature and consequences of the failure may dictate the duration for which a failure could be latent.
23-03	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC5 VTOL.2300 (b)(1)	Pg41	The intent behind this "Double failures, with either one latent, that can lead to a Catastrophic Failure Condition should be avoided in system design." is not clear. How can a latent issue (ie unknown or hidden) be assured to have been avoided? Both or neither failures could be latent, is this allowed?	Delete 'with either one latent' so that it reads: "Double failures that can lead to a Catastrophic Failure Condition should be avoided in system design."	No	Yes	Not accepted	Hidden is used in the sense that it is hidden from FCS detection, and hence also the crew.
23-04	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 5 VTOL.2300, sub-para (b) (1)	41	"Double failures, with either one latent, that can lead to a Catastrophic Failure Condition should be avoided in system design". This is not stringent enough.	Change to "…shall be avoided…"	No	Yes	Partially accepted	Text modified to "**should be avoided as far as practicable in system design. Deviations should be presented and accepted by EASA**".

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23-05	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC5 VTOL.2300	Pg41	The treatment of latent fail ures in this section is very muddled and needs a complete re-write. It would appear that the intention is to defend against either latent software or hardware errors having an impact on safety. This should be accounted for in proper application of ED-79A/ARP4754A and ARP4761. A discussion of latent error issues could be provided elsewhere but this section should be much shorter.	Suggest text: "To demonstrate compliance with VTOL.2300, in line with VTOL.2510, and to reach an acceptable level of safety, specific attention should be paid to latent failures. In the use of ED-79A/ARP4754A and ARP4761, account should be explicitly taken for the impact of latent errors on FCS safety. Appropriate architecture, design and implementation as well as verification strategies should be defined in order to justify the minimisation of their potential impact." No further text is then necessary.	No	Yes	Not accepted	The text here is identical to the one successfully used in many CS-25 certification programmes, where it has been found necessary to provide this guidance to applicants on how EASA expects latent failures to be addressed. This text is addressing failures. It is not addressing software or development errors, which are addressed elsewhere.
23-06	*Pipistrel*	MOC 5 VTOL.2300(b)(2)	41	MOC 5 VTOL.2300(b)(2) appears to be redundant with MOC 5 VTOL.2300(b)(1). At least one failure needs to be active to cause any CAT or HAZ event otherwise the event will not occur. As a result, the contribution of latent failures is not direct but only with an active failure, then (2) is the same as (1). The difference between (1) and (2) is not seen or should be explained.	Remove MOC 5 VTOL.2300(b)(2)	No	Yes	Not accepted	(b)(1) covers double failure combinations, while (b)(2) addresses latent failures more widely. As an answer to comment 23-04, (b)(1) will be reinforced and the difference between (b)(1) and (b)(2) should appear clearer.
23-07	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 5 VTOL.2300, sub-para (b) (4) (iii)	42	"The integrity of the evident part of the significant failure condition should meet a minimum standard…"	Add definition of a "significant failure condition"	Yes	No	Accepted	Definition (a)(4) will be added: **"(4) A significant failure condition is one, which is classified Hazardous or Catastrophic and contains one or more significant latent failures."**
23-08	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 5 VTOL.2300, sub-para (b) (4) (iii)	42	What is the rationale behind the failure probability requirements in (A) and (B)?	Add rationale	Yes	No	Noted	The criteria on hidden failures come from recommendations produced by the Airplane-level Safety Analysis Working Group (ASAWG) in 2010, and the Flight Controls Harmonisation Working Group (FCHWG) in 2002. These working groups were established by the FAA ARAC.
23-09	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC 5 VTOL.2300, sub-para (b) (4) (iv)	42	What is the rationale behind the 1x10-3 figure? Has it been validated such that it complements the requirements in (iii)?	Add rationale and show that it is in line with requirements of (iii)	Yes	No	Noted	Same answer as 23-08.
23-10	FAA RSB AdFC	MOC 5 VTOL.2300	41	Latent (hidden) failures requirements should be applied to all critical systems and not just FBW.	Move this section over to VTOL.2510 for all critical systems.	Suggestion		Not accepted	The hidden failure considerations in MOC 5 VTOL.2300 are more stringent than in MOC VTOL.2510 because of the full time critical nature of the FBW system. It is considered that for other systems, the achievement of the considerations in MOC 5 VTOL.2300 might be not always feasible and in general the considerations in MOC VTOL.2510 are considered sufficient to address latent failures and to reach an acceptable level of safety.
23-11	*Airbus Helicopters (SB)*	2300 (b)(3)	41	The definition of "*significant latent failure*" is too vague. Any very minor dormant failure may lead to CAT situation in combination with many other active failures.	"*significant latent failure*" should be limited to dormant failure which lead to CAT in combination with 1 other failure (or 2, up to EASA to define it) ➔ Notion of cut set order 2 or 3 can be introduced Notion of weight in the cut set can also be introduced	x		Partially accepted	The definition will be updated as explained in the reply to comment 23-02.

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23-12	*Airbus Helicopters (MM/SB)*	2300 MOC 5	41	HIRF and Lightning protection are often made of components which may be affected by dormant failures. No clear rule is given about how to fulfill safety objectives, considering such dormant failures, which may be catastrophic in combination with HIRF or lightning aggression. MOC 2515 and MOC 2520 are not accurate enough to cover such complex combinations.	Combine a lightning or HIRF aggression probability with protections dormant failures and take it as a contributor to the safety Failure Conditions. Aggression probabilities to be considered needs to be clarified in MOC2515 and 2520 .			Not accepted	The requested considerations are not deemed to belong to the MOCs with SC-VTOL but rather to future revisions of AMC 20-136A/158A. The raised subject is already an item under discussion in the frame of CATA HIRF Task Group activities. HIRF/IEL requirements are not supposed to combine the loss/malfunctioning of system/equipment due to HIRF/IEL threats and loss (or dormant failure) of other components of the system. Nevertheless, if dormant failures are "frequent" and not properly covered by CMR, this might be taken into account in the HIRF/IEL Assessment and agreed on case by case basis by EASA.
23-13	*Airbus Helicopters (SB)*	2300 MOC 5 (4)(iv)	42	Complex to understand	Considering (iii)(A) and this (iv), it means that no more than 10 significant dormant failures of this category (leading to CAT in combination with a single active failure) are allowed. Which is may be easier to understand.	x		Not accepted	We do not think the proposal clarifies this point, but we agree that it may not be easy to grasp these criteria for Applicants who are not familiar with CS 25 flight controls.
23-14	THALES Avionics	MOC 5 VTOL.2300	42	"It is recognised that, on occasion, there may be no possibility to meet 1) and 2). " Meeting 1) and 2) is somehow possible but has some side effect. I recommend to removing the word "no possibility". This will be more coherent with what is proposed in (ii) since compliance may use "previews experience", for example, to justify the existence of 1) and 2).	Proposed wording. It is recognised that, on occasion, 1) and 2) are not met.	Suggestion	Substantive	Partially accepted	Text reworded as "**It is recognised that, on occasion, it would be impracticable to meet 1) and 2)**".
23-15	THALES Avionics	MOC 5 VTOL.2300 (b) (4)	42	Failure rates of some latent failures may not be issued purely from experience, but from reliability standards such as MIL-HDBK-217F. Why such approach is no more part of the MOC ?	Proposed rewording: (A) the failure rates and/or service history of each component,	Suggestion	Substantive	Noted	We agree with the comment, but there should be at least no known adverse service history. We therefore propose to keep the wording as it is, as service history should be supporting.
23-16	*Leonardo Helicopters*	MOC 5 VOTL.2300	41	Point (b)(2). Latent failures that are detected during crew check allow to meet an high safety due to the very low interval (usually pre-flight and/or daily). Experience shows that not all the failures can be detected by CBIT. To identify same failures the pilot shall provede commands to start the check.	We suggest to removreference to flight crew tasks and to leave the possibility to perform dedicated checks to the pilot during pre-start procedure.	NOT	YES	Noted	We concur. However, we encourage the use of monitoring as a first means.

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23-17	*Leonardo Helicopters*	MOC 5 VTOL.2300 Par 4.(iv)	42	This approach should apply only for CAT/HAZ failure conditions caused by two events. For CAT/HAZ failure conditions caused by more than two failures, this should not be applicable because it is possible to easily meet the CAT/HAZ safety requirement Example: If the evident failure occurs with a probability of 10-4 for the Category Enhanced, and two latent failures occur with the same probability (10-4) the overall probability is 10-12 that met the target for the Catastrophic. However the system is not compliant with this requirement because the evident failure has a probability of occurrence of 10-4 bigger than the required 10-5.	Update this paragraph to be applicable only for a combination of two failures. For more than two failures, there should be no requirements of probability of occurrence of the latent one, but only to meet the overall probability	YES	YES	Not accepted	The integrity part assumes that one of the hidden failures has occurred at a time. We do not think the criteria should be limited to dual failures only.
23-18	*GAMA*	MOC 5 VTOL.2300(b)(2)	41	MOC 5 VTOL.2300(b)(2) appears to be redundant with MOC 5 VTOL.2300(b)(1). At least one failure needs to be active to cause any CAT or HAZ event otherwise the event wont occur. As a result, the contribution of latent failures is not direct but only with an active failure, then (2) is the same as (1). The difference between (1) and (2) is not seen or should be explained.	Remove MOC 5 VTOL.2300(b)(2)	No	Yes	Not accepted	See reply to comment 23-06.

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23-19	*Boeing*	MOC 5 VTOL.2300	41	THE PROPOSED TEXT STATES: 1) Latent = dormant = hidden 2) A failure is latent until it is made known to the flight crew or maintenance personnel. 3) A significant latent failure is one, which would in combination with one or more specific failures, or events result in a Hazardous or Catastrophic Failure Condition. REQUESTED CHANGE: 1) Failure. An occurrence that affects the operation of a component, part, or element such that it can no longer function as intended (this includes both loss of function and operation outside specified limits). Note: Errors may cause Failures, but are not considered to be Failures 2) Latent = dormant = hidden 3) A dormant failure is defined as one that has already occurred, but has not become evident to the flight crew or maintenance personnel. 4) Dormancy Period. The duration between actions necessary to check for the existence of a failure-, the action may be a pre-flight flight crew check, periodic maintenance check, or periodic maintenance inspection (including component overhaul). See also "Exposure Time." 5) A significant latent failure is one, which would in combination with one or more specific failures, or events result in a Hazardous or Catastrophic Failure Condition 6) "Exposure Time": The period of time between when an item was last known to be operating properly and when it will be known to be operating properly again. See also SAE ARP 4761.	JUSTIFICATION: Our suggestions add clarity to the definitions provided by EASA		yes	Not accepted	EASA sees no added value at this time in reproducing in the MOCs all definitions existing in the relevant literature, e.g. ARP4754A/4761.

24. MOC VTOL.2320(A)(2) OCCUPANT PHYSICAL ENVIRONMENT

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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24-01	*Rolls Royce (Adam Newman)*	MOC VTOL.2320(a)(2)	42	In the case of the unintended contact with a live electrical conductor (particularly those of medium or high voltage which have perhaps not previously been seen on-board an aircraft) should further elaboration on electrical safety and the instruction of safe operating procedures be made	Consider the MoC for medium / high voltage electrical safety, training and competency, maintenance, checking for dead, PPE, lockout etc	Yes	No	Noted	Electric Shock Protection is being developed by EUROCAE as part of ED-290 Guidance on High Voltage Definition and Consideration for Personal Safety.
24-02	*Airbus Helicopters (FXG)*	MOC 2320 (a)(2).	42	For clarification purpose, it should be precised if occupants protection by passivating/ shutting-down systems (e.g. engines/ rotors) during (des-)embarquement is an option.	To clarify	Yes	No	Accepted	Design precautions based on passivating / shutting down systems is an option to protect occupants while entering/exiting the aircraft, provided that the system reliability meets the objective associated to catastrophic classification and that this is combined with other design provisions or physical barriers to protect people on the ground. MOC wording is clarified with the following addition: "*If design precautions based on passivating or shutting down systems are used to protect occupants while entering/exiting the aircraft, these must be supplemented by other design provisions or physical barriers to protect people on the ground*"

25. MOC VTOL.2325(A)(4) FIRE PROTECTION - ENERGY STORAGE CRASH RESISTANCE

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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25-01	UK CAA	MOC VTOL.2325 (a)(4) Fire Protection - Energy storage crash resistance 1. Introduction and scope: Paragraph 2	43	"The similarity of VTOL aircraft and small rotorcraft justifies the consideration of the design and test criteria as being comparable and therefore applicable.." Two full stops in above sentence.	Remove second full stop.	Yes	No	Accepted	Second full stop is removed.
25-02	UK CAA	MOC VTOL.2325 (a)(4) Fire Protection - Energy storage crash resistance 1. Introduction and scope: Paragraph 3	43	This paragraph lists fuel among the possible energy sources in VTOL aircraft. This appears to be inconsistent with other paragraphs of the document (e.g Applicability Section 1, MOC VTOL.2270 etc).	It is possible that the use of aviation fuel as a source of energy for VTOL aircraft will be considered at a later date, however, it would be helpful if the references to the use of fuel throughout this document could be made consistent.	Yes	Yes	Not accepted	The SC VTOL does not prescribe any particular energy source. Therefore, the MOCs generally refer to "energy" and "energy storage system", except when a differentiation of the energy source is required to specify different provisions depending on its nature. This is clearly the case for some parts of the present MOC. This approach is consistently followed in the document.
25-03	*Rolls Royce (F. Musella)*	MOC VTOL.2325(a)(4)	43	Fire Protection - Energy storage crash resistance Exemption should be considered for energy storages installed in areas of the aeroplane where a post-crash fires will not reduce the occupants survivability. This exemption is considered for the "Energy storage system load factors" section but not for the "Drop test requirements" one. The "Drop test requirements" section only provide less stringent pass / fail criteria for those installation.	Extend the "Energy storage system load factors" exception to the "Drop test requirements" for energy storage systems located where their structural damage will not reduce the occupants survivability	Yes	No	Not accepted	It is a highly dynamic impact condition which cannot be reliably simulated in order to ensure that no fire or leakage of harmful fluids or gases will be contained for at least 15 minutes in a non-occupied area outside the evacuation path. Therefore, a test is needed. This follows the same approach as the CS-27 requirements. However, the section 2 of MOC VTOL.2325(a)(4) provides the possibility of using other means that are acceptable to EASA to minimise the hazard to occupants caused by energy storage systems following an otherwise survivable impact (crash landing)
25-04	*Rolls Royce (Adam Newman)*	MOC VTOL.2325(a)(4)	43	In the case where energy storage relates to permanently installed rechargeable Li-ion batteries (or similar) should direct reference be made to DO-311?	Consider if the MoC should directly include / make reference to DO-311 in applicable circumstances	Yes	No	Not accepted	Qualification and minimum performance standards of Li-ion batteries are not the object of MOC VTOL.2325(a)(4). While appropriate qualification of the installed equipment is expected, it does not constitute by itself an adequate means to comply with VTOL.2325(a)(4).
25-05	THALES Avionics	MOC VTOL.2325	43	Fire Protection does not mention battery. No mention to specific monitoring or installation requirements linked to Lithium Batteries for example. The word "battery" is not mentioned once in the document.	MOC VTOL.2325 (a)(1) should be developed to consider Lithium batteries fire risk	Suggestion	Substantive	Noted	This MOC only addresses only VTOL.2324(a)(4) and not VTOL.2325(a)(1). The request for development of MOC VTOL.2325(a)(1) is noted. In the present MOC, the term "energy storage system" is used in order to not restrict its applicability to batteries. However, this term obviously includes batteries.

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25-06	*Rolls Royce (F. Musella)*	MOC VTOL.2325(a)(4)	44	Fire Protection - Energy storage crash resistance *2. Energy Storage crash resistance:* *"These systems should be shown to be capable of sustaining the static and dynamic deceleration loads of this MOC [..] without structural damage to the energy storage system or their attachments that could cause any fire."* Alternative means of compliance could be to limit structural damage to the energy storage system **Fire/Containment wall**, if any. In this case fire can occur but it is contained for the time necessary for occupant egress.	The batteries could have several kind of internal structural damages resulting in fire but if the containment wall integrity is preserved the fire will not reduce the suvivability of occupant during an emerengy landing. Evaluate if this alterative method can be proposed.	Yes	No	Accepted	The text in Section 2 (b) is modified as follows: *« These systems should be shown to be capable of sustaining the static and dynamic deceleration loads of this MOC, considered as ultimate loads acting alone, measured at the system component's centre of gravity without structural damage to the energy storage system or their attachments that could cause any fire other than the contained battery fire allowed in point 3(f)(2)(ii) of this MOC*»
25-07	FAA RSB Systems	MOC VTOL.2325(a)(4) Fire Protection - Energy storage crash resistance	44	It is not clear what the minimum post crash time would be for occupied areas as identified in section 3.f.2.i. Section 3.f.2.ii states a minimum of 15 minutes for non-occupied areas. Does that imply that all other areas shall have no fire following the drop test regardless of time?	Please clarify the intent of sections 3.f.2.i and ii.		Objection	Not accepted	There shall be no fire within the occupied area or the evacuation path after a survivable crash. A post-crash fire is only allowed if it can be shown that the fire will be contained outside the occupied area or the evacuation path for at least 15 minutes in order to allow for the rescue of all occupants.
25-08	*Airbus Helicopters* *(MB)*	VTOL.2325 (a)(4) 3.(f)(2)(ii)	44	Containment for at least 15 minutes might be OK for a fire initiated by a thermal runaway during flight but not after a drop test.	Adaptation for the case of a crash which should allow evacuation in between 90 seconds and for a safe distance less than one minute. Better proposal could be 3 to 5 minutes.	Suggestion		Not accepted	Since the crash conditions specified in the MOC are accepting severe injuries of the occupants, it is assumed that the occupants are not able to evacuate themselves. Therefore, a time interval of 15 minutes is given for rescue personnel to reach the accident side and rescue the occupants.
25-09	*Leonardo Helicopters*	2325(a)(4) – Sect. 3(f)(2)(ii)	44	"any fire or leakage of harmful fluids, fumes or gases should be contained for at least 15 minutes in non-occupied areas and outside the evacuation path " The containment of fire or flammable gases for this long time could lead to harmful building up of high pressures in these compartments. Also consider that the battery casing will already be damaged by the impact and the casing strength for sustaining high gas pressures could be compromised.	"any fire or leakage of harmful fluids, fumes or gases should be vented through designated fireproof venting provisions"	YES	NO	Not accepted	"Contained […] in non-occupied areas and outside of the evacuation path" does not mean that the fire or leakage of harmful fluids have to be contained in a closed area. The containment area can be outside of the VTOL structure. Venting is allowed through dedicated venting provisions. These venting provisions have to sustain the fire for a minimum of 15 minutes and ensure that the venting happens outside the occupied area and outside the evacuation path. Additional clarification will be provided with the publication of MOC VTOL.2400(c)(3).
25-10	*Leonardo Helicopters*	2325(a)(4) – Sect. 3 (f)(3)	44	Projectile release trajectory and occupant protection from the hazard may be diffultly demonstrated it was expected that a projectile release was forbidden due to obvious safety concerns.	Please better specify the requirement or update it	YES	NO	Not accepted	In general, no projectile release is the favoured option. However, if an applicant can show that a released projectile can, i.e. due to the trajectory, not create a hazard, it could be acceptable.

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25-11	*Volocopter*	2325(a)(4) Section 3. (f)(2)(ii)	44	EASA states that a fire must be contained for at least 15 minutes. This value is taken from the helicopter world, which mostly operates outside of urban areas, why potential emergency services take more time to reach a crash site. In the case of VTOL, reaction times of rescuers might be well below 15 minutes considering the kind of operation.	Volocopter proposes to specify the text in a way, that the containement times could be further reduced, if the kind of operation ensures quicker reaction times Proposal: "(ii) any fire or leakage of harmful fluids, fumes or gases should be contained for at least 15 minutes in non-occupied areas and outside the evacuation path, **or a lower value that can be ensured by rescue services due to operational means**. "	yes	yes	Noted	The suggested alleviation would require further coordination with the operational rulemaking activities as to ensure consistency. In order to not interfere at this stage with generally accepted values, the current content shall remain unchanged while on project level dedicated values can be proposed with further evidence.
25-12	UK CAA	MOC VTOL.2325 (a)(4) Fire Protection - Energy storage crash resistance 2. Energy Storage crash resistance	44	The paragraph does not include the potential scenario of electrocution because of the usage of batteries as a power source. Is it not possible to for power pack to leak high voltage current?	Include suitable wording for the possible scenario of electrocution to occupants.	Yes	No	Noted	This scenario is covered in section 5 of the MOC
25-13	UK CAA	MOC VTOL.2325 (a)(4) Fire Protection - Energy storage crash resistance 3. Drop Test Requirements	44	Para 3(e) states: "the energy storage system should drop freely and impact in a horizontal position ±10°; and " Why +/- 10 in a horizontal position? Should the battery be orientated in its normal mounting position relative to the aircraft horizontal. This would ensure that damage is representative of the installation, which may or may not be more or less severe. This may also include damage caused by electrical connectors, that if impacted, may pierce the battery casing.	Revise text as follows: (e) "the energy storage system should drop freely <u>in an orientation that is representative of a typical installation on the aircraft</u> and impact in a horizontal position +/- 10°; and "	Yes	No	Accepted	The text has been clarified as follows: *"(e) the energy storage system should drop freely in an orientation that is representative of a typical installation on the aircraft and impact in a horizontal position ±10°with regards to the horizontal axis of the VTOL*"
25-14	*Leonardo Helicopters*	2325(a)(4) – Sect 5 (a)	45	"other means" could be a manual disconnection?	Please provide exemples	YES	NO	Noted	This wording is chosen in order to not limit the applicant to a specific design. It takes into account any other design the applicant proposes which provides a comparable level of safety.
25-15	*Volocopter*	2325(a)(4) Section 5 (a)	45	There is no direct causation between «relative motion of energy storage system (ESS) components to each other, or to local aircraft structure« and electrical isolation, so the rationale for linking the presence of «Self-sealing isolation means« to electrical ESS motion is not understood.	EASA is asked to clarify on the addressed topic, if batteries are affected by this requirement.	yes	no	Accepted	Text will be revised to make this part only applicable to liquid or gaseous fuels.
25-16	*Rolls Royce (Jonathan Holt)*	MoC VTOL.2325	P46	5(d)(ii) typo: 'ready accessible' should be 'readily accessible'.	Correct	Yes		Noted	Word is finally deleted

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25-17	Lilium GmbH	MOC VTOL.2325(a)(4) section 5 Energy storage system isolation means (d)	46	Ambiguous wording of (d)(1) and (d)(2). It is unclear whether the MOC is mandating both an automatic means and a manual means of isolation; or only an automatic means with the option of only a manual means if the automatic means is impractical.	Provide additional text: "Where an automatic means is fitted, a supplemental manual means is not required."	yes	no	Not accepted	(d)(1) requires an automatic disconnect which is indicated to the flight crew after activation. This is intended to ensure that, after a crash landing, the flight crew is aware that the evacuation can be safely performed with no hazard from high voltage. (d)(2) requires a manual isolation means for rescue personnel in order to ensure that the rescue can be performed safely with no hazard from high voltage. Both requirements have to be met in order to ensure safe evacuation as well as a safe rescue.
25-18	*Volocopter*	2325(a)(4) Section 5. (d)(1)(i)	46	In contrast to fuses that activate automatically in overcurrent events, a centralized, active disconnection of the energy sorage system in response to crash loads adds a single point of failure during the entire operation of the aircraft. This is considered not beneficial but adding a further Catastrophic Failure Condition and potentially leading to decreased reliability due to increased complexity of the system.	Remove expectation for a central automatic disconnect from MoC	yes	yes	Not accepted	It is acknowledged that an automatic disconnection means is not trivial to be implemented safely. However, the occupants and rescue personnel need to be protected against high voltage after a survivable crash landing. In addition, it is not stated that the automatic isolation means needs to be a single, centralized system. In addition, the text gives flexibility to show that, if it is demonstrated as impractical to implement such a system, other means can be proposed.
25-19	*Volocopter*	2325(a)(4) Section 5. (d)(1)(ii)	46	It is highly improbable that any forseen indication means regarding the activation of an automatic or manual isolation means will be operational after a crash landing due to loss of power to the indicating system. In automotive electric vehicles, rescue personnel is taught that there is no reliable indication of the HV system connection status after an accident. Therefore, there is no benefit in providing such an indication on aviation products.	One means could be to require the OEM to provide adequate rescue processes and checking points as part of the OSD, which then may be made available by the Operator to the rescue teams in the area of operation. This is a method that was also used successful in car industry when implementing novel designs that rendered classical rescue methods ineffective.	Yes	yes	Noted	It is acknowledged that not all types of indication system would work under all possible crash scenarios. However, it should be proven that the chosen indication system is capable of working after a crash scenario as described in this MOC. However, if other means of compliance are proposed in order to ensure a safe evacuation or rescue after a survivable crash landing, this can be proposed during a certification project.
25-20	*Volocopter*	2325(a)(4) Section 5. (d)(2)	46	Even in automotive electric vehicles, there is no «manual isolation means … readily accessible from the outside« of the vehicle. Instead, the manual isolation means is located in an accessible position inside the vehicle, as close as possible to the energy storage system. Extending power lines to position the manual isolation means outside the vehicle increases the risk of e.g. short circuits along this path, which remains under high voltage even after disconnecting the manual isolation means. It also increases the risk of inadvertent activation of this isolation means due to external factors, if it is not protected by the shell of the aircraft.	EASA is requested to remove section 5. (d)(2) from the document.	yes	yes	Partially accepted	Text is reworded to highlight the intent: that a manual isolation means is safely accessible for the use by the rescue personnel. New text: *"A manual isolation means has to be safely accessible for the rescue personnel and be clearly marked"*

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25-21	*Volocopter*	2325(a)(4) Section 5. (e)	46	The mentioned features may all have the capability of triggering a Catastrophic event. At the same time, the probability for inadvertend activation is described to be “improbable”. This is inconsistent.	Enhance wording from “improbable” to “**extremely** improbable”.	yes	yes	Not accepted	Rather than prescribing a specific safety objective that is generally applicable, the intent of the MOC is to highlight the need to consider and minimise this risk to the maximum possible extent, in view of the particular design and technologies used. This clarification has been introduced in the MOC text.: *“All individual isolation means, such as fuses, emergency stop, breakaway couplings, coupling fuel feed systems, or equivalent means should be designed, tested, installed and maintained so that inadvertent activation in flight is minimised to the maximum extent practicable. It should be ensured that the isolation means are not degrading beyond an acceptable level in accordance with the reliability requirements for systems and the fatigue requirements for structural installations.”*
25-22	*Airbus Helicopters (IE)*	VTOL.2325(a)(4) §5 (e)	45	Requiring all individual isolation means to ensure probability of inadvertent activation in flight to be improbable may be impractical in some cases. The failure probability of the isolation means should be linked to the System Safety Assessment and associated failure rate needs. For example, in large battery systems, fuses could lead only to degradation of the performance margins by isolating just one part of the full energy storage system.	Link the failure rate request for the individual isolation means to the System Safety Assessment and associated failure conditions and classifications.	Suggestion	Objection	Partially accepted	See comment 25-22. It is indeed expected that a System Safety Assessment is conducted to demonstrate that the risk of inadvertent activation is appropriately mitigated.
25-23	*Rolls Royce (Jonathan Holt)*	MoC VTOL.2325	P46	6(b) Reference to rotorcraft probably needs updating.	Update the term ‘rotorcraft’	Yes		Accepted	“rotorcraft” replaced by “aircraft”
25-24	THALES Avionics	MOC VTOL.2325	43	“ of energy storage system components to local rotorcraft structure “ « energy storage system components to local rotorcraft structure, whether “ Copy/paste error.	Change rotorcraft by aircraft	Suggestion	Substantive	Accepted	“rotorcraft” replaced by “aircraft”

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25-25	Uber	2325(a)(4) Section 6		2325(a)(4) Fire Protection - Energy Storage Crash Resistance Section 6 - Frangible or deformable structural attachments (c) The load required to separate a frangible energy storage system components attachment from its support structure, or to deform a locally deformable attachment relative to its support structure, should be between 25% and 50% of the minimum ultimate load (ultimate strength) of the weakest component in the attached system. In no case should the load be less than 1330 N (300 lbs). Question: If the ultimate load of the battery system is based on a 1.5 SF applied to the system defined limit loads, then the limit load is therefore ~66.7% of the ultimate load. Therefore, if "the load required to separate a frangible energy storage system components attachment from its support structure" should be between 25% and 50% of the min ultimate load, then this separation would occur prior to the limit load. How can the separation (or deformation) load be less than the designed limit load?				Noted	More information about frangible and deformable can be found in FAA AC 27-1B 27.952. The designing loading case for this requirement is the impact load during the drop test, which is considered as ultimate load. These loads are significantly higher than the flight or ground loads. Therefore 25%-50% of the ultimate load conditions are significantly higher than the loads expected to occur in service, excluding a crash scenario. For further information please refer to AC 27-1B 27.952 (d)(12-14)
25-26	*Rolls Royce (F. Musella)*	MOC VTOL.2325(a)(4)	47	Fire Protection - Energy storage crash resistance *8. Other basic mechanical design criteria.* ***Battery systems**, electrical wires, and electrical devices **should be designed, constructed and installed, as far as practicable, to be crash resistant.*** This seems an alleviation of the sec. 3 "Drop test requirements" for batteries. Is this understanding correct?	Confirm if the sec. 8. "Other basic mechanical design criteria" constitutes alleviation for batteries crash resistance.	Yes	No	Partially accepted	No, it does not constitute an alleviation. During design, as far as practical, all installations should be crash resistant in order to mitigate any hazard to the occupant. This also includes items not included in the energy storage drop test. The term “battery systems” is replaced by “battery system components” to provide more clarity.
25-27	*Rolls Royce (C Ludena*	MOC VTOL.2325(a)(4)	47	There is no further MOC for batteries to demonstrate crash resistance	refer to other standards for test or special conditions for batteries	yes	no	Noted	Further MOC for batteries is currently under development by EASA and EUROCAE.
25-28	*Rolls Royce (Dave Brown)*	MOC VTOL.2325(a)(4) Fire Protection - Energy storage crash resistance	47	**MOC VTOL.2325(a)(4) Fire Protection - Energy storage crash resistance** **8. Other basic mechanical design criteria.** Battery systems, electrical wires, and electrical devices should be designed, constructed and installed, as far as practicable, to be crash resistant. ***Electrical devices under crash conditions should have a requirement not to fail in a way which could cause electrocution or fire risk by, for example, exposure of live HV circuits, arcing risk.*** ***Also where is ‘crash resistant’ defined?***	Add the listed examples of unacceptable post-crash electrical device effects Define ‘crash resistant’	yes	no	Noted	Depending on the severity of this ground contact and its consequences, the following definitions are established: - Emergency Landing: Impact (crash) where the occupants are given every reasonable chance of escaping serious injury. The occupants should be able to evacuate the vehicle without assistance. The impact conditions are detailed in VTOL.2270 and associated MOC. - Survivable Emergency Landing: Impact (crash) which is potentially survivable, even with serious injuries to the occupants. The occupants should be protected from post-impact hazards as described in VTOL.2325(a)(4), VTOL.2430(a)(6) and associated MOC (Refer to Section 4 of MOC VTOL.2000)

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25-29	*Rolls Royce (Dave Brown)*	MOC VTOL.2325(a)(4) Fire Protection - Energy storage crash resistance	47	**9. Rigid or semi-rigid fuel tanks.** Rigid or semi-rigid fuel tank or bladder walls should be impact and tear resistant. ***Where is 'impact and tear resistant' defined?***	Define 'impact and tear resistant'	yes	no	Noted	More information about fuel tank or bladder walls can be found in FAA AC 27-1B for 27.952.
25-30	*Airbus Helicopters* *(FXG)*	MOC 2325 (a)(4) § 7	47	'*To provide maximum crash resistance, flammable fluids or gases should be located as far as practicable from all occupiable areas and from all potential ignition sources*.' The requirement should be clarified. One possible interpreation of this req. could be that locating energy storage underneath passengers is not allowed, is this the intent ?	To clarify	yes	no	Noted	The requirement is taken from the existing 27.952 for rotorcraft. As fuel tanks are also located underneath the passengers in rotorcraft, this MOC is not prohibiting this kind of design. The intention is to highlight that, if practical, flammable fluids or gases should not be located in the vicinity of occupiable areas.
25-31	*Airbus Helicopters* *(FXG)*	MOC 2325 (a)(4) § 9.	47	'*Rigid or semi-rigid fuel tank or bladder walls should be impact and tear resistant*.' Not clear enough	Refer to the TSO for bladder which is an already approved document	x		Noted	More information about fuel tank or bladder walls can be found in FAA AC 27-1B for 27.952.
25-32	*Leonardo Helicopters*	2325(a)(4) – Sect 8	47	Electric wires with different size and voltage will be installed.	clarify the statement to be "crash resistant" for electric wires.	YES	NO	Noted	During a survivable crash landing the damage of wires shall not lead to a hazard to the occupant, rescue personnel or people on ground.

26. MOC VTOL.2325(B)(1) AND (B)(2) FIRE PROTECTION: FIRE EXTINGUISHERS AND DESIGN OF INTERIORS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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26-01	*Airbus Helicopters (SB)*	2325(b)(1) and (b)(2)	47	The standardized flame is used to characterize material; this is the usual agreed method. During a real luggage compartment fire, the fire is different and dissipated heat is also different. There is a need to characterize it in order to evaluate the thermal impact on equipment behing the ceiling, sidewall liners and floor.	To define a luggage compartment fire	yes	yes	Noted	The wording used is common wording used for rotorcraft certification. However, it is acknowledged that a definition of a representative and conservative assumption for a luggage compartment fire would be beneficial. It will be considered if such a fire can be generally defined and included in a later revision of the MOC.
26-02	*Airbus Helicopters (MG)*	2325 (b)(1) and (2) § 2	47	*Typo: ' For Category Enhanced the means of compliance accepted for Category Basic should be completed with the following provisions are in addition to the means of compliance accepted for Category Basic:'*	To correct as: *' For Category Enhanced the means of compliance accepted for Category Basic should be completed with the following provisions* ~~*are in addition to the means of compliance accepted for Category Basic*~~*:'*	yes	no	accepted	Corrected as suggested
26-03	*Airbus Helicopters (FXG)*	2325 (b)(1) and (2)	47	§(b)(2) seems to be partially in contradiction with §(b)(1). Indeed §(b)(1) provides a certain level of fire protection (adapted to a cabin) but §(b)(2) requires to 'contain any fire' which would not be the case if the design comply with §(b)1.	To clarify	yes	no	Not accepted	The applicant can choose to apply either (b)(1) or (b)(2). Both options are considered to provide an equivalent level of safety. The option (b)(2) was introduced in order to provide more flexibility to the designer. It is less prescriptive with regards to the performance of the liner and sidewall material and the heat source.
26-04	*FLUTR*	MOC VTOL.2325(b)(1) and (b)(2)		Smoke detectors are not considered as a MOC. A smoke detector may alert the pilot to landing earlier. A fire in say an aft cargo compartment may burn undetected causing significant damage, and depending on the location of avionics or critical control structures, create an undetected hazardous scenario. Undeetcted fires may cause loss of flight control within 20 minutes. For aircraft being used in semi-autonomous or full autonomous modes, this situation would also apply "(b) Baggage compartment: A baggage compartment that is located where the presence of a fire would not easily be discovered by a pilot while at his station should:…"	Smoke detector systems shall be used in addition to flame resistant materials, when aircraft are used with ground based remote pilots or autonomous systems, or when baggage compartment is located where the presence of a fire would not be easily discovered/detected by a pilot while at his station.	suggestion	substantive	Partially accepted	The possibility of a fire detection system is added to the MOC: *"Be constructed and sealed to contain any fire within the compartment or must have a device, to ensure detection of fires or smoke by a crew member while at his station and to prevent the accumulation of harmful quantities of smoke, flame, extinguishing agents, and other noxious gases in any crew or passenger compartment."*

27. MOC VTOL.2400(B) ACCEPTED SPECIFICATIONS FOR ELECTRIC/HYBRID LIFT/THRUST UNITS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
27-01	*Airbus Helicopters* *(FXG)*	2400 (b)	48	"*EASA SC E19 … is an accepted specification to be met by electric/hybrid lift/thrust units that are installed in VTOL aircraft*" Does it mean that the lift/thrust system : - Is either certified under CS-E, CS-P or CS-APU - Or meets SC E-19, in case of electric/hybrid lift/thrust unit But is the option to develop the lift/thrust system in the frame of SC-VTOL only accepted ?	To clarify	yes	no	Noted	Article 11 of the EASA ´Basic Regulation´ (i.e. Regulation (EU) 2018/1139 of the European Parliament and of the Council) states that: "No separate type certificate shall be required for the design of engines and propellers that have been certified as part of the design of an aircraft in accordance with this Article". In line with this regulatory provision, SC-VTOL establishes in VTOL.2400(b) that: "Each aircraft engine, propeller and auxiliary power unit (APU) must be type certified, or meet accepted specifications." A "lift/thrust unit" for the purpose of SC-VTOL is defined in MOC VTOL.2000 as follows, thus comprising certain engines: "A lift/thrust unit is considered to be any engine that directly contributes to providing lift or thrust and includes its controller, the connected effector (e.g. rotor, propeller, fan) and any related actuators (e.g. pitch change, tilting, vectoring)." MOC VTOL.2400(b) clarifies that when an engine meeting the definition of electric/hybrid lift/thrust unit installed in VTOL aircraft does not hold its own type certification, "EASA Special Condition E-19 on Electric/Hybrid Propulsion System is an accepted specification" for its certification as part of the aircraft type design under VTOL.2400. It may be important to clarify that the applicability of SC E-19 is not limited to VTOL propulsion system. It is intended as a transversal SC for hybrid and electric propulsion, like CS-E for turbines or reciprocating engines. An EHPS according to the SC E-19 can be considered as an "engine" product and can be therefore type certified as such (standalone) or included in the aircraft certification. An EASA Certification Memorandum in envisaged to provide additional clarifications. Regarding the devices that produce lift or thrust: - Propellers are certified with CS-P or CS-22 subpart H - Fans are certified as part of the engine (or EHPS) - Aircraft rotors are certified with aircraft requirements.
27-02	*Volocopter*	2400 (b)	48	EASA only addresses "lift/thrust units", for which SC-EHPS is an accepted specification. However, far more systems are covered under EHPS.15 (e.g. EWIS, energy storage systems).	Proposal: "to be met by electric/hybrid **propulsion systems** that are installed in VTOL aircraft."	Yes	yes	Not accepted	VTOL.2400 (b) applies to "engine, propeller and APU". MOC VTOL.2400(b) cannot extend the applicability or scope of the overlying requirement.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
27-03	UK CAA	MOC VTOL.2400(b) Accepted Specifications for Electric/Hybrid Lift/Thrust Units	48	SC VTOL.2400(b) makes it clear that it is the engine, propeller and APU which must be type certified or must meet an accepted specification. The text in the MoC changes the focus of this by introducing the conept of the lift/thrust system which is not mentioned in the requirement. By describing a specification (EASA SC E-19 EHPS) which includes many more elements of the lift/thrust system than the engine. It becomes confusing to understand whether an engine or electric motor can be certified independently to be used as part of a lift/thrust system. It shold be noted that SC E-19 creates some confusion as to what an EHPS includes, as it specifically states that it does not cover Propellors. However in its definitions it makes clear that the EHPS intended to be the system which produces lift or thrust. But this is not practical if the EHPS does not include the propulsor which converts the engine/motor power into lift or thrust, ie a propeller, as featured in most current VTOL designs.	The MoC needs to be revised to clarify whether an engine or electric motor can be certified independently, either to be used as part of an EHPS, or directly within a VTOL aircraft lift/thrust system. Recogniisng the range of specialist capabilities within this emerging sector, a number of paths for approval of the principal elements within an EHPS or lift/thrust system, will provide flexibility for applicants who wish to use a standard motor integrated into their specific lift/thrust architecture. As well as for EHPS designers who wish to offer an integrated system, but wish to be able to access the most advanced motor designs.	Yes	Yes	Not accepted	See reply to comment 27-01.

28. MOC VTOL.2430(A)(6) ENERGY RETENTION CAPABILITY IN AN EMERGENCY LANDING

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
28-01	FAA RSB Systems	MOC VTOL.2430(a)(6)	48	Agree with the proposal to use the MOC as described in MOC VTOL.2325(a)(4). However, the additional reductions allotted for aircraft that may fly over water is not appropriate as those aircraft may still impact solid ground in a crash unless they are limited to only operating over water.	Remove language in 2.a.1 which allows dropping on water and 2.b which allows for a reduced drop height.		Objection	Not accepted	*As clearly expressed in the MOC, Section 2 applies "in addition to Section 1 of this MOC".* This means that Section 1 has to be always followed, whereas Section 2 is only expected to be followed when operations on or over water with electric aircraft are envisaged.

29. MOC 1 VTOL.2500(B) INTENDED FUNCTION OF SYSTEMS AND EQUIPMENT

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
29-01	*Rolls Royce (Dave Brown)*	MOC 1 VTOL.2500(b) Intended function of systems and equipment	49	**MOC 1 VTOL.2500(b) Intended function of systems and equipment** **…….** (a) the full normal envelope of the aircraft, as defined by the Aircraft Flight Manual, with any modification to that envelope associated with abnormal or emergency procedures; (b) any anticipated external aircraft environmental conditions: external environmental conditions such as atmospheric turbulence, HIRF, lightning, and precipitation, which the aircraft is reasonably expected to encounter, with severities limited to those established by certification standards and precedence; ***Given that VTOL's may spend all their life at low altitude, should there be an additional consideration of atmospheric pollution (dust, sand, acid rain etc.)***	Consider including suggested additional environmental threat	yes	no	Not accepted	It is agreed that atmospheric pollution may need to be considered as "anticipated external aircraft environmental conditions", depending on the specific Concept of Operations and the particular VTOL technologies used. However it shall be noted that (b)(1) does not intend to provide an exhaustive and comprehensive list of all possible external conditions to be considered for compliance with VTOL.2500(b), but only to provide some generally valid examples, clearly introduced by the words "such as".
29-02	*Airbus Helicopters (FXG)*	VTOL.2500(b)	49	For lift/thrust system, it should be stated that this requirement demonstration is covered by the compliance demonstration with VTOL.2400 requirements.	Add wording in MOC 1 VTOL.2500(b) such as: "For lift/thrust sytem, compliance with VTOL.2400 can be used to support demonstration of this requirement."	yes	no	Partially accepted	It is agreed that demonstrating compliance with the EASA Special Condition for electric/Hybrid Propulsion System (SC-EHPS) for electric/hybrid lift/thrust units installed in a VTOL aircraft, as allowed by VTOL.2400 and MOC VTOL.2400, may also support compliance with VTOL.2500(b). However, this may not be the case for propellers or aircraft rotors not currently covered under this SC-EHPS but which would be certified as part of the aircraft design. The following sentence is added at the end of Section 2: "*For lift/thrust system, compliance with VTOL.2400 can be used to support the compliance demonstration with VTOL.2500(b) regarding the Electric Hybrid Propulsion System (EHPS) scope defined in the Special Condition E-19 EHPS*"
29-03	*Airbus Helicopters (MB)*	VTOL.2500(b)(a)	49	"abnormal … procedures"	Please give definition for abnormal, because in other cases everything not normal envelope would be "abnormal" and the scope resulting would mean everything.	Suggestion		Noted	VTOL.2500(b) requires that equipment and systems are "designed and installed so that they perform their intended function throughout the operating and environmental limits for which the aircraft is certified". MOC 1 VTOL.2500(b) in its Section (a) clarifies that this includes not only the full normal envelope, but also those changes to this envelope that are already considered in Aircraft Flight Manual procedures at the time of the type certification, as corresponding to anticipated abnormal or emergency operations.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
29-04	*Leonardo Helicopters*	1-2500(b)	49	Missing something similar to AC 27.1309 which states that: "In order to ensure that the components and systems under consideration will function properly when exposed to adverse environments, they should be tested in the laboratory under a simulated adverse environment. If a TSO exists and it is appropriate in environmental range and performance for an equipment installation, it is preferable that the equipment be TSO approved. If there is no applicable TSO or an existing TSO does not provide for a sufficiently adverse environment, the latest revision of Radio Technical Commission for Aeronautics (RTCA) Document DO-160 is an acceptable environmental standard for laboratory qualification of aircraft equipment."	Suggested addition of: "ETSO/TSO usage shall be preferred for components and systems certification. Alternatively, the latest revision of RTCA DO-160 may be used as an acceptable Environmental Standard for laboratory qualification of aircraft equipment."	YES	NO	Not accepted	The intent of this MOC is not to provide detailed guidance and methods on how to qualify equipment in the frame of the airworthiness certification, for which there is already abundant regulatory material available (e.g. FAA AC 27.1309 a, b(1) and b(2) or FAA AC 29.1309 a, b(9)(i) and b(9)(ii)) This MOC rather intends to clarify the conditions for the applicability of VTOL.2500(b) and in particular to offer the EASA interpretation of the "operating and environmental limits" mentioned in this requirement, to enable the compliance demonstration process.

30. MOC 2 VTOL.2500(B) ELECTROMAGNETIC COMPATIBILITY

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
30-01	*Airbus Helicopters (MM)*	2500(b) MOC2. 2)	49	*"Any EMI noted on the ground should be repeated…at the frequency at which…"* *At the frequency*…here a specific EMI is mentioned, the sentence should more general. If there is something to be underlined, this should be after in the § and more detailed in order to explain what it shall be prevented.	*"at the frequency at which the EMI occurred on the ground"* should be removed of the sentence and an additional sentence at the end of § to explicit this point	yes	no	Not accepted	The specific EMI refers to a possible anomaly seen in the ground test. If this cannot be solved, a flight test should follow up whether the anomaly could be acceptable. Of course, the preferred way is that all found issues during a ground test are 100% solved before conducting a flight test.
30-02	*Leonardo Helicopters*	MOC 2 VTOL.2500(b) Electromag Compatibility	49	Equipments malfunctions are normally not considered for EMC assessments but effects are notmally considered into FMECA. EUROCAE ED-248 points out that malfunctions verification is only required for Part 25, but normally limited to Circuit Breakers operation. ED-248 is not recommending specific EMC verifications for equipment malfunctions.	Propose to delete bullet (c) "Malfunctioning of electrically-powered apparatus". Otherwise it should better specify whether the verification should be limited to protection devices (circuit breakers operation not causing adverse effect) or what other effects need to be considered.	NO	YES	Accepted	(c) is removed and the list renumbered accordingly.
30-03	*Leonardo Helicopters*	MOC 2 VTOL.2500(b) Electromag Compatibility	49	Lightning currents effects are covered by VTOL. 2515 and shold not be mentioned in VTOL.2500	Propose to delete "lightning currents" from bullet (d).	YES	NO	Not accepted	The addition in here is already in existing other AMC material. This reminds the applicant that any EMI effects stemming from induced Lightning currents should not cause further negatively impact. Typically, HIRF, Lightning and EMC go in concertation, as appropriate of course for the situation at hand. See also ED-248 for some further helpful information.
30-04	Lilium GmbH	MOC 2 VTOL.2500(b)	49	Sub-section "2. Electromagnetic compatibility" says "fuel control computer". It seems to be a typo for Flight Control Computer.	Re.word to "Flight Control Computer" if intended.	yes	no	Partially accepted	VTOLs still could use conventional fuel, the SC is not excluding this possibility. However, to be more aligned with the SC we will change the wording slightly and refer to "energy supply system control" instead of "fuel control computer."
30-05	*Volocopter*	MOC 2; 2500(b)	49	"Since some systems are difficult to operate on the ground (e.g. air data system, **pressurisation** etc.)..." as VTOL.2000 (c) states that SC-VTOL applies to non-pressurised aircraft, the example might be not the right one	Proposal: "Since some systems are difficult to operate on the ground (e.g. air data system etc.)..."	yes	no	Accepted	"pressurisation" deleted

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
30-06	*GAMA*	MOC 2 VTOL.2500(b)(2)	50	"EMI should be limited to negligible levels in wiring related to systems that are necessary for continued safe flight, landing and egress.." The above Implies you only need to worry about CAT systems. Unlike external env, the internal environment is not necessarily transient in nature and therefore ***all functions required for operation*** of the aircraft should work with negligible effects.	Suggest revising to "EMI should be limited to negligible levels in wiring related to functions required for operation of the aircraft."	No	Yes	Not accepted	Though in HIRF and Lightning rules specific requirements are on "function level" for certain situations, EASA is reluctant to introduce the concept in the way GAMA is proposing. The text has been revised to further clarify the intent: *"Electromagnetic interferences can ~~also~~ exist between systems, but also between wires, and between wires and systems. Electromagnetic interference can be introduced into aeroplane systems and wiring by coupling between electrical cables or between cables and coaxial lines or other aeroplane systems. The correct functioning of systems should not be affected by EMI generated by adjacent wires. EMI between wiring which is a source of EMI and wire susceptible to EMI increases in proportion to the length of parallel runs and decreases with greater separation. Wiring of sensitive circuits that may be affected by EMI should be routed away from other wiring interference, or provided with sufficient shielding to avoid system malfunctions under operating conditions. Regardless of the function performed, the equipment and its interconnecting wiring will unavoidably generate and be exposed to various types of electrical transients, electrical and magnetic fields, and spurious noise, spanning over a wide range of frequencies and amplitudes. For sure, EMI should be limited to negligible levels in wiring related to systems that are necessary for continued safe flight, landing and egress. A comprehensive victim and source testing is typically expected to ensure the proper functioning of the systems on the aircraft (unless another way is agreed with EASA). The following sources of interference should be considered:"*
30-07	*GAMA*	MOC 2 VTOL.2500(b)(2)(d)	50	"Parasitic currents and voltages in the electrical distribution and grounding systems, including the effects of lightning currents or static discharge." The EMI interference is intended for sources internal to the aircraft and therefore it should remove lightning since that is an external env and has its own dedicated rule.	Remove the highlighted text.	No	Yes	Not accepted	See Comment 30-03

31. MOC 3 VTOL.2500(B) AIRWORTHINESS SECURITY IN THE CATEGORY ENHANCED

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
31-01	*Pipistrel*	MOC 3 VTOL.2500(b) Airworthiness Security in the Category Enhanced	50	Per the section title and paragraph (a) beneath, this requirement applies to Category Enhanced type for Catastrophic and Hazardous effects. But the last paragraph of this section mentioned AMC 20-42 is MOC for VTOL.2500(b). *"AMC 20-42 – Airworthiness Information Security Risk Assessment is an accepted means of compliance with VTOL.2500(b) for Airworthiness Security aspects."* It is unclear that whether Airworthiness Security applies to Category Basic and other hazards classification of Category Enhanced.	Clarify if Airworthiness Security applies to Category Basic as well as Enhanced.	Yes	No	Not accepted	The applicability of this MOC is clearly defined in its title. No additional clarification is considered necessary.
31-02	*GAMA*	MOC 3 VTOL.2500(b) Airworthiness Security in the Category Enhanced	50	Per the section title and paragraph (a) beneath, this requirement applies to Category Enhanced type for Catastrophic and Hazardous effects. But the last paragraph of this section mentioned AMC 20-42 is MOC for VTOL.2500(b). *"AMC 20-42 – Airworthiness Information Security Risk Assessment is an accepted means of compliance with VTOL.2500(b) for Airworthiness Security aspects."* It is unclear that whether Airwothiness Security applies to Category Basic and other hazards classification of Category Enhanced.	Clarify if Airworthiness Security applies to Category Basic as well as Enhanced.	Yes	No	Not accepted	See Comment 31-01
31-03	FAA RSB SW	MOC 3 VTOL.2500 (b) Airworthiness Security in the Category Enhanced	50	AMC 20-42 and the Part 25 Transport guidance for ASISP (RTCA DO-326, DO-355, and DO-356) does not provide a safety continuum for these small UAM vehicles. As with the current struggle and positions held for the experimental market, telling UAM applicants they must follow Transport guidance for compliance could potentially be too costly for this industry.	We need a harmonized approach tailored to the size and capabilities of this industry. Recommend the use of the ASTM standards for ASISP or allow a tailoring of RTCA documents.		Objection	Noted	The EASA MOC Material offers possible means to demonstrate compliance with the requirements in the Special Condition VTOL. MOC 3 VTOL.2500(b) merely confirms the acceptability for EASA of AMC 20-42 as means of compliance with VTOL.2500(b) for Airworthiness Security aspects, but nowhere renders it mandatory. Furthermore, the ASTM standard for ASISP has not yet been issued and it may also need some adaptation to be useful in this context, for instance regarding the intended proportionality in this standard through airplane certification levels 1 to 4. The MOC may be revised to incorporate additional applicable and acceptable references when available.
31-04	THALES Avionics	MOC 3 VTOL.2500(b)	50	Airworthiness Security in the Category Enhanced -why to consider Cyber security protection only for Enhanced? Why nothing for Basic (not seen) ?	Make the same text applicable to BASIC , or provide the rationale for making a difference. Security concerns exist also for Basic, even if impacts are lower as reflected in safety objectives	Suggestion	Objection	Not accepted	The application of a risk-based approach and the principle of proportionality are considered suitable and beneficial with regards to airworthiness security, considering the different risks and safety objectives of VTOL aircraft in the categories basic and enhanced. Consequently, EASA expects Airworthiness Security to be ensured at least in all Category Enhanced VTOL type designs.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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31-05	Boeing	MOC 3 VTOL.2500(b)	50	THE PROPOSED TEXT STATES: Airworthiness Security is the protection of the airworthiness of an aircraft and its occupants from the information security threat: harm due to human action (intentional or unintentional) using access, use, disclosure, disruption, modification, or destruction of data and/or data interfaces. REQUESTED CHANGE: We request replacing the paragraph with the following: The protection of the airworthiness of an aircraft from intentional unauthorized electronic interaction: harm due to human action (intentional or unintentional) using access, use, disclosure, disruption, modification, or destruction of data and/or data interfaces. This also includes the consequences of malware and forged data and of access of aircraft systems from ground systems, but does not include physical attacks or electromagnetic disturbance.	JUSTIFICATION: Our suggested rewording of the paragraph provides better clarity on the scope of work.		yes	Accepted	Text is modified as suggested
31-06	*Volocopter*	AMC 3; 2500(b)	50	Referenced AMC 20-42 cannot be found on EASA homepage. Does this still refer to NPA 2019-01?	EASA is asked to provide feedback on the status of AMC 20-42.	yes	no	Noted	AMC 20-42 was published on July 1, 2020 as part of AMC-20 Amendment 18, in Annex I to ED decision 2020/006/R: https://www.easa.europa.eu/document-library/certification-specifications/amc-20-amendment-18

32. MOC VTOL.2510 EQUIPMENT, SYSTEMS, AND INSTALLATIONS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
32-01	*Airbus Helicopters (MB)*	VTOL.2510	51	IDAL is mainly addressed for software ED-12 and RTCA DO-178 but not linked to DO-254 for high complex hardware.	Introduce also DO-254 as resulting impact of the IDAL classification.	Suggestion	no	Noted	There is a specific focus on IDAL D for software, due to additional proportionality considerations beyond AMC 20-115D. For hardware, the DO-254 /ED-80 is called through the AMC 20-152A.
32-02	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.10	60	This is applicable whether systems are so integrated, or not, and applies to all systems anyway. So. I'm unsure of point of text. Challenge is the top down safety analysis and functional allocation	Update text as follows: "For most VTOL aircraft designs, the Flight Control System and the Lift/Thrust system are highly integrated, i.e. the propulsion system directly contributes to the controllability of the aircraft. Therefore the development of the Lift/Thrust system should take into consideration failures affecting both functions simultaneously, as will be defined as aircraft level safety objectives and should follow the provisions of VTOL.2510 and associated guidance."	Yes	No	Noted	The comment is correct. However, this paragraph is needed to highlight that, in contrast to traditional engine installations, the lift/thrust system in distributed propulsion products has to be treated as any other system on the aircraft. Also section 10 (now became 11) is updated to give guidance for highly integrated systems in general, not only lift/thrust systems.
32-03	*UK CAA*	MOC VTOL.2510 Equipment, systems, and installations 10. Lift/Thrust System Considerations	60	MOC VTOL.2510(10) Lift/Thrust System Considerations Are there any elements of: • CS-E.50 – Engine Control System • CS-E.60 – Provision for Instruments • CS-E.510 - Safety Analysis • CS-E.515 - Critical Parts that would also be applicable for hybrid lift/thrust systems that use an engine?	It may be helpful to consider whether any elements of CS-E would be applicable to this MOC. It would also be helpful if this paragraph referenced SC.EHPS as SC.VTOL is assuming predominantly Electric propulsion systems, which are not covered by CS-E.	Yes	Yes	Noted	In contrast to CS-E, the lift/thrust system is treated as any other system on the aircraft, hence it has to comply with the requirements derived from the aircraft level failure classifications. If the lift/thrust system is an electric/hybrid system, SC EHPS will be raised in parallel.
32-04	*Lilium GmbH*	MOC VTOL.2510, §10	60	It is stated that "the development of the Lift/Thrust system should take into consideration the aircraft level safety objectives". Where can the definition of the mentioned aircraft level safety objectives be found?	Clarification from the Agency requested on quantitative aircraft level safety objectives.	yes	no	Accepted	The term "aircraft level safety objectives" might be misleading. Text changed to: "Therefore the development of the Lift/Thrust system should take into consideration the safety objectives of section 8 and should follow the provisions of VTOL.2510 and associated guidance."
32-05	*Lilium GmbH*	MOC VTOL.2510, §10	60	The wording in para 10 may not be understood by the whole eVTOL industry, and there is potential to under-estimate the usage of highly integrated systems (i.e. beyond Flight Control and Lift-Thrust systems applicability) in eVTOL aircraft.	Re-title "Lift/Thrust system considerations" to "Considerations for Highly Integrated Systems" and re-word the text to: The development of each highly integrated system should take into consideration the aircraft level safety objectives and [reference to specific guidance material, e.g. use of transfer failure conditions] for aircraft designs, where: (1) multi-system functions or inherent cause-effect relationships exist between functions in different systems; or (2) the use of IMA computing resources to perform multiple system functions;	no	yes	Partially accepted	Acknowledged, section 10 (now became 11) is updated to give guidance for highly integrated systems in general, not only lift/thrust systems.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
32-06	*Leonardo Helicopters*	MOC VTOL.2510	60	§11 Latent failure considerations Latent failures that are detected during crew check allow to meet an high safety due to the very low interval (usually pre-flight and/or daily). Experience shows that not all the failures can be detected by CBIT. To identify same failures the pilot shall privede commands to start the check.	We suggest to removreference to flight crew tasks and to leave the possibility to perform dedicated checks to the pilot during pre-start procedure.	NO	YES	Not accepted	The paragraph is originating from CS 25.1309. It is recognized that the use of flight crew checks may help detecting the presence of a significant latent failure, it is however not the preferred solution. if a new technical solution allows practical and reliable failure monitoring and indications, this should be preferred in lieu of periodic maintenance or flight crew checks.
32-07	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.8(b) – last para	58	"Additional considerations may be appropriate for some specific systems and functions. In particular for Fly- by-wire Flight Control Functions, MOC 4 VTOL.2300 applies"	Can we list all applicable VTOL references	Yes	No	Partially Accepted	Considering the published MOC material (issue 1), MOC 4 VTOL.2300 is the only applicable paragraph, as of today.
32-08	*Leonardo Helicopters*	MOC VTOL.2510	60	§11 Latent failure considerations It is not clear why the additional consideration performed in the MOC 5 VTOL.2300 cannot be applied for all the equipment in the same circumstances.	Update the statement in: Additional considerations as per MOC 5 VTOL.2300 (d) (4) can be applied to all systems.	NO	YES	Not accepted	The hidden failure considerations in MOC 5 VTOL.2300 are more stringent than in the MOC VTOL.2510, because of the full time critical nature of the FBW system. It is considered that for other systems, the achievement of the considerations in MOC 5 might be not always feasible and in general the considerations in MOC VTOL.2510 are considered sufficient to address latent failures and to reach an acceptable level of safety.
32-09	*Leonardo Helicopters*	MOC VTOL.2510	61	§12 point (b) "If this approach is taken, and the failure condition is hazardous or catastrophic, then a maintenance task should be established." The above statement seems to be in contrast with the statmente reported in the §1 "Within the frame of the no single failure criterion, dual failure combinations, with either one latent, that can lead to a Catastrophic Failure Condition should be avoided in system design"	Please clarify the use of "should".	NO	YES	Noted	As stated in MOC 5 VTOL.2300. The objective is to obtain a design with a minimum number of significant latent failures. When it is not possible to meet this objective, scheduled maintenance tasks are expected to be used to detect latent failures.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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32-10	*UK CAA*	MOC VTOL.2510 Equipment, systems, and installations 12. Flight Crew and Maintenance considerations Para (a) Flight Crew actions	60	MOC VTOL.2510(12)(a) Flight Crew and Maintenance Considerations, Flight Crew Actions. This section states that: "… credit may be taken for correct flight crew performance if overall flight crew workload during the time available is not excessive and if the tasks do not require exceptional pilot skill or strength." The definition of Hazardous in Section 6(a)(4) includes a clause that states that a hazardous failure condition "…would reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be… (ii) physical distress or excessive workload such that the flight crew's ability is impaired to where they could not be relied on to perform their tasks accurately or completely…" This implies that flight crew actions cannot be assumed to mitigate failure conditions classified as Hazardous (and, by inference, Catastrophic). It might be helpful for less experienced applicants if the text on flight crew actions were updated to reiterate this element of the definition of Hazardous (and, therefore, Catastrophic).	Update the flight crew actions text to make it clear that flight crew actions cannot be assumed to mitigate Hazardous and Catastrophic failure conditions.			Not accepted	There are a number of failure conditions existing today, for which the effect would be Hazardous or Catastrophic without pilot intervention. Hence, credit can be taken for flight crew actions used in the classification of failure conditions, when aspects described in paragraph 12) are taken into account.
32-11	*Leonardo Helicopters*	MOC VTOL.2510	61	§12 point (b) This paragraph seems to be in contrast with the §11 Latent failure considerations. In addition, it should be better clarify what means to "give credit to MTBF". Considering the following scenario: an item presents a dormant failure mode that contributes to Catastrophic/Hazardous/Major failure condition and from the fault tree analysis results a task higher than the MTBF. Does "To give credit to the MTBF" mean that the task is not published becouse of the MTBF is higher than interval task? In this case we disagree with this approach retaing that it does not go in the direction to improve the safety	We suggest to update the paragraph and specify that cannot be given credit to the MTBF of an item to not publish a dedicated task coming from the fault tree analysis.	NO	YES	Not accepted	Leonardo's approach of not taking into account the MTBF is noted. Still, if proper precautions are taken into account (as described in the MOC), it may be possible in some cases to take some credit from the MTBF. This approach is the same as described in AC 23.1309-1E. If the LRU MTBF is much lower than the identified failure rate from the safety assessment and the latent failure is assumed to be identified based upon return to service test on the LRU following its removal and repair (component mean time between failures (MTBF) should be the basis for the check interval time), credit can be taken from the MTBF.
32-12	*THALES Avionics*	MOC VTOL.2510	51	"For example, it does not apply to an aircraft's inherent stall characteristics or their evaluation, but it does apply to a stall warning system used to enable compliance with VTOL.2150." The example needs to be revised because stall characteristics is linked to MHQRM which is linked to VTOL.2510.	Delete the example	Suggestion	Substantive	Partially accepted	Sentence in Section 2 (b) has been reworded: "For example, it does not apply to an aircraft's inherent stall characteristics, but it does apply to a stall warning system used to enable compliance with VTOL.2150."

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32-13	*UK CAA*	MOC VTOL.2510 Equipment, systems, and installations 2. Applicability	51	The MoC VTOL.2510 section 2 Applicability states "As specified in SC VTOL.2500(a), paragraph SC VTOL.2510 is intended as a general requirement that should be applied to any equipment or system as installed, in addition to specific systems requirements …". This is in contradiction to the SC VTOL.2500 requirement that states; "and should not be used to supersede any other specific SC VTOL requirement."	If the MoC is correct then the SC VTOL.2500 requirement should be changed to something like; "and should be used in addition to any other specific SC VTOL requirement".	Yes	Yes	Not accepted	The wording used in SC VTOL.2500 is the same as CS 23.2500. The two paragraphs should be used in conjunction. The SC VTOL.2510 is used in addition to specific system requirements and if there is an overlap, the specific system requirement takes precedence.
32-14	*UK CAA*	MOC VTOL.2510 Equipment, systems, and installations 4. Definitions Para 4(i)	52	MOC VTOL.2510(4)(i) Definition of Failure VTOL.2500 (a) states: "Requirements SC VTOL.2500, SC VTOL.2505 and SC VTOL.2510 are general requirements applicable to systems and equipment installed in the aircraft, and should not be used to supersede any other specific SC VTOL requirement." This is misleading and might be interpreted that other specific safety assessment requirements such as VTOL.2250(c) should take precedence over VTOL.2510.	Either wording of VTOL.2500 (a) should state something like; (a) 'Requirements SC VTOL.2500, SC VTOL.2505 and SC VTOL.2510 are general requirements applicable to all systems and equipment whose functioning is required by this SC VTOL and should be complied with in addition to any other specific SC VTOL requirement. VTOL.2510 should not supersede any other specific SC VTOL requirements affecting mission specific equipment.' Or MOC added to make the same clarification.	Yes	Yes	Not accepted	The SC-VTOL wording is the same as in CS 23.2500 and it is not subject of this CRD to comment on the wording of the SC-VTOL. VTOL.2510 is a general requirement, but if there are specific system requirements, they may take precedence. Note: VTOL.2250 is not applicable to systems and equipment, but is related to structures. Some items may both be considered as structure and system, in that case both requirements should be considered. VTOL.2205 requires consideration of the interaction of systems and structures, addressing systems that may affect structural performance. MOC for this requirement are in preparation.
32-15	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 4. Definitions	52-53	It would be helpful to include definitions for "*Function*", "*FDAL*" "*Item*" and "*IDAL*" as they are referenced in the abbreviations section.	Include definitions for Function and Item, e.g. "Function: Intended behaviour of a product based on a defined set of requirements regardless of implementation" "Function Development Assurance Level (FDAL): The level of rigour of development assurance tasks performed to function. [NOTE: The FDAL is used to identify the ED-79 / ARP 4754 objectives that need to be satisfied for the aircraft/system functions" "Item: A hardware or software element having bounded and well-defined interfaces" "Item Development Assurance: The level of rigour of those development tasks performed on item(s) [e.g. IDAL is the appropriate software level in ED-12/DO-178, and design assurance level in ED-80 / DO-254 objectives that need to be satisfied for an item" Source for all definitions – ARP 4754A. Amendments made to remove specific versions of referenced standards, in line with the MOC.	Yes	No	Not accepted	There is no need to repeat the definition of function / item, as they do not support the understanding of the IDAL and FDAL definition. It has been chosen to better identify that FDAL applies to functions, systems and equipment, whereas IDAL applies to items.

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32-16	*Vertical Aerospace*	MOC VTOL.2510 Equipment, systems, and installations 4. Definitions	52	Malfunction is not defined yet Error and failure are. Malfunction is used 17 times throughout the document and is even used in the definition of failure. The other uses throughout the document could lead to a misunderstanding of the intent.	Please be explicit in the definition of malfunction so as to clearly understand how the word as used throughout. Examples can be provided to illustrate if required	Yes	No	Accepted	Definition from AC 23.1309-1E will be added: Failure of a system, subsystem, unit, or part to operate in the normal or usual manner. The occurrence of a condition whereby the operation is outside specified limits.
32-17	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (4)(f)	52	How can the definition of Development Assurance Level (DAL) be adapted from ED-12C/DO-178C? ED-12C/DO-178C doesn't use the term Development Assurance Level, except for one implicit reference to ED-79A/ARP4754A.	Change to "adapted from ED-79A/ARP4754A".	yes	no	Accepted	Changed to "adapted from ED-79A/ARP4754A"
32-18	*Lilium GmbH*	MOC VTOL.2510(4)(f)(1)	52	FDAL definition below, does not make sense: "FDAL: Development Assurance Levels for aircraft functions, systems and **systems**"	Reword to: FDAL: Development Assurance Levels for aircraft functions, systems and **sub**systems	yes	no	Partially accepted	Changed to "FDAL: Development Assurance Levels for aircraft functions, systems and equipment."
32-19	Collins Aerospace	MOC VTOL.2510	52	Typo in 4. (f) (1): "...functions, systems and systems"	Correct the typo	Yes	No	Accepted	See comment 32-18
32-20	THALES Avionics	MOC VTOL.2510 (4.Definitions)	52	"Note: Errors may be the cause of failures" This Note is very misleading because it can lead: - to the interpretation that "no single failure" would also be applied to errors, leading to the requirement "No single error". - to the misunderstanding compared to the ARP4754A sect 5.2 which differentiate errors and failures, so does the AMC25.1309 which recalls that "..error are not considered to be failure" **THALES strongly request to precise that errors are not considered to be failures as defined in AMC 25.1309 of CS-25 Amdt. 24. It is a fundamental point of the certification process that must not be modified by a Special Condition.**	Replace the current Note by the same wording of the current AMC 25.1309: "Note: Errors may cause Failures, but are not considered to be Failures."	Suggestion	Objection	Accepted	It is not the intent to change the meaning of the note stemming from 25.1309. For the sake of clarity, the definition for "Error" is changed/amended to: "Note: Errors may cause failures, but are not considered to be failures "

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32-21	*Airbus Helicopters (SB)*	2510.4	52	(i)&(g) it's mentioned in (g) that errors may be the cause of failures, but it's not mentioned in (i) Despite it is recalled on pages 55/56 (b), it could be not crystal clear for applicants not familiar with this notion. In particular, the sentence "When performing a CMA, the notion of single failure is not sufficient, therefore the notion of a single error should be considered" on page 57 introduces some confusion as it may be understood that failures and errors are not linked. By the way, with such definition, it could also be understood that errors are a subset of failures which is not systematically the case. It would better to say that Errors may cause Failures, but are not considered to be Failures (as stated in AMC 25.1309)	Make in (i), a link toward (g) on page 52, and clarify the notion of error	yes	yes	Partially accepted	For the sake of clarity, the definition for "Error" is changed/amended to: "Note: Errors may cause failures, but are not considered to be failures "
32-22	*Pipistrel*	Definitions	52	Page 52 aligns with CS 25.1309 regarding "No Single Failure" for Catastrophic Failure Conditions, however, the very important note is different from the note in AMC 25.1309. Where the definition of a failure in AMC 25.1309, Amdt 24 includes a note: **p. Failure. An occurrence, which affects the operation of a component, part, or element such that it can no longer function as intended, (this includes both loss of function and malfunction). Note: Errors may cause Failures, but are not considered to be Failures**. MOC SC VTOL has deleted the note in the definition of a Failure and added a note to the definition of Error that implies a very different meaning. **(g) Error: An omission or incorrect action by a flight crew member or maintenance personnel, or a mistake in requirements, design, or implementation. Note: Errors may be the cause of failures (Source: adapted from AMC 25.1309 in Book 2 of CS-25 Amdt. 24).** This is clearly different from AMC 25.1309 Amdt. 24	Align MOC with CS 25.1309 and AMC 25.1309. Simply stating that "Errors may cause failures" and omitting "are not considered to be failures" is a fundamental shift in safety regulation away from long established FAR/EASA harmonized regulations. Suggest definitions align with AMC 25.1309.	No	Yes	Accepted	It is not the intent to change the meaning of the note stemming from 25.1309. For the sake of clarity, the definition for "Error" is changed/amended to: "Note: Errors may cause failures, but are not considered to be failures "

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32-23	*Vertical Aerospace*	MOC VTOL.2510 Equipment, systems, and installations 4. Definitions	52	Page 52 aligns with CS 25.1309 regarding "No Single Failure" for Catastrophic Failure Conditions, however, the very important note is different from the note in AMC 25.1309. Where the definition of a failure in AMC 25.1309, Amdt 24 includes a note: **p. Failure. An occurrence, which affects the operation of a component, part, or element such that it can no longer function as intended, (this includes both loss of function and malfunction). Note: Errors may cause Failures, but are not considered to be Failures**. MOC SC VTOL has deleted the note in the definition of a Failure and added a note to the definition of Error that implies a very different meaning. **(g) Error: An omission or incorrect action by a flight crew member or maintenance personnel, or a mistake in requirements, design, or implementation. Note: Errors may be the cause of failures (Source: adapted from AMC 25.1309 in Book 2 of CS-25 Amdt. 24).** This is clearly different from AMC 25.1309 Amdt. 24	Align MOC with CS 25.1309 and AMC 25.1309. Simply stating that "Errors may cause failures" and omitting "are not considered to be failures" is a fundamental shift in safety regulation away from long established FAR/EASA harmonized regulations. Suggest definitions align with AMC 25.1309.	No	Yes	Accepted	See comment 32-22
32-24	*GAMA*	Definitions	52	Page 52 aligns with CS 25.1309 regarding "No Single Failure" for Catastrophic Failure Conditions, however, the very important note is different from the note in AMC 25.1309. Where the definition of a failure in AMC 25.1309, Amdt 24 includes a note: **p. Failure. An occurrence, which affects the operation of a component, part, or element such that it can no longer function as intended, (this includes both loss of function and malfunction). Note: Errors may cause Failures, but are not considered to be Failures**. MOC SC VTOL has deleted the note in the definition of a Failure and added a note to the definition of Error that implies a very different meaning. **(g) Error: An omission or incorrect action by a flight crew member or maintenance personnel, or a mistake in requirements, design, or implementation. Note: Errors may be the cause of failures (Source: adapted from AMC 25.1309 in Book 2 of CS-25 Amdt. 24).** This is clearly different from AMC 25.1309 Amdt. 24	Align MOC with CS 25.1309 and AMC 25.1309. Simply stating that "Errors may cause failures" and omitting "are not considered to be failures" is a fundamental shift in safety regulation away from long established FAR/EASA harmonized regulations. Suggest definitions align with AMC 25.1309.	No	Yes	Accepted	See comment 32-22

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32-25	*Garmin (via GAMA)*	Definitions	52	The definition of Error is not aligned with existing regulatory or industry guidance. AMC 25.1309 and the current draft of SAE ARP 4761A include the additional text in the note for the definition of Error: Note: Errors may be the cause of failures, but are not considered to be failures.	Align definition with AMC 25.1309 and upcoming draft of SAE ARP 4761A.	No	Yes	Accepted	It is not the intent to change the meaning of the note stemming from 25.1309. For the sake of clarity, the definition for "Error" is changed/amended to: “Note: Errors may cause failures, but are not considered to be failures “
32-26	*UK CAA*	MOC VTOL.2510 Equipment, systems, and installations 4. Definitions Para 4(i)	52	MOC VTOL.2510(4)(i) Definition of Failure. The AMC 25.1309 definition of failure contains the following statement: “Note: Errors may cause Failures, but are not considered to be Failures.” This statement is missing from the MOC VTOL.2510 definition of failure. The statement regarding the relationship of errors to failures is important and has implications for how development assurance processes are defined. It also has implications for how failures are addressed in the safety assessment process. Removing this statement constitutes a significant change in policy from the certification standards used in other areas of aircraft certification. Was this a deliberate decision? If so, this is a significant change, but one that it would be easy to miss. It would be helpful if • The difference between MOC VTOL.2510 and AMC 25.1309 was specifically highlighted and Further clarification could be provided to explain the reasoning for this difference.	If this was a typographical error, add the missing statement from the AMC 25.1309 definition of failure. If this was a deliberate decision, it would be helpful to: • Highlight the difference between MOC VTOL.2510 and AMC 25.1309 Provide additional clarification of the intent behind removing this statement and the intended effect on system/function architecture and design.	No	Yes	Accepted	See comment 32-25
32-27	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.6(a)	53	During the work by EUROCAE WG105 SG41 in producing a generic UAS FHA, the descriptions of the FC severity classifications have been clarified a little further.	I recommend these are incorporated here. See Draft ED-279 "Generic Functional Hazard Assessment (FHA) for UAS and RPAS"	Yes	No	Noted	ED-279 has not been formally reviewed and endorsed by EASA. SC VTOL does not currently address the remote piloting capability or different possible levels of autonomy.

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32-28	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 6. Failure conditions classifications and probability terms Para a(4)	53	MOC VTOL.2510(6)(a)(4) Definition of Hazardous The reasoning behind excluding potential fatalities from the definition of Hazardous for Enhanced Category aircraft is understood. However, changing the definitions of the basic safety assessment terms between types of aircraft may lead to confusion in the long term, especially for equipment designers/manufacturers supplying both the VTOL industry and other parts of the commercial air transport industry. The industry is used to the permitted probabilities of occurrence changing between certification specifications, so would it be easier (and less confusing for the industry) to simply re-classify failure conditions that are not expected to lead to fatalities as Major and adjust the permitted probabilities of occurrence accordingly in the Enhanced Category?	Possibly re-classify failure conditions that could result in fatalities as Major, with the associated adjustments of permitted probabilities, for the Enhanced Category.	Yes	Yes	Noted	Failure conditions which can lead to more than one fatality are classified catastrophic, irrespective of the category of the VTOL. Failure conditions, which do not lead to any fatality are classified either as with no safety effect, minor or major (basic and enhanced, or hazardous (only enhanced). The reasons for having different definitions for hazardous failure conditions is stated in the explanatory note of the MoC, i.e. being proportionate and to account for product specificities and operations.
32-29	*GAMA*	MOC VTOL.2510 – Equipment, systems, and installation Section 6(a) – Failure Conditions Classifications	53-54	The proposed failure conditions classifications are inconsistent with existing regulatory standards for normal category aeroplanes (CS-23) and small rotorcraft (CS-27). We recommends that these classifications be harmonized with the latest industry consensus standards for small aircraft.	We recommends replacing the Failure Condition Classifications with those in Table 1 of ASTM F3309 (Standard Practice for Simplified Safety Assessment of Systems and Equipment in Small Aircraft). Alternatively, Garmin recommends including the explanatory notes included with Table 1 of ASTM F3309 to better define the failure condition classifications.	No	Yes	Not accepted	The failure condition classification was chosen to fit to the specific context of small VTOLs and their operational environment. The rationale supporting the definition of HAZ and CAT FC can be found in the explanatory note. Product specificities have been taken into account to propose proportionate performance based requirements
32-30	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 6. Failure conditions classifications and probability terms Para a(2)	53	MOC VTOL.2510(6)(a)(2) Definition of Minor The AMC 25.1309 definition of minor references “*physical discomfort to … cabin crew*”. The reference to cabin crew has been removed from the MOC VTOL.2510 definition of Minor. Was this deliberate? If so, is an assumption being made that no VTOL aircraft will have cabin crew, or is the subject of cabin crew going to be addressed in a later amendment? If the subject of cabin crew is going to be addressed in a later amendment, it may be helpful to include them in the definition of Minor from the beginning. This will avoid having to update basic definitions later in the process, which may cause confusion.	If this was a typo, add a reference to cabin crew to the definition of Minor. If this was deliberate: • If cabin crew will be addressed in a later amendment, add a reference to cabin crew to the definition now to avoid later updates to basic terms. If an assumption is being made that cabin crew will not be used in VTOL aircraft, it may help to make the assumption really clear. This should ensure that applicants and operators are aware of it and highlight to EASA any operational decisions/assumptions that are contrary to the MOC VTOL.2510 assumption.	Yes	No	Noted	First applications do not foresee cabin crew. Cabin crew will be taken into account in future developments for VTOL when necessary.

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32-31	FAA RSB HF	2510 (6.(a)(3), (4)	52	(Major)". . . , possibly including injuries, or physical discomfort to the flight crew. If the injury to the pilot leads to the pilot being unable adequately perform their duties, what is the hazard classification Regarding "Hazardous" is the statement ". . . possible serious injury to an occupant other than the flight crew." Intend to mean the pilot is more protected from the other occupants or not as protected?		Yes		Noted	The definitions are in line with CS 23.2510 and CS 25.1309 on the aspect of physical distress of the flight crew and the fact that the flight crew is excluded from possible serious injury to occupants.
32-32	*Pipistrel*	Safety Assessment Process	53	Definition for Hazardous failure condition inconsistent with prior standards. FAA Part 23 and Part 25 include both include serious or fatal injury to occupant. Do not believe that "Category Enhanced" criteria should be more severe then Part 25. UAM market will be limited to high density regions, short duration trips with limited number of routes due to infrastructure.	Align failure condition definitions directly with Part 23 and Part 25 guidance.	No	Yes	Not accepted	The definitions for Failure conditions have been adapted to the context of urban air mobility, which also needs to take into account the harm to people on the ground. This also aligns with the approach for SC Light UAS and SC RPAS where a fatality (on the ground) would be classified Catastrophic.
32-33	*GAMA*	Safety Assessment Process	53	Definition for Hazardous failure condition inconsistent with prior standards. FAA Part 23 and Part 25 include both include serious or fatal injury to occupant. Do not believe that "Category Enhanced" criteria should be more severe then Part 25. UAM market will be limited to high density regions, short duration trips with limited number of routes due to infrastructure.	Align failure condition definitions directly with Part 23 and Part 25 guidance.	No	Yes	Not accepted	See comment 32-32
32-34	*Airbus Helicopters (SB)*	2510 (6)(a)(4)	53	Hazardous definition is more stringent than for helicopters, for which one fatality, excluding flight crew, is part of the definition	Have a better harmonization of HAZ definition between AMC25, AC27/29 and this document	yes	yes	Not accepted	See comment 32-32
32-35	*Embraer*	MOC VTOL.2510 Equipment, systems, and installations, item 6 (a) (4)	53	The definition of a Hazardous Failure Condition is more rigorous than that of part 25 and part 29. This might prevent the use of traditional aerospace architectures and components, as well as their traditional compliance demonstration.	To align the definition of Hazardous Failure Condition to its typical understanding.	Yes	No	Not accepted	See comment 32-32
32-36	*GAMA*	MOC VTOL.2510 Equipment, systems, and installations, item 6 (a) (4)	53	The definition of a Hazardous Failure Condition is more rigorous than that of part 25 and part 29. This might prevent the use of traditional aerospace architectures and components, as well as their traditional compliance demonstration.	To align the definition of Hazardous Failure Condition to its typical understanding.	Yes	No	Not accepted	See comment 32-32

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32-37	*Rolls Royce (F. Musella)*	MOC VTOL.2510	53	The definition of Hazardous Failure Conditions for Category Enhanced excludes fatal injury to an occupant due to the high number of operations anticipated and the public safety expectations in the air taxi/urban air mobility context. Seems now that the Major and Hazardous definition are very similar and it could be difficult to assess those Failure Conditions uniformly to guarantee equal treatment of all applicants. The public safety expectations has been already covered by the Safety Objectives that for Category Enhanced are independent from the maximum passenger seating configuration. I agree that fatalities on the ground need to be Catastrophic, and this is reflected in the CAT definition *"Failure conditions that would prevent continued safe flight and landing of the aircraft are also considered catastrophic"* assuming that a safe landing definition does not include only the safety of the VTOL occupants.	Re-evaluate the definition of Hazardous Failure Conditions for Category Enhanced	Yes	No	Not accepted	For category enhanced the distinction between major and hazardous is based on the crew efficiency vs. ability to perform a task and the notion of serious injuries. Please note that, there is MOC VTOL.2320(a)(2) on serious injuries, which helps making the distinction between Major and Hazardous for the aspect of injuries.
32-38	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 6. Failure conditions classifications and probability terms Para a(4) & a(5)	53 & 54	MOC VTOL.2510(6)(a)(4) & (5) Definitions of Hazardous & Catastrophic The distinction between Enhanced Category and Basic Category is an operational one. The operators of VTOL aircraft might not have the same experience of the link between design and operational considerations as the operators of more traditional commercial air transport activities. As the distinction between Enhanced and Basic is fundamental to the level of integrity required for the affected systems, it may be helpful to include a reference to the CONOPS for VTOL. This will help to ensure that both the design/manufacturing and the flight operations communities are aware of the need to fully consider the interaction between design integrity and operational use.	Provide supporting information that highlights the criticality of defined operational use to the integrity of the onboard systems. Consider adding AFM requirements related to a specific statement to the effect that aircraft certificated within the Basic Category cannot be used for Enhanced Category operations.	Yes	Yes	Noted	It is planned that operational limitations will be included in the AFM and Type Certificate Data Sheet (TCDS). See also SC-VTOL-01 Comment Response Document Explanatory Note 10.
32-39	THALES Avionics	MOC VTOL.2510	53	Considering that there may be only one onboard flight crew member, flight crew incapacitation is likely to be higher than 1E-7. How does EASA intend to tackle this issue? Shouldn't ground crew member, auto landing system, or others mitigations strategies be used to alleviate the vulnerability related to the flight crew member? If so, Catastrophic and Hazardous classification (MOC VTOL.2510) may need to take that into consideration.		Observation	Substantive	Noted	System failures leading to flight crew incapacitation will be considered Catastrophic. This is the same approach as for other CSs (e.g. CS 23 single pilot). Flight crew incapacitation as a single originating event is outside of the scope of VTOL.2510, as there are no system failures involved.

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32-40	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (6) (a)	53	The definitions proposed for Hazardous and Catastrophic failure conditions for Category Enhanced are more onerous than the existing definitions in AMC 25.1309 for large aeroplanes. In particular, a failure condition that could result in fatal injury to a relatively small number of the occupants other than the flight crew is considered Hazardous by AMC 25.1309 but Catastrophic by MOC VTOL.2510. EASA have claimed that VTOL aircraft need to be "safer than airliners" because they will be deployed in large numbers and will operate over populated areas. When I participated in the external consultation for JARUS SORA, I objected that SORA does not take the size of the fleet into account when determining the Specific Assurance and Integrity Level (SAIL). JARUS rejected my comment, responding that "Fleet impact on safety level is not typically considered in aviation". It is inconsistent to claim that the size of the fleet does not need to be taken into account for UAS, but that it does need to be taken into account for VTOL aircraft. Either JARUS SORA (which has now been accepted by EASA) is wrong or MOC VTOL.2510 is wrong. If JARUS SORA is wrong, it means that very large fleets of UAS are about to be deployed with inadequate levels of assurance and integrity.	Change to "(iii) for Category Enhanced, serious or fatal injury to a relatively small number of the occupants other other than the flight crew, or" Change to "(i) For Category Enhanced, failure conditions, which would result in multiple fatalities, usually with the loss of the aircraft. Failure conditions that would prevent continued safe flight and landing of the aircraft are also considered catastrophic".	no	yes	Not accepted	A high number of operations was the assumption for establishing the safety objectives for the MOC to SC.VTOL. In addition it is linked to the public expectation in an air taxi operation. SORA is driving the operational risk assessment and does not impose safety objectives. If in the future an UAS becomes a small VTOL, used to carry passengers, it will need to comply with the safety objectives set out in SC VTOL.
32-41	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 6 (5) Catastrophic	53	It is not clear what is the difference between (i) Category Enhanced and (ii) Category Basic. It seems to be that both include one fatality (" or fatal injury to a flight crew member") and multiple fatalities as well as loss of aircraft and failure to make a landing, emergency or otherwise.	Make clear the difference of the definition of Catastrophic for the 2 Categories or merge and only have one.	Yes	No	Noted	The difference between those definitions is focused on the prevention of "continued safe flight and landing" as opposed to "controlled emergency landing". Please also see the definitions of "continued safe flight and landing" and "controlled emergency landing" in the MOC VTOL.2000.Regarding the use of "multiple" for Category Basic: For Category Basic a Failure Condition which would result in <u>one</u> fatality of an occupant other than the flight crew is not considered catastrophic. Based on these clarifications, no change to the text is deemed necessary.
32-42	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 6. Failure conditions classifications and probability terms Para a(5)	53 & 54	MOC VTOL.2510(6)(a)(5) Definition of Catastrophic The definition of Catastrophic for Enhanced Category appears to exclude the possibility of fatalities to occupants other than the flight crew. As the rest of the definition relates to loss of the aircraft and/or prevention of continued safe flight and landing, this might not be practically achievable. Additionally, the explanatory note at the end of this section only addresses the removal of passenger fatalities from the definition of Hazardous. It does not cover the removal of passenger fatalities from the definition of Catastrophic.	If the removal of the reference to fatalities of occupants other than the flight crew was unintentional, update the definition of Catastrophic for the Enhanced Category. If the removal of the reference to fatalities of occupants other than the flight crew was intentional, update the explanatory note to: • Include Catastrophic for Enhanced Category Provide some guidance on how the industry would be expected to approach this, given the base definition of hull loss and/or inability to maintain continued safe flight and landing.	Yes	Yes	Accepted	The explanatory note has been complemented in order to clarify what the term fatalities is referring to. Fatalities include any occupant (flight crew and passenger) of the VTOL and people on ground.

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32-43	Collins Aerospace	MOC VTOL.2510 6. (a) (5)	53	Wording seems a bit unclear. If taken literally, it seems to state that incapacitation of a crew member, without loss of life or loss of aircraft would also be considered a catastrophic event. Is this normally considered a catastrophic event / consistent with other guidance?	Perhaps in the explanatory note state that since the assumption / expectation that incapacitation is included because the assumption / expectation is that these are single piloted vehicles.	Yes	No	Noted	It is a standard wording as used in the standard recognized as AMC to CS 23 (ASTM_F3230-17).
32-44	*GAMA*	6. Failure conditions classifications and probability terms	54	*Definition for Category Enhanced in SC-VTOL-01 is "operation over congested areas or for commercial Air Transport operations", but it described as "when flying over congested areas and when conducting commercial air transport".* *The "or" and "and" make the scope differently.* *VTOL.2005(b)(1)* *Aircraft intended for operations over congested areas or for Commercial Air Transport operations of passengers must be certified in this category* *"Explanatory Note: The Categories Basic and Enhanced were introduced in the Special Condition to allow proportionality in safety objectives. The highest safety levels of Category Enhanced apply for the protection of third-parties when flying over congested areas "and" when conducting commercial air transport of passengers."*	Determine if 'flying over congested areas "and" when conducting commercial air transport of passengers' should be 'flying over congested areas "or" when conducting commercial air transport of passengers'	Yes	No	Accepted	Explanatory Note changed to: "*Explanatory Note: The Categories Basic and Enhanced were introduced in the Special Condition to allow proportionality in safety objectives. The highest safety levels of Category Enhanced apply for the protection of third-parties when flying over congested areas **or** when conducting commercial air transport of passengers"*
32-45	*Pipistrel*	6. Failure conditions classifications and probability terms	54	*Definition for Category Enhanced in SC-VTOL-01 is "operation over congested areas or for commercial Air Transport operations", but it described as "when flying over congested areas and when conducting commercial air transport".* *The "or" and "and" make the scope differently.* *VTOL.2005(b)(1)* *Aircraft intended for operations over congested areas or for Commercial Air Transport operations of passengers must be certified in this category* *"Explanatory Note: The Categories Basic and Enhanced were introduced in the Special Condition to allow proportionality in safety objectives. The highest safety levels of Category Enhanced apply for the protection of third-parties when flying over congested areas and when conducting commercial air transport of passengers."*	Determine if 'flying over congested areas and when conducting commercial air transport of passengers' should be 'flying over congested areas or when conducting commercial air transport of passengers'	Yes	No	Accepted	See answer to comment 32-44

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32-46	*GAMA*	MOC 3 VTOL.2510 (6)(a)(5)(iii)	54	"For Category Basic, failure conditions, which are expected to result in multiple fatalities, or incapacitation or fatal injury to a flight crew member, usually with the loss of the aircraft."	Replace the highlighted text with "resulting in." "For Category Basic, failure conditions, which are expected to result in multiple fatalities, or incapacitation or fatal injury to a flight crew member, resulting in the loss of the aircraft."	Yes	No	Not accepted	The comment proposes to link the two conditions, i.e. effect on occupants and effect on aircraft, which EASA does not deem appropriate. The wording is the same as in AMC 25.1309
32-47	*Leonardo Helicopters*	MOC VTOL.2510	54	Please clarify the point (b) Qualitative Probability Terms. It should be clarify when it is possible to use the qualitative approach: • As alternative to quantitative or in conjuction • for what system (structural, electrical, hydraulic, simple, etc.) for what severity classification	Please take in consideration the ASTM F3230 4.2.4.1 and 4.2.4.2	NO	YES	Noted	The MOC VTOL.2510 recognizes ARP4761, which addresses this particular aspect in figure 4 and can be used to define the type of analysis needed.
32-48	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (6) (b)	54	The plural of "aircraft" is "aircraft".	Change "aircrafts" to "aircraft".	yes	no	Accepted	Wording changed.
32-49	*Rolls Royce (Mark Bellis)*	MOC VTOL.2510 7(a)	P55	Observation: in Table 1, craft carrying few people (0-1 or 2-6) have more lenient FDAL requirements, despite the fact that any craft could be the cause of an incident involving multiple craft or personnel on the ground. Other aspects, such as No Single Failure and probability (or rate) targets, often require a system architecture of at least two nodes. Note A states that "no considerations of the system architecture for a DAL reduction are acceptable". Note A should encourage single-failure elimination and rate reduction by system architecture, despite the stance denying DAL reduction.	Suggested text: "Note A: Considerations of the system architecture are acceptable for single-failure elimination and for failure probability (and rate) compliance but not for a DAL reduction, as the FDAL classification already constitutes a proportionate approach. Where this note applies, all redundant trains of the system architecture should meet the stated minimum DAL."	Yes		Noted	Indeed system architecture considerations to comply with safety objectives are required (No single failure criterion and quantitative probabilities) , but it is not the purpose of the Note A to emphasize this aspect. We confirm your understanding, however the note is clearly focused on the DAL reduction considerations.

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32-50	*Boeing*	MOC VTOL.2510 Equipment, systems, and installations (7)(a)	54-55	THE PROPOSED TEXT STATES: Note A: no considerations of the system architecture for a DAL reduction are acceptable, as the FDAL classification already constitute a proportionate approach. REQUESTED CHANGE: Remove Note A: ~~Note A: no considerations of the system architecture for a DAL reduction are acceptable, as the FDAL classification already constitute a proportionate approach.~~	JUSTIFICATION: 1) ARP 4754A section 5.2.1. "If a Catastrophic Failure Condition could result from a combination of possible development errors between two or more independently developed aircraft/system functions or items then, either one Development Assurance process is assigned level A, or two Development Assurance processes are assigned at least level B. The other independently developed aircraft/system functions or items are assigned no lower than Development Assurance Level C. The Development Assurance process establishing that the two or more independently developed aircraft/system functions or items are in fact independent should remain level A. 2) FDAL/IDAL assignment requires the following information: 1) AFHA/SFHA FC Data 2) Functions and Sub functions descriptions 3) Proposed A/C and System Architecture 4) Relevant PASA/ PSSA data which provides information on interdependencies 5) Then, the applicant will assess the initial FDAL / IDAL assignment against architecture considerations, which will produce a revised FDAL/IDAL with FFS and independency substitution. 3) ARP 4754 Section 5.2.3.2.1.1 Functional Independence, and section 5.2.3.2.1.2 Item Development Independence provides clear guidance on the attributes to be require to establish independency of functions These three points within ARP4754 allows to have FDAL/IDAL which allows for considerations of the system architecture for a DAL reduction are acceptable since this allows to creates robust system which are being in Part 25 and Part 29 aircraft. This would represent a higher level of conservatism than those use in Part 29 & Part 25 which are higher risk than part 23/Part 27			Not accepted	The approach is the same as for the aircraft classes in CS-23. As the lower categories of VTOL (Basic 1-3) are not used for commercial air transport or over congested areas where people on the ground are at risk, a higher overall risk for a given Failure Condition can be acceptable. The resulting alleviation in allowable probabilities is accompanied by lowering the required FDAL for a given Failure Condition. As this already constitutes a proportionate approach, further alleviation (through application of ARP4754A section 5.2.1) is not considered appropriate. A single DAL reduction is allowed in ED79A. When note A is applicable, the DAL reduction is already performed at MOC VTOL.2510 level as part of the proportionate approach.
32-51	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (7) (b)	55	The text does not make it clear whether EASA accept that the mitigation strategy for systematic errors can be a single DAL A development process for a Catastrophic Failure Condition, as per ED-79A/ARP4754A sections 5.2.1 and 5.2.3.1. MOC VTOL.2510 (7) (b) makes some ambiguous statements and concludes with "Early coordination with EASA on this aspect is advised".	Clarify whether EASA accept that the mitigation strategy for systematic errors can be a single DAL A development process for a Catastrophic Failure Condition. If not, explain and justify why the EASA position differs from that of ED-79A/ARP4754A and that of the FAA.	no	yes	Noted	ED79A/ARP4754A is indeed allowing an FDAL A function to be implemented by a single IDAL A item. Still, as captured in ED79A/ARP4754A in this particular case the applicant may be required to provide further substantiation. See for example table 3 note 1 of ED79A/ARP4754A. Furthermore, EASA has been informed through Continued Airworthiness of a number occurrences due to development error in IDAL A item. EASA position is that common mode, including development error, should be analysed in the CMA and proper mitigation put in place.

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32-52	*Airbus Helicopters (SB)*	2510.7	54/55	The qualitative definitions of (6)(b) are based on occurrence on the fleet. It is translated in (7) in quantitative probabilities. Nevertheless such a translation depends on the soze of the fleet	Assumptions about the size of the fleet are not mentioned, and quantitative objectives may be conflicting with some market projections.	yes	yes	Noted	The definition is equivalent to other .1309 qualitative probability terms and similar definitions have been used for other aircraft types in order to define the safety objectives. The quantitative safety objectives of table 7 should be used, irrespective of the fleet size.
32-53	Collins Aerospace	MOC VTOL.2510	55	The intent of the Category Enhanced in SC VTOL 01 is to ensure that catastrophic events involving eVTOL aircraft flying over congested areas or carrying passengers for a fee, are extremely improbable. This will become exceedingly important when such operations become widespread, e.g. orders of magnitude more frequent than existing helicopter air taxi operations. If there are tens of millions of Category Enhanced operations a year, then pilot incapacitation or hazardously erroneous pilot actions in a single pilot aircraft will likely become the leading source of catastrophic events. This leads to a question: should incapacitation of a pilot and hazardously erroneous pilot actions be considered in the safety analysis for the Category Enhanced? In our view, they should be considered. There is a reference to pilot errors in VTOL.2600 (b): "The system and equipment design must account for flight crew errors, which could result in additional hazards. " This could create an avenue for including specific actions in the means of compliance.	Impose a requirement for the Category Enhanced that an aircraft shall be able to achieve continued safe flight and landing in the event of incapacitation of one pilot. This allows airframers to pursue a couple of routes to achieve compliance: a) have a second pilot b) design appropriate automation and procedures to ensure that aircraft can continue safe flight and landing after incapacitation of a sole pilot onboard, rendering this event non-catastrophic. It is not clear how to deal with hazardously erroneous actions of a single pilot, but at least adding a requirement for dealing with an incapacitated pilot will help alleviate this concern as well, since the pilot or passengers could potentially activate such a system as a last resort.	No	Yes	Noted	See answer to comment 32-39 In addition, the proportion of pilot related accident does not depend on the number of aircraft in service. Pilot incapacitation (Partial/complete) is not meant to be addressed through 2600(b).
32-54	*Pipistrel*	MOC VTOL.2510(7)(Table 1)	55	MOC VTOL.2510(6)(a)(1) introduces Failure Conditions that would have no effect on safety, but they are not included in Table 1 in MOC VTOL.2510(7).	Update Table 1 to cover all failure conditions from MOC VTOL.2510(6)(a). Add 'No Safety Effect' to the Table.	Yes	No	Not accepted	FC having No Safety Effect do not have safety objectives associated, adding it to the Table does not add value.
32-55	*GAMA*	MOC VTOL.2510(7)(Table 1)	55	MOC VTOL.2510(6)(a)(1) introduces Failure Conditions that would have no effect on safety but they are not included in Table 1 in MOC VTOL.2510(7).	Update Table 1 to cover all failure conditions from MOC VTOL.2510(6)(a). Add 'No Safety Effect' to the Table.	Yes	No	Not accepted	See comment 32-54
32-56	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (7) Table 1	55	I have no objection to the principle of alleviating the safety objectives for Category Basic, but it is illogical to change the quantitative safety objectives in Table 1 while leaving the qualitative probability terms unchanged. For example, in MOC VTOL.2510 (6) (b) (4), Extremely Improbable Failure Conditions are defined to be those that are so unlikely that they are not anticipated to occur during the entire operational life of all aircraft of one type. In Table 1, Extremely Improbable is variously defined to be $\leq 10^{-9}$, $\leq 10^{-8}$ and $\leq 10^{-7}$, yet it is the safety objective that is changing, not the expected operational life or the number of aircraft of one type.	It would be more logical to update VTOL.2510 to state that the safety objectives are alleviated for Category Basic, rather than modifying the probability associated with Extremely Improbable in MOC VTOL.2510. Perhaps it is VTOL.2510 that ought to contain a table rather than MOC VTOL.2510?	yes	no	Noted	The definition is equivalent to other .1309 qualitative probability terms and similar definitions have been used for other aircraft types in order to define the safety objectives. The proportionality is introduced at the level of the safety objective considering the societal acceptance of the risk for a given category of aircraft. The same approach has been taken for CS 23 and accepted by industry.

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32-57	FAA RSB SW	7. Safety Objectives Table 1	55	Pursuant to EASA's regulations and guidance that all UAM vehicles (i.e., large and small) are required to meet the Enhanced Category, this section has assumptions about how UAMs will be publically used. UAMs may be adopted/demanded by the general public as mass transit and/or personal vehicles. This one-size fits all for the Category Enhanced needs Safety-Continuum tiering as was done for the Basic category.	Recommend a Safety Continuum for Category Enhanced.		Objection	Noted	The special condition is limited to VTOL designs with a maximum of 9 passengers. For larger VTOL further requirements will need to be defined in the future. As stated in the explanatory note of the Special Condition: "The highest safety levels [in the frame of this SC] of Category Enhanced [apply for] the protection of third-parties when flying over congested areas or when conducting commercial air transport of passengers." "Both evaluations [*the second one 'based on the Concept of Operations that were provided by applicants and further complemented by market projection analyses'*] confirmed that the current system safety objectives for CS-25 and CS-27/29 aircraft should be maintained as a minimum for the commercial air transport operations of passengers as well as for urban air mobility using VTOL aircraft to address the risks to persons on board and on the ground."
32-58	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 7 Safety Objectives Table 1	55	There is an inconsistency between the FDAL allocated for 0-1 passengers and the EASA issued guidance for unmanned aircraft (see JARUS SORA). Given the size of aircraft needed to be able to carry 1 passenger, FDAL C is below that needed for the relevant UAS category. The allocation by use of a table of such categorisation is highly suspect and largely arbitrary and has been generally discontinued as an approach to safety as a result.	A complete review of this table, its removal would be best and left to the Applicant to justify the appropriate FDAL through proper application of ED-79A/ARP4754A and ARP4761 which is outlined in sub-para 8 and 9 of this section.	No	Yes	Noted	The AMC1 Article 11 Rules for conducting an operational risk assessment to EASA regulation (EU) 2019/947 (which is based on JARUS SORA) is proposing a methodology for operational safety assessment. It is not allocating any DAL for given UAS categories. The DAL needed for a relevant failure condition in a given UAS category will be indicated in the relevant CS/SC applicable to the product in question, not through the SORA methodology. Due to different assumptions, no immediate comparison between JARUS SORA and SC VTOL is possible. Table 1 is a key fundament of the proportionality framework for VTOL products. It is considered acceptable to have a FDAL C for a VTOL in the Category Basic 1 (0-1 passengers).
32-59	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (7) Table 1	55	I am confused as to the meaning of Note A. ED-79A/ARP4754A allows an FDAL A aircraft function to be implemented by a single item, which is IDAL A. It also allows the FDAL A aircraft function to be implemented by two independently developed items, one of which is IDAL A and the other is IDAL C, or both of which are IDAL B. It is hinted elsewhere in this MOC that EASA would not accept a single item developed to IDAL A, though this is never stated explicitly. In any case, what does Note A mean? For Category Basic 2, would EASA accept a single IDAL B item? Would EASA accept one item developed to IDAL B and a second item developed to IDAL D? Presumably, EASA would not accept two items developed to IDAL C? Likewise, for Category Basic 1, would EASA accept a single IDAL C item? Would EASA accept one item developed to IDAL C and a second item developed to IDAL D?	Clarify what is meant by Note A, giving examples.	no	yes	Noted	This note is based on the consideration that due to proportionality, the quantitative probabilities have been already reduced once, therefore no further reduction is deemed acceptable. The same principle has been used in other product categories, e.g. in CS-23. To the second part of the comment: The considerations for FDAL/IDAL allocation are application dependent and can be only discussed on a case by case basis.

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32-60	*Rolls Royce (C Ludena)*	MOC VTOL.2510	55	Table 1 Safety Objectives Suggestion to add a Note to capture the single failure requirements for the different categories (basic vs. enhanced) as defined in MOC VTOL.2240(d) and MOC.VTOL2250c	Please clarify	yes	no	Not accepted	The no single failure criterion for structures is contained in VTOL.2250(c) and associated MOC and does not need to be repeated in MOC VTOL.2510. The MOC VTOL.2240(d) is linked to MOC VTOL.2510 through the paragraph on single failure and common cause considerations, which is referring to PRA. Therefore a note is not considered necessary. Note that there are also some considerations related to independence in VTOL 2430(a)(1) and to single failure in SC-EHPS
32-61	*GAMA*	Table 1: Safety Objectives Note C	55	Recommend to consider whether this guidance is too vague to ensure a consistent approach is applied across applicants. The concern is that this may become overly burdensome if, for example, service history is unavailable and a "buffer" is then the only acceptable way of showing compliance. In many cases a conservative safety approach may already be used and it should be supported that this an acceptable means of accounting for uncertainty.	Consider removing.	No	Yes	Not accepted	A similar note exists in CS 25.1309 11. (e)(4). This approach commonly used on other products for years has not prevented applicant to introduce new technologies or resulted in inconsistent approach. The note reinforces the importance that uncertainty should be accounted for in a way that does not compromise safety, i.e. conservatively estimating the component failure rate, when calculating estimated probability of a certain failure condition.
32-62	*Leonardo Helicopters*	MOC VTOL.2510	55	Please clarify the Note C. How is it possible to take into account the component failure rate uncertainty?	Replace the Note C with what reported in the ASTM F3230 point 4.2.5 also reported below: *"It is recognized that there is inherent variance in predictions used to demonstrate that these probabilities are met; it may therefore be acceptable, provided the analysis can be shown to be conservative and is acceptable to the governing civil aviation authority, to be slightly above the probabilities shown."* As alternative please use the "order of magnitude" as per AC 29-2C.	NO	YES	Not accepted	See comment 32-61
32-63	*GAMA*	Table 1: Safety Objectives Note D	55	Suggest allowance for not performing quantitative analysis for major failure conditions when the system is simple/not complex similar to Figure 1 of ASTM F3230 (referenced by AMC and GM to CS-23 Issue 2). Although VTOL systems are new, there are likely many systems/functions which will not be new or complex enough to warrant a quantitative analysis. A similar allowance is made for Development Assurance in section 9 on page 58, allowing for simple systems to be considered DAL A without the rigor required of complex systems.	Update "Minor" to "Major" or reference a depth of analysis flowchart like that found in ASTM F3230.	No	Yes	Noted	The MOC VTOL.2510 recognizes ARP4761, which addresses this particular aspect in figure 4 and can be used to define the type of analysis needed.
32-64	*Leonardo Helicopters*	MOC VTOL.2510	55	Note D. Is it not clear if for Minor failure condition the OEM shall perform a qualitative analysis for the Minor failure condition.	We suggest to update the Note D as: "For Minor failure conditions it is expected that the applicant performs only FDAL/IDAL assessment.	NO	YES	Noted	See answer to comment 32-63 For Minor Failure Conditions, usually a qualitative assessment, such as Design and Installation Appraisal, may be necessary to show compliance with the safety requirements

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32-65	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.7, Table 1	55	Can we include rationale for the lower probability and FDAL requirements for Category Basic 2 and Basic 1?	Add rationale	Yes	No	Noted	The Basic Categories objectives have been derived from the Enhanced Category objectives by applying proportionate downgrading of objectives. The differences with similar CS-23 safety objectives is justified through the relative increased complexity of VTOL systems compared to General Aviation. Refer to SC VTOL Paragraph “Link to type of Operations” for more background.
32-66	*Airbus Helicopters (FXG)*	VTOL 2510 (7)	55	Safety objectives in category basic are lower than CS-27 ones for less or equal than 6 occupants. Pending the update of CS-27 with the safety continuum concept foreseen on 2022-Q1 (RMT.0712 – Rotorcraft Safety Assessment) a non-level playing field will exist between VTOLs of the ‘Basic’ category and CS-27 rotorcraft.			X	Noted	One of the reasons of the introduction of proportionality for CS 27 rotorcraft (in the frame of RMT 0712), is that it is envisaged that VTOL and rotorcraft will to a certain extent cover similar types of operations in a similar operational environment and equal treatment will need to be ensured to allow a level playing field.
32-67	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 7. Safety Objectives Para (a) Table 1: Safety Objectives	55	Table 1 states that the safety objective for catastrophic failure for Basic Cat VTOL aircraft for >6 passengers is <10-9 failures per hour. This failure rate has generally not been achievable for single, complex fatigue loaded mechanical components on CS 29 helicopters. Turbine engine disks have a target of 10-8 in CS-E.	Clarification should be provided in the MoC that designs will not be accepted where single fatigue loaded rotating components need to achieve a failure rate of 10-9. If such parts have a means of condition monitoring, this may then be acceptable, but the associated means of condition monitoring would need to be substantiated using direct evidence (see CS 29.1465 AMC). It may also be prudent to extend this guidance to failures with catastrophic effect on Basic Cat VTOL aircraft for >1 passenger, with a target of 10-8.	Yes	Yes	Noted	SC VTOL and the associated MOC aims at being non prescriptive and reference to specific technologies is being avoided. If a specific design does not meet the quantitative and qualitative safety objectives, it is not acceptable. See also MOC VTOL.2250(c) for design and construction principles and MOC VTOL.2240(d) for PRA on High Energy Fragments.
32-68	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 7 Safety Objectives (a) Table 1	54/55	This section partially pre-supposes the analysis that should be undertaken by the Applicant under ED-79A/ARP4754A and ARP4761. It seems to provide a reduction in FDAL that would not be accepted even for General Aviation in that FDAL C would not be approved for Catastrophic/ Extremely Improbable. Numerous other FDAL assignments are unjustified against passenger/occupants. The allocation by use of a table of such categorisation is highly suspect and largely arbitrary and has been generally discontinued as an approach to safety as a result.	A complete review of this table, its removal would be best and left to the Applicant to justify the appropriate FDAL through proper application of ED-79A/ARP4754A and ARP4761 which is outlined in sub-para 8 and 9 of this section.	No	Yes	Not accepted	The use of such a table mapping DALs to Failure conditions in a proportionate manner is not new and is already used e.g. in the AMCs to CS-23 issue 5, AC 23.1309-1E. We do not agree to remove this table as it is a key fundament of the proportionality framework for VTOL products. The rationale for the Enhanced Category is based on a thorough analysis of the risk posed by VTOL products in an urban mobility environment. The Basic Categories objectives have been derived from the Enhanced Category objectives by applying proportionate downgrading of objectives. The differences with similar CS-23 safety objectives is justified through the relative increased complexity of VTOL systems compared to General Aviation. Refer to SC VTOL Paragraph “Link to type of Operations” for more background.
32-69	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 7. Safety Objectives Para (b) Single failure and common cause failure considerations	55 & 56	MOC VTOL.2510(7)(b) Single Failure and Common Cause Failure Considerations Will any form of EWIS analysis be required for VTOL aircraft?	Question only, no proposed resolution.	Yes	Yes	Noted	There are no specific EWIS requirements for VTOL aircraft (as there are not in the CS23, CS27 or CS29). The TGM 21/7 can be followed to demonstrate compliance with general requirements (2510 and others), as is already the case for small/large rotorcraft. It includes a dedicated paragraph for Safety Assessment for wiring.

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32-70	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 7. Safety Objectives Para (b) Single failure and common cause failure considerations	55	MOC VTOL.2510(7)(b) Single Failure and Common Cause Failure Considerations, states; "While single failures should normally be assumed to occur, experienced engineering judgment and relevant service history may show that a catastrophic failure condition by a single failure mode is not a practical possibility." This contradicts SC VTOL.2250(c) which is unequivacol in stating "For Category Enhanced, a single failure must not have a catastrophic effect upon the aircraft".	Either remove this paragraph from the MoC, or allow this as a possibility by changing the SC to something like: VTOL.2250(c) – "*For Category Enhanced, where a single failure is considered to be a practical possibility it must not have a catastrophic effect upon the aircraft unless …….*".	Yes	Yes	Not accepted	The intent of this paragraph is to provide a similar framework as in AMC 25.1309 11(b)(2). VTOL.2510(a)(1) states that "each catastrophic failure condition is extremely improbable and does not result from a single failure;" This is not considered to be contradicting the paragraph the comment is referring to. It does not supersede requirement such as VTOL.2250.
32-71	*Rolls Royce (F. Musella)*	MOC VTOL.2510	55	*(b) Single failure and common cause failure considerations:* *According to VTOL.2510(a)(1), a catastrophic failure condition must not result from a single failure.* *While single failures should normally be assumed to occur, experienced engineering judgment and relevant service history may show that a catastrophic failure condition by a single failure mode is not a practical possibility. The logic and rationale used in the assessment should be so straightforward and obvious that the failure mode simply would not occur unless it is associated with an unrelated failure condition that would, in itself, be catastrophic.* Does the statement above mean that an assessment based on experienced engineering judgment and relevant service history that the failure mode causing a catastrophic failure condition simply would not occur is allowed?	Please clarify	Yes	No	Noted	The intent of this paragraph is to provide a similar framework as in AMC 25.1309 11(b)(2). There might be a limited number of cases, where based on engineering judgement it can be shown that because of a specific design, certain failure mode(s) cannot happen, i.e. it does not exist within the design. In these cases, service experience can support the analysis. Note that service history needs to be relevant: Usually service history data are limited to the fleet of aircraft type(s) for which the applicant is the holder of the Type Certificate(s), the owner of the data, or, if accepted by the Agency, has an agreement in place with the owner of the data that permits its use by the applicant for this purpose.
32-72	*Airbus Helicopters* *(SB)*	2510.7	55	According to VTOL.2510(a)(1), "*each catastrophic failure condition …does not result from a single failure.*" Straight forward for "physical failures/random failures", nevertheless as errors are a subset of failures, the understanding is that "catastrophic failure condition must not result from a single error."	This goes beyond spirit of ARP4754A/4761, it should be added "*without appropriate mitigation*"	yes	yes	Partially accepted	The wording used in VTOL.2510(a)(1), can also be found in CS 25, SC RPAS, SC LIght UAS The note in the definitions for "Error" will be amended to make clear, that errors may cause failures, but are not considered to be failures. SC VTOL does not contain a requirement which is requesting that no single error shall result in a catastrophic failure condition. Errors in development, manufacturing, installation, and maintenance can result in common-cause failures (including common mode failures) and cascading failures. They should, therefore, be assessed and mitigated as part of the common-cause and cascading failures considerations. The section on single failure considerations has been updated for clarification.

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32-73	*GAMA*	MOC VTOL.2510(7)(b)	56	MOC VTOL.2510(7)(b) has added a note that includes common mode errors in a section devoted to single failures and common cause failures. Failures are not errors, so it is unclear why EASA has included errors in this section about failures. The addition of common mode errors under the single failure discssuion is inconsistent with existing Part 23/25/27/29 regulations. The existing regulations establish design assurance as an acceptable mitigation for common mode errors.	Remove common mode errors from a section devoted to how to address failures. If common mode errors need to be mitigated by more than DAL, EASA should provide more complete and clear direction in a dedicated section on what the acceptable means are for mitigating various types of common mode errors.	No	Yes	Accepted	Wording changed to common mode failure. Paragraph has been updated to clarify the link between errors and common cause/common mode failures
32-74	*Pipistrel*	MOC VTOL.2510(7)(b)	56	MOC VTOL.2510(7)(b) has added a note that includes common mode errors in a section devoted to single failures and common cause failures. Failures are not errors, so it is unclear why EASA has included errors in this section about failures. The addition of common mode errors under the single failure discussion is inconsistent with existing Part 23/25/27/29 regulations. The existing regulations establish design assurance as an acceptable mitigation for common mode errors.	Remove common mode errors from a section devoted to how to address failures. If common mode errors need to be mitigated by more than DAL, EASA should provide more complete and clear direction in a dedicated section on what the acceptable means are for mitigating various types of common mode errors.	No	Yes	Accepted	See answer to comment 32-73
32-75	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 7 Safety Objectives (b)	55/6	It is not clear what the intended outcome from this guidance would be. It is clear that ARP4761 is to be used, but does not mention ED-79A/ARP4754A which should be used together. The issue would then be what is meant by 'independence'. For example, independence can mean that a triplex system is adequate (as per B777) with same software but different hardware, or quadruplex (as per Eurofighter) with same software and hardware in each channel, or it can mean independent verification activities in perhaps a duplex system. The analysis should show what is required. My view is that it is better to have one DAL A system developed really well (using eg triplex to provide the requisite independence) than to have multiple attempts at diversity/independence, especially for software. This approach for software has been borne out for many years (Leveson/Knight) I am not convinced that "Early coordination with EASA on this aspect is advised" is needed as this is always the case.	Rewrite this section in its entirety. The following need to be addressed: 1. Give a proper definition of ‚independence' 2. Include ED-79A/ARP4754A. 3. Emphasis that it is better to develop one system really well, with the aspects of Leveson/Knight highlighted as an exemplar. 4. Remove the sentence: "Early coordination with EASA on this aspect is advised."	No	Yes	Noted	1. As of today no harmonized/agreed definition of independence is available; 2. ED-79A is referenced in several instances in the MOC VTOL.2510 (e.g. in Section 8. "Guidance on how to perform the Safety Assessment process can be found in ED-79A/ARP4754A and ARP4761", in Section 9. "For the aircraft and for systems of FDAL A, B, C or D, this MOC recognises the ED-79A/ARP4754A as acceptable guideline for establishing a development assurance process from aircraft and systems levels down to the level where software/ Airborne Electronic Hardware (AEH) development assurance is applied." 3. It is not the intent to put emphasis on any technical solution in this AMC. 4. Current practice is that through dedicated system CRI, EASA is requesting to be involved early in CMA discussion. The intent is to ensure that the necessary CMA activities are performed during the specification and validation phases and that the necessary independence requirements are generated. This method aims at avoiding late findings and redesign in the final phases of the project
32-76	*Rolls Royce (C Ludena)*	MOC VTOL.2510	56	*"The ARP4761 describes types of common cause analyses, which may be conducted, to ensure that independence is maintained (e.g. particular risk analyses, zonal safety analysis, common mode analyses), see also 7 (b) and 7 (c)."* Ref 7c is not available in the document	Ref 7c is not available in the document. Clarify reference 7c	yes	no	Accepted	Reference is removed

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32-77	Lilium GmbH	MOC VTOL.2510 7. Safety Objectives (b)	56	"... common mode analyses), see also 7 (b) and 7 (c)". There is no 7 (b) and 7 (c) in this document. 7b is its own paragraph and 7c does not exist. It seems to be a reference to another section or another document.	Correct references per comment.	no	yes	Accepted	Reference is removed
32-78	FAA RSB SW	8. Safety Assessment Processes	56	All references to Industry Standards and/or guidance in this section appears to be appropriate. Everything else in this section that duplicates and/or tries to supplement those Standards (e.g., whether for COMMON MODE, COMPLEX SYSTEMS or other), is not appropriate and leads to confussion, new vague requirements, loss of applicant time, and increased applicant costs. This includes, but is not limited to all commentary and/or new requirements beyond what is described in the Safety documents (i.e., Special analysis, exhaustive testing, ect.).	Recommend removal of all duplications and/or attempts to supplement Industry Standards and Guidance. If this suggestion is not acceptable to EASA, recommend they go through the normal processes (i.e., Committees, Harmonsization Groups, etc.) to implement changes. This way all parties, including applicants, can weigh-in, understand, and adhere to a consistent approach in all arenas.		Objection	Not accepted	It is also the purpose of an MOC to provide necessary clarification and/or additions to properly use the existing industry standards and guidance in VTOL certification. All the material provided in this paragraph is considered necessary to support applicants in the compliance demonstration.
32-79	*Airbus Helicopters (SB)*	2510.8	56	"*Common mode analysis (CMA) is an analytical method to define independence principles and associated requirements*," Yes, but CMA is also a method to show that sufficient mitigation exists when a DAL A alone strategy is selected.	The point is explained below on page 57 (IDAL A simultaneously affected) but it should be properly introduced	yes	no	Noted	Comment is acknowledged, however the point mentioned is covered by the Section 9 (b) on CMA. It is acknowledged that CMA is used not only to define independence principle in the early stage of the design but also as part of the verification. EASA concur also with the fact that allocating FDAL/IDAL A to function/item should not prevent the applicant to perform a CMA. Development errors should be considered in the CMA irrespective of the FDAL/IDAL of the system/item.
32-80	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (8) (b)	57	What is meant by "When performing a CMA, the notion of single failure is not sufficient, therefore the notion of a single error should be considered in all life cycle of the addressed function/system (development, manufacturing/production phase, support, repair)"? ED-79A/ARP4754A already makes it clear that a CMA should analyze the effects of development, manufacturing, installation, maintenance and crew errors, and failures of system components that defeat the independence.	Clarify what is meant by this sentence.	yes	no	Partially accepted	Paragraph is deleted and clarification added in 7(b): "Common-cause failures (including common mode failures) and cascading failures should be evaluated as dependent failures from the point of the root cause or the initiator. Errors in development, manufacturing, installation, and maintenance can result in common-cause failures (including common mode failures) and cascading failures. They should, therefore, be assessed and mitigated in the frame of the common – cause and cascading failures consideration."
32-81	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.11	60	"Additional considerations may be appropriate for some specific systems and functions. In particular for Fly-by-wire Flight Control Functions, MOC 5 VTOL.2300 applies"	Can we list all applicable VTOL references	Yes	No	Accepted	Considering the published MOC material (issue 1), MOC 4 VTOL.2300 is the only applicable paragraph, as of today.

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32-82	*GAMA*	MOC VTOL.2510(8)(b)(4)	58	MOC VTOL.2510(8)(b)(4) includes the statement: "Additional considerations may be appropriate for some specific systems and functions. In particular for Fly-by-wire Flight Control Functions, MOC 4 VTOL.2300 applies." This doesn't seem appropriate for a standard since it is arbitrary. Assume there are two systems that use the same technology/part and loss of/erroneous operation of either system leads to one or more catastrophic FHA events. What is the rationale for having one system held to a different standard than the other? It's the exact same technology/part in each system, so any potential common mode failures are present in both systems and they both have the same end result (a catastrophic FHA event). The MOC should be written to provide equal standards to all aircraft systems based on their contributions to FHA events. This is especially important for SC VTOL vehicles which will have increasingly integrated solutions where the conventional boundaries between systems become less distinct. Note: reference GAMA letter (GAMA19-19)	Update the MOC to apply equally to all systems.	No	Yes	Noted	There are specific considerations for addressing common mode failures and errors in fly by wire flight control functions, which are related to the high criticality of that particular system and hence are addressed in MOC 4 VTOL.2300 and not in 2510. In a more general sense, the section 2. Applicability states that "*VTOL.2510 is intended as a general requirement that should be applied to any equipment or system as installed, in addition to specific systems requirements*"
32-83	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.8(b)	56	"EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis."	To be clarified. Does this mean identical items in multiple functions all failing together are not allowed to be able to lead to a CAT FC because it is classed as a single failure (error) and DAL A is insufficient mitigation? (E.g. dual channel FADEC is identical equipment on aircraft. Both channels DAL A with lots of common modes and this is accepted)	No	Yes	Noted	The purpose of the paragraph is not about acceptability of architecture, but that IDAL A should not prevent the applicant to perform a CMA. Development errors should be considered in the CMA irrespective of the FDAL/IDAL of the system/item.
32-84	*GAMA*	MOC VTOL.2510(8)(b)	57	MOC VTOL.2510(8)(b) includes the following statement: "It is important to note that even Items that are developed to IDAL A may be subject to development error. Such error may simultaneously affect several instances of the same item with potential functional or safety consequences. EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis." This paragraph does not contain any means of compliance.	Remove this paragraph as it adds no requirements for applicants.	No	Yes	Not accepted	MOC can also include Guidance Material and the intent of this paragraph is to emphasize that development errors should be considered in the CMA irrespective of the FDAL/IDAL of the system/item. We consider this paragraph to give background information and to substantiate our expectations, thus it is in our view important guidance.

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32-85	*Pipistrel*	MOC VTOL.2510(8)(b)	57	MOC VTOL.2510(8)(b) includes the following statement: "It is important to note that even Items that are developed to IDAL A may be subject to development error. Such error may simultaneously affect several instances of the same item with potential functional or safety consequences. EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis." This paragraph does not contain any means of compliance.	Remove this paragraph as it adds no requirements for applicants.	No	Yes	Not accepted	see comment 32-84
32-86	*Vertical Aerospace*	MOC VTOL.2510 Equipment, systems, and installations	57	Page 57 indicates an intent to require dissimilarity as a means to mitigate design errors: ***"When performing a CMA, the notion of single failure is not sufficient, therefore the notion of a single error should be considered in all life cycle of the addressed function/system (development, manufacturing/production phase, support, repair).*** ***It is important to note that even Items that are developed to IDAL A may be subject to development error. Such error may simultaneously affect several instances of the same item with potential functional or safety consequences. EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis."***	CS 25.1309 and AMC 25.1309 have never implied a requirement of "No single error". This implies a fundamental shift in safety regulation away from long established FAR/EASA harmonized regulations. If an individual applicant failed to comply with proper design assurance processes in the past, that should not be construed to imply the processes are deficient or inadequate in any way. It is the obligation of the applicant, and EASA as the auditor, to apply design assurance activities correctly and achieve the intended safety objectives. These objectives have been accomplished many times on many aircraft and continues to be the accepted means of compliance for Part 23 & 25 aircraft. Align MOC with CS 25.1309 and AMC 25.1309.	No	Yes	Accepted	There is no requirement that no single error should lead to a catastrophic failure condition. Errors in development, manufacturing, installation, and maintenance can result in common-cause failures (including common mode failures) and cascading failures. They should, therefore, be assessed and mitigated in the frame of the common-cause and cascading failures consideration. First sentence quoted in the comment ("When performing a CMA…") is deleted as it might be misleading, and clarification is added at the end of the quoted text.

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32-87	*GAMA*	Safety Assessment Process	57	Page 57 indicates an intent to require dissimilarity as a means to mitigate design errors: ***"When performing a CMA, the notion of single failure is not sufficient, therefore the notion of a single error should be considered in all life cycle of the addressed function/system (development, manufacturing/production phase, support, repair).*** ***It is important to note that even Items that are developed to IDAL A may be subject to development error. Such error may simultaneously affect several instances of the same item with potential functional or safety consequences. EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis."***	CS 25.1309 and AMC 25.1309 have never implied a requirement of "No single error". This implies a fundamental shift in safety regulation away from long established FAR/EASA harmonized regulations. If an individual applicant failed to comply with proper design assurance processes in the past, that should not be construed to imply the processes are deficient or inadequate in any way. It is the obligation of the applicant, and EASA as the auditor, to apply design assurance activities correctly and achieve the intended safety objectives. These objectives have been accomplished many times on many aircraft and continues to be the accepted means of compliance for Part 23 & 25 aircraft. Align MOC with CS 25.1309 and AMC 25.1309.	No	Yes	Accepted	See comment 32-86
32-88	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 8 Safety assessment process	57	"EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment." If this had been the case, then it is a failure of certification authorities to properly review architectures, design and implementation.	Remove this sentence.	No	Yes	Not accepted	It is generally recognised that IDAL A does not (cannot) fully prevent errors (no bug free SW & AEH). Development errors should be considered in the CMA irrespective of the FDAL/IDAL of the system/item. EASA has been informed through Continued Airworthiness of a number of occurrences due to development error in IDAL A item. Some of these occurrences were not safety critical thanks to other mitigation means but could have been otherwise. It is deemed relevant to take these occurrences into consideration and to keep the statement so that designers are aware that such occurrences may happen, and that proper mitigation discussed through the CMA process is necessary. This kind of information cannot be published as it is proprietary material.
32-89	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (8) (b)	57	It is claimed that "EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment". No further detail of these cases is provided. If these cases were the result of software development errors that were due to shortcomings in ED-12C/DO-178C, these should have been brought to the attention of EUROCAE and RTCA so that ED-12C/DO-178C could be corrected. This has not happened, to the best of my knowledge. If these cases were the result of development errors outside the scope of ED-12C/DO-178C, there are no grounds to mandate multiple-version dissimilar software, as is implied by this statement. Regulation cannot be based on anectodal evidence.	Provide more detail and analysis of these cases, otherwise delete the sentence.	no	yes	Not accepted	EASA has been informed through Continued Airworthiness of a number of occurrences due to development error in IDAL A item. In particular, EASA is being reported common mode failure/error that are not necessarily made public (not resulting in an AD/SB, accident/serious incidents investigations…). Some of these occurrences were not safety critical thanks to other mitigation means but could have been otherwise. Still, it is deemed relevant to take these occurrences into consideration and to keep the statement so that designers are aware that such occurrences may happen and that proper mitigation discussed through the CMA process is necessary. This kind of information cannot be published as it is proprietary material.

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32-90	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (8) (b)	57	It is stated, “EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis”. What then? It is implied, based on anectodal evidence, that a ED-12C/DO-178C Level A software process is insufficient to mitigate a Catastrophic Failure condition. Analysis of historical aircraft accidents suggests that in those accidents where software was involved, the software implemented its requirements correctly, but the requirements specified behaviour that was unsafe in some unforeseen circumstance. For example, an Airbus A320 overran the runway at Warsaw on 14 September 1993. A contributing factor was that deployment of the ground spoilers and engine thrust reversers was delayed because of a requirement to deploy them only when both main landing gear struts indicated Weight on Wheels. In another accident, an Airbus A320 overran the runway at Sao Paulo on 17 July 2007. A contributing factor was that the pilot only pulled one thrust lever into the reverse thrust position (the other thrust reverser was known to be inoperative), but a requirement stated that both thrust levers must be in the idle or reverse thrust position for either of the thrust reversers to be deployed. Finally, in the two recent Boeing 737 MAX accidents on 29 October 2018 and 10 March 2019, the MCAS software implemented its requirements correctly, but the requirements caused full nose down trim to be applied following an Angle of Attack sensor failure.	Add, “If a Catastrophic Failure Condition could result from a possible development error in an aircraft/system function or item, then the associated Development Assurance process is assigned level A. If a Catastrophic Failure Condition could result from a combination of possible development errors between two or more independently developed aircraft/system functions or items then, either one Development Assurance process is assigned level A, or two Development Assurance processes are assigned at least level B. The other independently developed aircraft/system functions or items are assigned no lower than Development Assurance Level C. If the Common Mode Analysis is unable to confirm that the aircraft/system functions or items are truly independent, all the Development Assurance process are assigned Level A”.	no	yes	Not accepted	Development errors should be considered in the CMA irrespective of the FDAL/IDAL of the system/item. Consequences from a common mode error varies taking into account various attributes (criticality, complexity, aircraft function, etc.). For highly complex and critical systems (e.g. Flight controls), EASA will not accept full reliance on Development Assurance and Quality Assurance as sole mitigation of a common mode leading to a total loss of system function. Architectural means are usually necessary. EASA expects the PASA/CCA process to be applied as early as possible in the development process and to have EASA involved, as it is an essential element of a critical system architecture validation.
32-91	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 8 Safety assessment process	57	The statement “Such error[s] may simultaneously affect several instances of the same item with potential functional or safety consequences” implies that software or complex electronic hardware (eg FPGAs) is the focus of concern. This is because there has to be a systematic error. If this is such a concern, then it is inconsistent with the approach adopted earlier by allocating FDAL to such low a low levels as this reduces the opportunities to find them. Furthermore, allowing an FDAL to be decomposed into multiple lower FDALs, which may themselves have systematic errors, reduces the opportunities to find them. The concern should be to emphasise that architecture for defending against systematic errors should be explicitly addressed in the system and safety analysis.	Remove the Table 1. Remove: „It is important to note that even Items that are developed to IDAL A may be subject to development error. Such error may simultaneously affect several instances of the same item with potential functional or safety consequences. EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis.“ With: Replace with the following suggested text: „Systematic errors should be explicitly addressed in the system and safety analysis conducted using ARP4754A/ARP 4761 in accordance with the guidance in sub-para 9.”	No	Yes	Not accepted	Table 1 is a key fundament of the proportionality framework for VTOL products. We agree that development errors need to be addressed in the frame of compliance demonstration with VTOL 2510. Purpose of this paragraph is to highlight the importance of addressing development errors in the CMA.

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32-92	*Pipistrel*	Safety Assessment Process	57	Page 57 indicates an intent to require dissimilarity as a means to mitigate design errors: ***"When performing a CMA, the notion of single failure is not sufficient, therefore the notion of a single error should be considered in all life cycle of the addressed function/system (development, manufacturing/production phase, support, repair).*** ***It is important to note that even Items that are developed to IDAL A may be subject to development error. Such error may simultaneously affect several instances of the same item with potential functional or safety consequences. EASA has experienced cases, where a Development error in IDAL A item has even resulted in simultaneous failures of all affected equipment. Therefore, it should not be assumed that IDAL A items are protected from such simultaneous failures and consequently it should be included in the scope of the common mode analysis."***	CS 25.1309 and AMC 25.1309 have never implied a requirement of "No single error". This implies a fundamental shift in safety regulation away from long established FAR/EASA harmonized regulations. If an individual applicant failed to comply with proper design assurance processes in the past, that should not be construed to imply the processes are deficient or inadequate in any way. It is the obligation of the applicant, and EASA as the auditor, to apply design assurance activities correctly and achieve the intended safety objectives. These objectives have been accomplished many times on many aircraft and continues to be the accepted means of compliance for Part 23 & 25 aircraft. Align MOC with CS 25.1309 and AMC 25.1309.	No	Yes	Accepted	See comment 32-86
32-93	*Airbus Helicopters (SB)*	2510.8	57	"This identification step should encompass all independence principles and requirements derived from both Hazardous and Catastrophic Failure Conditions. " Proposed severity is not in line with SC VTOL	If DAL alleviation is applied, independence requirements are generated and should be evaluated whatever is the severity (not limited to CAT/HAZ). If a DAL A alone strategy is retained, it should be part of the CMA in order to cover the "no single failure criteria".	yes	yes	Accepted	The commented sentence is removed
32-94	*GAMA*	Safety assessment process	58	There are four "basic safety design feature (fault tolerance, fault detection, fault removal, and fault avoidance)" introduce in this SC but no clear definition has been provided.	Define the terms fault tolerance, fault detection, fault removal, and fault avoidance. These terms are not consistent with DO-178 or DO-254 processes or definitions and should be removed.	Yes	No	Accepted	The commented sentence is removed.
32-95	*Pipistrel*	Safety assessment process	58	There are four "basic safety design features (fault tolerance, fault detection, fault removal, and fault avoidance)" introduce in this SC but no clear definition has been provided.	Define the terms fault tolerance, fault detection, fault removal, and fault avoidance. These terms are not consistent with DO-178 or DO-254 processes or definitions and should be removed.	Yes	No	Accepted	See comment 32-94

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32-96	*GAMA*	8. (b) (3)	58	This section includes the text (bolded text is relevant text of comment): Design precautions, such as the basic safety techniques (fault tolerance, fault detection, fault removal, and fault avoidance), should be taken to preclude Common Mode Failures/Errors that could impair the identified independence principles and requirements. **Priority should be given to fault tolerance over the other techniques.** While fault tolerance is an important safety technique, one could argue that a combination of the other three examples would be preferable in order to avoid, detect, and remove faults before they become an issue to the system/aircraft.	Suggest removal of bolded text, or rewording such that it is not considered the best method in all cases.	No	Yes	Accepted	Commented sentence is removed
32-97	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.8(b)(3)(ii)	58	Why give priority to fault tolerance over fault removal or fault avoidance?	Change text to give priority to Fault removal, then avoidance and then tolerance	No	Yes	Partially accepted	Commented sentence is removed
32-98	*Pipistrel*	MOC VTOL.2510(8)(b)(4)	58	MOC VTOL.2510(8)(b)(4) includes the statement: "Additional considerations may be appropriate for some specific systems and functions. In particular for Fly-by-wire Flight Control Functions, MOC 4 VTOL.2300 applies." This doesn't seem appropriate for a standard since it is arbitrary. Assume there are two systems that use the same technology/part and loss of/erroneous operation of either system leads to one or more catastrophic FHA events. What is the rationale for having one system held to a different standard than the other? It is the exact same technology/part in each system, so any potential common mode failures are present in both systems and they both have the same end result (a catastrophic FHA event). The MOC should be written to provide equal standards to all aircraft systems based on their contributions to FHA events. This is especially important for SC VTOL vehicles which will have increasingly integrated solutions where the conventional boundaries between systems become less distinct.	Update the MOC to apply equally to all systems.	No	Yes	Noted	See answer to comment 32-82
32-99	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (9)	58	The paragraph on simple systems is open to misuse. Exhaustive testing is only feasible for very simple systems. I can foresee applicants misusing this text to claim that some software-intensive systems are simple just because they are not highly integrated with other aircraft systems.	Delete this paragraph. Alternatively, it needs to be clarified that this only applies to the simplest of software components. I suggest something like "There are situations where a software component of an airborne system or equipment is so simple and isolated that the set of inputs and outputs can be bounded. In such cases, exhaustive input testing of this input space can be substituted for one or more of the software verification process activities identified in Section 6 of ED-12C/DO-178C". This text proposal is based on section 12.3.1 of ED-12C/DO-178C.	no	yes	Partially accepted	The paragraph on simple systems is not encompassing systems that embed software or complex electronic hardware. The paragraph is clarified to make it clearer.

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32-100	*Boeing*	MOC VTOL.2510 Equipment, systems, and installations (9)(a)	58-59	THE PROPOSED TEXT STATES: Guidelines, which may be further used for the allocation of development assurance levels to aircraft and system functions (FDAL) and to items (IDAL), are described in the document ED-79A/ARP4754A, section 5.2. In the absence of agreed guidelines on FDAL/IDAL allocation, the FDAL should be commensurate with those applicable to the category of aircraft as per Section 7(a) in this MOC and the IDAL of all components contributing to a given function should be equal to the FDAL of that function. REQUESTED CHANGE: Guidelines, which may be further used for the allocation of development assurance levels to aircraft and system functions (FDAL) and to items (IDAL), are described in the document ED-79A/ARP4754A, section 5.2. ~~In the absence of agreed guidelines on FDAL/IDAL allocation, the FDAL should be commensurate with those applicable to the category of aircraft as per Section 7(a) in this MOC and the IDAL of all components contributing to a given function should be equal to the FDAL of that function~~	JUSTIFICATION: 4) ARP 4754A section 5.2.1. "If a Catastrophic Failure Condition could result from a combination of possible development errors between two or more independently developed aircraft/system functions or items then, either one Development Assurance process is assigned level A, or two Development Assurance processes are assigned at least level B. The other independently developed aircraft/system functions or items are assigned no lower than Development Assurance Level C. The Development Assurance process establishing that the two or more independently developed aircraft/system functions or items are in fact independent should remain level A. 5) FDAL/IDAL assignment requires the following information: 6) AFHA/SFHA FC Data 7) Functions and Sub functions descriptions 8) Proposed A/C and System Architecture 9) Relevant PASA/ PSSA data which provides information on interdependencies 10) Then, the applicant will assess the initial FDAL / IDAL assignment against architecture considerations, which will produce a revised FDAL/IDAL with FFS and independency substitution. 6) ARP 4754 Section 5.2.3.2.1.1 Functional Independence, and section 5.2.3.2.1.2 Item Development Independence provides clear guidance on the attributes to be require to establish independency of functions These three points within ARP4754 allows to have FDAL/IDAL which allows for considerations of the system architecture for a DAL reduction are acceptable since this allows to creates robust system which are being in Part 25 and Part 29 aircraft. This would represent a higher level of conservatism than those use in Part 29 & Part 25 which are higher risk than part 23/Part 27			Not accepted	The applicant is free to choose the ARP4754A/ED-79A as guidelines for the allocation of Development Assurance Levels, and by choosing so, take credit of the provisions of section 5.2 of the ARP. In case there are no guidelines agreed on the allocation of DAL between the applicant and EASA, the way of allocating DAL is described in this paragraph.

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32-101	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 9. Development Assurance process Para (a) Development Assurance Level (DAL) allocation	58	MOC VTOL.2510(9)(a) Development Assurance Process, DAL Allocation This section contains the following statement: "However, it is recognised that credit can be taken from system architecture (i.e. functional or item development independence) for the FDAL/IDAL allocation process." Per Note A of MOC VTOL.2510(7)(a) Table 1 Safety Objectives, this is not always the case. It would be helpful to re-word this sentence slightly to avoid potential confusion.	Potentially reword the statement in MOC VTOL.2510(9)(a to read: "However, it is recognised that, where applicable, credit can be taken from system architecture (i.e. functional or item development independence) for the FDAL/IDAL allocation process."	No	Yes	Partially accepted	This sentence is potentially misleading and has been removed.
32-102	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (a) Development assurance process	58	The section that states: "However, it is recognised that credit can be taken from system architecture (i.e. functional or item development independence) for the FDAL/IDAL allocation process." Should be removed. Whilst it is correct, this should be undertaken as part of the process of using ARP4754A/4761 and not, as is implied here, an additional activity that can further alleviate DAL. Note that it should be consistent with the wording at sub-para (b) in this regard.	Delete sentence	No	Yes	Accepted	Sentence deleted. The next sentence pointing to ED-79A/ARP4754A can be considered sufficient.
32-103	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (a) Development assurance process	58	The section that states: "Initial FDAL allocation is performed in accordance with Section 7(a) in this MOC." Should be removed. The FDAL process described at 7(a) is inadequate as other comments highlight and Table 1 in particular gives cause for concern.	Delete sentence	No	Yes	Not accepted	Table 1 is a key fundament of the proportionality framework for VTOL products. Removing Table 1 would result in allocating the highest safety objectives to all VTOL categories and therefore jeopardize the proportionality that is expected by industry.
32-104	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (b) Aircraft /system development assurance	59	It is worrying that "Early concurrence with EASA is essential." It implies that regardless of the analysis undertaken by the Applicant, some arbitrary application of architecture/FDAL, etc can be applied. Consider removing this as it is always the case that early engagement of the regulator is desirable.	Remove sentence.	Yes	No	Not accepted	While most applicants are using this opportunity in certification process, not all applicants are aware of it. The intent is to highlight this possibility to reduce the risk of late findings by EASA. On early concurrence for CMA aspects: CMA are qualitative analyses. Due to this they are up to a certain extent dependent on company experience. Early coordination is advised to reduce the risk of identifying late that the CMA qualitative analyses and conclusions are not fully acceptable to EASA: Due to its role both in the IAW (type certifications) and CAW (occurrence reporting) processes, EASA is both aware of EU certified/validated designs and of their actual failures in the field. In particular, EASA is being reported common mode failure/error that are not necessarily made public (not resulting in an AD/SB, accident/serious incidents investigations…). Some of these occurrences are not safety critical thanks to other mitigation means but would be otherwise.

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32-105	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (9) (b)	59	What does "The extent of application of ED-79A/ARP4754A to substantiate functional development assurance activities would be related to the complexity of the systems used and their level of interaction with other systems. Early concurrence with EASA is essential" mean? Does EASA disagree with the contents of ED-79A/ARP4754A? Does the FAA share EASA's concern?	Replace MOC VTOL.2510 (9) (b) with "This MOC recognises ED-79A/ARP4754A as an acceptable means of establishing a development assurance process".	no	yes	Partially accepted	The purpose of the paragraph is to highlight that the applicability of ARP4754A can be tailored, depending on the complexity and on the level of integration of the systems. The wording has been updated to avoid the confusion.
32-106	*Airbus Helicopters (LF)*	MOC VTOL.2510 9.(c)	Page 59	(c) Software development assurance: The current SC-VTOL intends to be compatible with "remote piloting" capability or different level of autonomy as indicated in § Applicability. These remote system features will be implemented in an end-to-end system architecture with airborne and ground installed equipments fitted with several software items. The standard proposing a software development assurance guidance for ground based system is the ED-109A/DO-278A brother document of the ED-12C/DO-178C. This standard is also proposing an association table between ED-12C/DO-178C levels and ED-109A/DO-278A levels easing the IDAL allocation. It is then proposed to consider also this standard as an acceptable MoC. Proposing the use of the ED-109A/DO-278A guidance for COTS software items beyond the standard limits is an helpful and interesting proposal. Nevertheless fulfilling COTS objectives may raise some issues and claims and may need mixed approach with alternative methods that should need coordination with EASA.	Proposed modified text (highlighted in bold characters): *« This MOC recognises AMC 20-115( ) as an accepted means of compliance with requirement VTOL.2510(a).* ***This MOC also recognizes DO-278A / ED-109A as an accepted means of compliance with requirement VTOL.2510(a) when software item of the system architecture are installed on ground.*** *Note A* *For Commercial-Off-The-Shelf (COTS) software items and open-source software, this MOC recognises guidance from DO-278A/ED-109A section 12.4 as generally applicable beyond the limits of CNS/ATM systems* *Note A*. ***Early coordination with EASA is advised when COTS is intended to be used in an IDAL A or B software.*** ***Note A: The association between IDAL level and DO-278A / ED-109A AL (Assurance Level) should follow DO-278A / ED-109A table 2-2 of section 2.3.3. Assurance Level Definitions."***	yes	no	Partially accepted	DO-278A/ED-109A is not considered to be applicable to ground stations for remotely piloted aircraft systems, as it was developed for ATM/CNS systems. Therefore AMC 20-115() remains the primary proposed MOC. We agree with the second comment, however the note on early coordination is not considered necessary. The proposed Note on the correspondence between IDAL and AL has been integrated in the text.
32-107	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (9) (c)	59	The COTS guidance from ED-109A/DO-278A section 12.4 should not be applied to airborne software. SC-205/WG-71, which wrote both ED-12C/DO-178C and ED-109A/DO-278A, voted specifically against doing so. The FAS UAS Ad-Hoc Group concluded that the COTS guidance in ED-109A/DO-278A can be onerous and, perhaps, impossible to meet in full.	Delete this paragraph. Suggest EASA waits for WG-117/SC-240 to publish new industry standards for COTS. It would be premature for EASA to make a unilateral decision when a panel of software experts, including EASA, FAA and industry has just been convened to look at exactly this issue.	no	yes	Partially accepted	Notwithstanding the future results of WG-117/SC-240, means of compliance are currently needed by our industry. EASA considers that ED-109A/DO-278A COTS guidance is providing some clarifications and flexibility compared to ED-12C/DO-178C COTS guidance (which in essence requests simply to comply with all ED-12C/DO-178C objectives). This is the reason why section 12.4 of ED-109A/DO-278A is proposed as an alternative to ED-12C/DO-178C guidance for COTS. The wording has been slightly modified to clarify that this is an alternative. An applicant can of course strictly apply AMC20-115D and follow ED-12C/DO-178C guidance for COTS.

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32-108	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (c) Software development assurance	59	The COTS/open source guidance in DO-278A/ED-109A is not achievable and this is recognised by FAS as well as the UAS domain. Remove this mis-leading criteria and rely instead upon the guidance within DO-178C/ED-12C. Note that there will be further guidance on COTS coming out from EUROCAE WG 117.	Replace DO-278A/ED-109A with DO-178C/ED-12C	No	Yes	Partially accepted	Notwithstanding the future results of WG-117/SC-240, means of compliance are currently needed by our industry. EASA considers that ED-109A/DO-278A COTS guidance is providing some clarifications and flexibility compared to ED-12C/DO-178C COTS guidance (which in essence requests simply to comply wth all ED-12C/DO-178C objectives). This is the reason why section 12.4 of ED-109A/DO-278A is proposed as an alternative to ED-12C/DO-178C guidance for COTS. The wording has been slightly modified to clarify that this is an alternative. An applicant can of course strictly apply AMC20-115D and follow ED-12C/DO-178C guidance for COTS.
32-109	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2510, Sect.9(c)	59	Why highlight DO-278A/ED-109A for COTS SW development assurance as opposed to DO-178C and its supplements? SW will be airborne and ground-based	Add DO-178C instead of DO-278A, or as well as, if there is a good reason.	No	Yes	Partially accepted	Using ED-109A/DO-278A section 12.4 guidance is proposed as an alternative to ED-12C/DO-178C COTS guidance as recognized in AMC20-115D. Note that an applicant can of course strictly apply AMC20-115D and follow ED-12C/DO-178C guidance for COTS. The wording has been slightly modified to indicate that this is an alternative.
32-110	*Dewi Daniels, Callen-Lenz*	MOC VTOL.2510 (9) (c)	59	I don't understand the justification for alleviation for software items of IDAL D. I'm also puzzled by the note that the system-level processes are not considered to replace software development assurance processes.	Remove the alleviation for software items of IDAL D. Suggest EASA waits for WG-117/SC-240 to publish new industry standards on software considerations in low risk applications. It would be premature for EASA to make a unilateral decision when a panel of software experts, including EASA, FAA and industry has just been convened to look at exactly this issue.	no	yes	Partially accepted	See answer to comment 32-111.
32-111	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (c) Software development assurance (1)	59	The "Alleviation for software items of IDAL D contributing to Minor Failure Conditions" has a number of issues: 1. The definition of equipment" needs to be clear. For example, this could mean the entire ground station (for 0 passengers). 2. What is "an acceptable development assurance process" if it is not DO-178B Level D? If it is not this, then this must be defined. If this is Level D, then there is no alleviation and this section makes no sense. 3. What are acceptable system level development assurance processes? Most of the problems associated with software are poor system processes, especially requirements, so this approach gives little confidence.	Delete Table 1. Remove all of this section on "Alleviation for software items of IDAL D contributing to Minor Failure Conditions"	No	Yes	Not accepted	This alleviation for level D software is proposed as an alternative to applying AMC20-115D objectives for level D software, under the conditions identified in this section 9.c. Applicants not feeling at ease with this provision can apply strictly AMC20-115D. EASA will consider WG117/SC-240 deliverables when available, but did not want to wait to propose risk-based alternatives where possible.

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32-112	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (c) Software development assurance (2)	59	The "Alleviation for software items of IDAL D contributing to Minor Failure Conditions" has a number of issues: 1. It's not much use verifying that software HLRs satisfy the system requirements if there is no verification that the software implementation satisfies the HLR. 2. If software requirements are derived, there has to be proper verification that those requirements are properly developed into the software, otherwise it's a pointless exercise 3. Derived requirements also have to be verified as having no impact on the system level (as noted by using ED-79A) but should also use ARP4761.	Delete Table 1. Remove all of this section on "Alleviation for software items of IDAL D contributing to Minor Failure Conditions"	No	Yes	Not accepted	See comment 32-111
32-113	UK CAA	MOC VTOL.2510 Equipment, systems, and installations 9. Development Assurance process Para (c) Software development assurance Para 2(ii)	59	**MOC VTOL.2510 (9) Development Assurance process, (c) Software Development Assurance 2(ii)** This section refers to the term "derived requirements". This is a term that has frequently been misunderstood by some parts of the industry. It would be helpful to include a definition of "derived requirements" in the definitions section of MOC VTOL.2510.	Include a definition of "derived requirements" in the definitions section (4) of MOC VTOL.2510, e.g. "Derived Requirements – Additional Requirements resulting from design or implementation decisions during the development process which are not directly traceable to higher-level requirements." Source ARP 4754A.	Yes	No	Partially accepted	A definition has been added. As it is not the one directly taken from the ARP4754A, section 9(f) has been added to clarify the background of the chosen definition
32-114	Collins Aerospace	MOC VTOL.2510 9.(c)(2) (ii)	59	There is an "or" between statements (I) and (ii). If taken literally, the "or" path into (ii) would imply that one only needs to worry about derived requirements, and nothing needs to be done with "non-derived" requirements.	Recommend changing the "or" between (i) and (ii) to an "and". Else, perhaps the "Note" after (ii) needs to be clarified to better describe the intent of this section.	No	Yes	Accepted	Paragraph is changed, by removing "fully" and changing "or" to "and"
32-115	*D-RisQ Ltd (Nick Tudor) / DRisQ Limited*	MOC VTOL.2510 9 (c) Software development assurance Note	59	The Note "Note: In both cases, the system-level processes are not considered to be replace software development assurance processes" is clearly in conflict with the whole of the previous 2 sections (1) and (2). Exactly what message is meant to be conveyed? Either system level assurance is (only) required or software level assurance is? Unfortunately, this section shows the problems with using tables such as Table 1 in trying to determine safety without requiring the Applicant to think for themselves.	Delete Table 1. Remove all of this section on "Alleviation for software items of IDAL D contributing to Minor Failure Conditions"	No	Yes	Not accepted	The note reinforces that this alleviation is a risk-based approach (based on the identified conditions in the 2 previous sections (1) and (2)), but should not be considered by the applicant as a pure software development approach. In particular, upgrade of software baselines (e.g. to level C) would not be acceptable. Note that this is a proposed alternative but that an applicant can strictly apply AMC20-115D instead.

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32-116	Collins Aerospace	MOC VTOL.2510	59	Typo: “are not considered to be replace software…”	Remove the word “replace”	Yes	No	Accepted	Changed wording as suggested
32-117	Collins Aerospace	MOC VTOL.2510 9.(d)	59	Refers to AMC 20-152 (). Has this been published or is it still in draft? Is it meant / assumed to be equal to AC 20-152?	If the existing AC 20-152 is considered acceptable, may want to state “AMC 20-152() / AC 20-152()”.	Yes	No	Noted	AMC 20-152A and AMC 20-189 have been published and are included in AMC 20 Amendment 19 https://www.easa.europa.eu/document-library/certification-specifications/amc-20-amendment-19
32-118	*Lilium GmbH*	MOC VTOL.2510, §3 and §9	52 and 59	AMC 20-152 and AMC 20-189 are used as reference; however these AMCs are not released. They can only be found in NPA 2018-09, under public consultation since 24.08.2018, and expected to be released in Q1 2019.	Can the Agency clarify on the applicability of the referenced AMCs?	yes	no	Noted	AMC 20-152A and AMC 20-189 have been published and are included in AMC 20 Amendment 19 https://www.easa.europa.eu/document-library/certification-specifications/amc-20-amendment-19
32-119	Collins Aerospace	MOC VTOL.2510 9.(e)	59	Refers to AMC 20-189 (). Has this been published or is it still in draft? I believe AC 20-189 may also be in draft state.	May want to add a note stating that pending initial release of AMC 20-189, that draft material in NPA 2018-09 is acceptable.	Yes	No	Noted	AMC 20-152A and AMC 20-189 have been published and are included in AMC 20 Amendment 19 https://www.easa.europa.eu/document-library/certification-specifications/amc-20-amendment-19

33. MOC VTOL.2515 ELECTRICAL AND ELECTRONIC SYSTEM LIGHTNING PROTECTION

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33-01	*Rolls Royce (F. Musella)*	MOC VTOL.2515 MOC VTOL.2520	-	Guidance for High Voltage equipment / harnesses for those MOCs need to be provided assuming VTOL could include High Voltage Power systems.	Guidance for High Voltage equipment / harnesses	yes	no	Noted	Guidance for High Voltage application on VTOL aircraft is already under development by standardisation organisations, e.g. refer to Eurocae ED-290 “Guidance on High Voltage Definition and Consideration for Personal Safety”.
33-02	*EUROCAE WG-31*	Common to HIRF & LIE 2515 and 2520 MoC		It is stated that “if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should be considered to be as a level B system.” Back-up channel should be assigned IEL Criticality appropriate to the specific Safety assessment, which might be lower than B if demonstrated by specific safety assessment.	Proposed to remove the part “, however this back-up channel should be considered to be as a level B system.” and replace with “in this case the back-up channel should be qualified in accordance with the failure classification of that channel’s failure”			Not accepted	See reply to comment 34-42
33-03	*EUROCAE WG-31*	Common to 2515, 2335 and 2430 (a)(2) lightning MoC		Nothing about identification of lightning scenarios considered by the applicant	Since the VTOL have unconventional shape and architecture, a lightning hazard analysis should be provided by the applicant with description of lightning strike scenarios considered for the protection of airframe, mechanical/electrical systems including fuel systems. To be noticed that this process is all the more crucial that generic zoning of ED91 guide are not covering VTOL because of their novelty . WG31 should be mandated to develop guidance for this lightning hazard analysis addressing VTOL in the next issue of ED91.			Noted	EASA also welcomes additional contributions from Eurocae and other SDOs with further guidance to facilitate the certification of VTOL aircraft
33-04	*Leonardo Helicopters*	MOC VTOL.2515, Section 4	Several pages	Specific ED-14G test categories are recommended in this section (mamely A3J3L3, B3K3L3 and others). Waveform set H for unshielded wiring (aperture and resistive coupling) is not mentioned and as such appears as not applicable at all. Recommending specific waveforms and not others without recommending proper selection based both on aircrafe and wiring design may induce to mistakes.	Categories and waveforms selection should be left to the airframer as it depends on both the aircraft and wiring type, as defined in ED-14 guidelines. Sugggest remove specific categories and to point to ED-14G for categories selection.	NO	YES	Accepted	Text updated by referring to ED-14G for the categories selection
33-05	*Airbus Helicopters (MM)*	MOC VTOL.2515 1.	Page 61	“*reliable weather reports*”: What is considered reliable or not? Data from national agencies? Private organization? And which rule to be considered, for example distance from storm cells? CAVOK and NSC and TSRA are cited in definitions p62 & 63, but not mentioned in the text.	Reliable should be precised and criteria to allow flight or not (CAVOK? NSC?). EUROCAE WG31 might be consulted and something standardized.	no	yes	Not accepted	The MOC does not intend to be as prescriptive as suggested in the comment. The intent is to inform of an acceptable path to avoid the compliance demonstration with electrical and electronic system lightning protection requirements, as mentioned in VTOL.2515. Details on the justification of the specific approach selected by an applicant for a particular project shall be discussed during the certification process.

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33-06	*EUROCAE WG-31*	MOC VTOL.2515	61	§1: **reliable** weather reports	It is difficult for the applicant to know what can be considered reliable enough. What are the acceptable means and criteria to considered that the reliability is enough.			Not accepted	See comment 33-05
33-07	*Airbus Helicopters (MM)*	MOC VTOL.2515 1.	Page 61	Accepted means to avoid compliance demonstration to lightning protection requirements are only for VFR flight (VFR Day, VFR) and not for IFR. We understand that IFR flight needs usual hardening against lightning, i.e at VTOL level. Some IMC conditions do not conduct to a lightning risk (e.g fog) and flight in IFR in these conditions (including autonomous flight) should be open to what it is proposed here for VFR flight. Moreover a notion of mission range would be relevant for flying urban taxi for example. For short mission range, e.g. less than 30 NM, on-board systems should not be required, weather report as for any VFR day flight is relevant.	The two bullets should be rewritten as follows: *.VFR day and any short range mission with reliable weather reports stating…* *.VFR and IFR with a certified system to detect lightning or storm cells* *+ the maximum distance for a short range mission: our proposal is 30NM*	no	yes	Not accepted	The mitigation means allowing not to apply electrical and electronic system lightning protection requirements are only considered practically applicable and valid for VFR operations. The suggested operational limitations for IFR according to real VMC conditions are deemed difficult to manage and justify from an airworthiness perspective.
33-08	*EUROCAE WG-31*	MOC VTOL.2515	61	§1: certification without lightning protection at VTOL level only allowed for VFR flight (VFR & VFR day)	Maybe it is too restrictive to be really used by the applicant. Some flights can be performed in IMC conditions like fog or even rain (depending of clouds) without any risk of lightning and then reliable weather reports or lightningdetection systems / weather radar should be also acceptable in these degrraded weather conditions.			Not accepted	See comment 33-07
33-09	*Airbus Helicopters (MB)*	VTOL.2515	61	Inside the lightning protection and HIRF/EMI protection some sentence similar to:"*In addressing the Failure Condition … the indirect effects of lightning should not be combined with random failures…*". This is in contradiction to the newer CS §29.1316 and 29.1317 requiring for redundant items of a system to also take into account one failure of the redundancies and still be able to demonstrate compliance.	Please clarify relation to latest CS-29 updates.	Observation		Not accepted	MOC VTOL.2515 Section 4 (c)(2)(iii) and MOC VTOL.2520 Section 4(c)(5) are not in contradiction with 29.1316 and 29.1317. For large rotorcraft the combination of random failure and failure related with HIRF and lightning exposure does not have to be considered.
33-10	*Airbus Helicopters (MM)*	MOC VTOL.2515	61	Direct effect of lightning seems missing especially at VTOL structure /mechanical & dynamical assemblies and systems. And the zoning document (ED 91) referenced in the lightning MOC does not present any generic lightning zoning which may help for VTOL manufacturer. Some instructions for a relevant use of zoning modelling or for conservative approach to protect VTOL would be helpful for the applicant (in default of experience in service like for H/C and A/C obviously).	Some statements should be added for lightning direct effect protection to ensure the safety of VTOL. Current Lightning guides are poor to treat specificities of VTOL (exposed electrical engine, lightning zoning), Eurocae WG31 may contribute.	no	yes	Not accepted	Lightning Direct Effect is addressed in MOC VTOL.2335. EASA would also welcome additional contributions from Eurocae and other SDOs with further guidance to facilitate the certification of VTOL aircraft

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33-11	*Leonardo Helicopters*	MOC VTOL.2515, Section 1	61	One way proposed to avoid compliance demonstration to lightning protection requirements is to have the following operational limitation "VFR with certified system to detect Lightning Condition" More precise guidance is required.	The MOC should direct to minimum performance requirements which would be acceptable to certify detection systems, commensurate to the criticality of their functional failures (assumed Level A?). The MOC should specify that such systems shall be included into aircraft MMEL. The MOC should speficy that if an aircraft is certified without showing compliance to Ligthning requirements, than a limitation into the Flight Manual is required to forbic to fly into known or forecast lightning conditions.	NO	YES	Not accepted	The MOC does not intend to be as prescriptive as suggested in the comment. The intent is to inform of an acceptable path to avoid the compliance demonstration with electrical and electronic system lightning protection requirements, as mentioned in VTOL.2515. Details on the justification of the specific approach selected by an applicant for a particular project shall be discussed during the certification process.
33-12	UK CAA	MOC VTOL.2515 Electrical and electronic system lightning protection	61	Aircraft flying day VFR and with lightning detection systems, will not always be able to avoid lightning conditions. Therefore, a 9 seat VTOL aircraft that is restricted to Day VFR and has a lightning detection system, would not require any protection from direct or indirect effects of lightning. Allowing a 9 seat VTOL to operate (with some limitations) with no lightning protection is a significant reduction in safety for a relatively large number of people.	Consideration should be given to restrict this alleviation for lightning protection to a smaller number of people.	No	Yes	Not accepted	VTOL.2515 offers the possibility to demonstrate that the exposure to lightning is unlikely. EASA believes that the combination of VMC Condition plus lightning detection system should allow to avoid lightning conditions.
33-13	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.1	61	Sect.4(d)(1) on pg. 65/66 also states ways to justify the "unlikely" case so should be added to the bullet list here	Add additional ways to bullet list	Yes	No	Not accepted	The two criteria/mitigations mentioned at the beginning of the Section 4(d)(1) are only intended to recap the same criteria/mitigations already mentioned in Section 1. They refer to the likelihood of the exposure to lightning. In some cases, even if the exposure to lightning cannot be directly considered unlikely, it may be justified to consider the Hazard associated with a lightning strike as unlikely. This is addressed in the last part of this Section.
33-14	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.1	61	For the 1st bullet, how reliable can a weather report be? I suppose it depends on flight duration & location. Is this an acceptable method today on traditional aircraft?	Add caveats to define what reliable means and emphasise for the whole flight	Yes	No	Not accepted	See comment 33-05

33-15	*Volocopter*	MOC VTOL.2515 Section 1.	61	Defining a commonly acessible threshold for "exposure to lightning shown to be unlikely" through "no significant clouds" is generally supported. However, existing meteorlogical equipment, methods and models allow for prediction of lightning conditions in a way, that significantly broader operational windows may be achieved. The subject is tricky, as this is an overlap with Operations, which is beyond the Scope of an aircraft Type Certificate. This challenge increases, as SC-VTOL is planning for significantly different ways of operation, which also leads to the differentiation between Basic and Enhanced category, where one essential criterion is Commercial use, which on the other hand mandates an approved Air Operator to be in control. eVTOL aircraft are prone to significant weight limitations, which is one of the key reasons for OEM to avoid consideration of lightning as likely, having effect to systems and structures weight of the aircraft. Adding a Stormscope to the aircraft may even overcompensate the weight saving to the heavy side, therefore not offering a realistic method. Another factor is the range and endurance of the individual concepts. When having a concept that cruises in wing-lift mode at high speeds over large distances for significant endurances, reliability of predictions reduces. On the other hand, vehicles with very short endurance and range operate in conditions that are perfectly predictable at the time of takeoff. This advantage of the short-endurance aircraft must not be penalized with expecting heavy Stormscope equipment that can be even useless in the given environment being inner-city with blockages from buildings. It is proposed to enhance the MoC in the sense that: - If no extended means are held available, those general limitations as quoted in the draft may be used. - On-board equipment as drafted can be used to allow for in-flight detection, hence active avoidance of situations with likelihood of lightning - Range / Endurance of the aircraft is actively considered - Clearance from the operator that lightning is unlikely, based upon local sensing data can be used as alternative to on-board sensing equipment. This also builds upon the understanding, that a ground-based network of sensing equipment from different locations is providing a significantly enhanced situational awareness and information quality, compared to one single on-board sensing equipment.	MOC VTOL.2515 Electrical and electronic system lightning protection 1. Unlikely Exposure to Lightning It is stated in VTOL.2515 that sub paragraphs (a) and (b) are applicable "unless it is shown that the exposure to lightning is unlikely". The demonstration on this condition should be based on reliable meteorological reports and/or on-board means to detect lightning, directly or indirectly (e.g. Lightning Detector, Weather Radar). Therefore, an accepted means to avoid the compliance demonstration to electrical and electronic system lightning protection requirements is to establish the following operational limitations: - VFR Day with reliable weather reports stating the absence of significant clouds before and/or during the flight for departure, en-route, terminal and alternate vertiports, or - VFR with a certified system to detect lightning or storm cells, or - VFR with enhanced ground-based support (equipment) to detect lightning, storm cells or likelihood for lightning. Due consideration should be given to the range and endurance of the VTOL, which may have effect on the likelihood of changing weathers during the flight, and consequently on the kind and capability of support (equipment). Qualification of such ground based support (equipment) is ensured through the Operator and relevant Operator approvals.	yes	yes	Partially accepted	The MOC has been modified as follows: *"It is stated in VTOL.2515 that sub paragraphs (a) and (b) are applicable "unless it is shown that the exposure to lightning is unlikely". The demonstration of this condition should be based on reliable meteorological reports and/or on-board means to detect lightning, directly or indirectly (e.g. Lightning Detector, Weather Radar). Therefore, an accepted means to avoid the compliance demonstration with electrical and electronic system lightning protection requirements is to establish the following operational limitations:* *- VFR Day with reliable weather reports stating the absence of significant clouds before and/or during the flight for departure, en-route, terminal and diversion vertiports, or* *- VFR with means to detect lightning or storm cells via a certified onboard system, and/or ground base support plus appropriate communication with aircraft pilot. The qualification of such ground-based system should be ensured by the operator."*

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33-16	*Airbus Helicopters (MM)*	MOC VTOL.2515 3.	62 & 63	c) m) p) definitions are not used in the text. Should be removed or used to explain expectations regarding weather reports (page 61 – see specific comments)	Keep or delete definitions according to their use in the text.	Yes	No	Partially Accepted	(m) "TSRA" is deleted (c) "CAVOK" and (p) "NSC" are used in the flowchart in Section 6
33-17	*Airbus Helicopters (MM)*	MOC VTOL.2515 4.(a).(2)	Page 63	Typography only: *'To allow lightning'*	Typography correction	Yes	No	Accepted	A space is added between the words.
33-18	*Leonardo Helicopters*	MOC VTOL.2515, Section 4.(a)	63	Section 4.(a) appears too generic and missing significative points (electrical wiring protection as one example).	As a minimum suggest to add a short section on electrical wiring protection and a reference to point to the recently published ED-158 (User's Manual for certification of aircraft electrical/Electronic Systems for the IEL) Chapter 4, for more exausthive design considerations.	NO	YES	Accepted	The following sentence is added at the end of Section 4 (a): "Additional wiring protection consideration can be found in ED-158 A (User's Manual for certification of aircraft electrical/Electronic Systems for the Indirect Effect of Lightning)."
33-19	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.4(c), Table 2	64	Scope of requirements could be better defined	In (a) of 1st cell, I would write "…could lead to a potentially Catastrophic Failure Condition…" rather than "…would prevent continued safe flight and landing for Category Enhanced, or a controlled emergency landing for Category Basic…"	Yes	No	Not accepted	This column simply reproduces the wording of the requirement VTOL.2515, as indicated in its head.
33-20	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.4(c), Table 2	64	Scope of requirements could be better defined	In note (b) of bottom left cell, I would write "…could lead to a potentially Hazardous or Major Failure Condition…" rather than "…would reduce the capability of the aircraft or the ability of the flight crew to respond to an adverse operating condition…"	Yes	No	Not accepted	This column simply reproduces the wording of the requirement VTOL.2515, as indicated in its head.
33-21	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.4(c), Table 2	64	Note (ii) needs clarification regarding how deep we should go with the analysis.	Should we consider multiple Minor FC's that when added up could be CAT/HAZ, for example? Do we run the risk of saying that any Lightning Strike will be CAT for a small VTOL and, if so, is that ok?	Yes	No	Not accepted	See comment 34-08

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33-22	*GAMA*	MOC VTOL.2515(4)(a)(c)(1)	64 & 74 for HIRF	"The elements of the system that performing a function should be defined, considering the use of redundant and/or backup equipment that constitutes the system" The definition section defines the system as "A piece of equipment connected via electrical conductors to another piece of equipment, both of which are required to make a system function. A system may contain pieces of equipment, components, parts, and wire bundles." With the above there can be multiple systems producing the same function, which is the way most ACs define the system. Example → AMC20-136 page 5 excerpt "For example, "display aircraft heading to the pilots" is a function. One or more systems may perform a specific function or one system may perform multiple functions." AMC20-158 page 10 excerpt "The analysis should evaluate the failures, either singularly or in combination, which could adversely affect system performance. This should include failures that could negate any system redundancy, or failures that could influence more than one system performing the same function"	Change the text to: "The elements of the system that perform a function should be defined, ~~considering redundant and/or backup equipment that constitutes the system~~."	No	Yes	Partially accepted	Definition of System is reworded: *"System: an electrical or electronic system includes all electrical and electronic equipment, components and electrical interconnections that are required to perform a particular function"*
33-23	*Airbus Helicopters* *(SB)*	2515.4	65	Table 2 offers a mean to allocate a LCL at system level. Nevertheless it does not provide guidance to allocate at equipment level. For example with CS-29.1316/1317, it is wished to have table 2 objectives fulfilled, even after a single random failure.	Ensure at least for enhanced category a global consistency for CAT objectives (order of magnitude 1E-9/Fh) when combining a lightning strike (probability TBD depending on operationa limitations) and a random failure. May be 2515.5 can be a support to such a rationale.	Yes		Not accepted	See comment 34-09

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33-24	*GAMA*	MOC VTOL.2515(4)(a)(c)(2) Table 2	65 & 75 Table 2	Paragraph b "reduce capability" is for classification of MAJ. In the subsequent compliance verification for IEL group I and II there is no reqt for MAJ (or Level C). Propose it be separated out for HAZ and MAJ and the text in the MAJ one would show it is applicable to group III only. This way the compliance verification sections line up with what the rule is requiring. Otherwise the rule is requiring level C for all groups, and the guidance is not.	Add the red text. "(b) Each electrical and electronic system that performs a function, the failure of which would significantly reduce the capability of the aircraft or the ability of the flight crew to respond to an adverse operating condition, must be designed and installed such that the system recovers normal operation of that function in a timely manner after the aircraft is exposed to lightning." and "(c) For IEL group III, each electrical and electronic system that performs a function, the failure of which would reduce the capability of the aircraft or the ability of the flight crew to respond to an adverse operating condition, must be designed and installed such that the system recovers normal operation of that function in a timely manner after the aircraft is exposed to lightning."	No	Yes	Not accepted	The distinction between "reduce" and "significantly reduce" capability is not in VTOL.2515: In VTOL, only "reduce capability" is applicable for both Level B/C. "Significantly reduce capability" is not applicable for VTOL.
33-25	*GAMA*	MOC VTOL.2515(4)(a)(c)(2)	65 & 75(6)	"Due to the similar approach in the safety assessment process related to IEL and HIRF, the System Certification Levels for HIRF and Lightning should be the same." There should not be reqts to make them the same and they can be different since HIRF & IEL do not need to be considered together.	Suggest changing to: "Due to the similar approach in the safety assessment process related to IEL and HIRF, the System Certification Levels for HIRF and Lightning can be the same." OR removing the sentence.	No	Yes	Partially accepted	Lightning Certification Level (LCL) and HIRF Certification Level (HCL) are usually the same. This general case is what the use of the term "should be" intended to highlight. When the certification levels are different it should be substantiated. The text has been modified to clarify this point: *"Due to the similar approach in the safety assessment process related to IEL and HIRF, the System Certification Levels for HIRF and Lightning are usually the same."*
33-26	*EUROCAE WG-31*	MOC VTOL.2515	65 and 66	Section 4- Specific ED-14G test categories are recommended in this section (namely A3J3L3, B3K3L3 and others). Waveform set G/H for unshielded bundle/cabless are not mentioned as supposed there are not unshielded bundles/cables. In a same manner M category is not mentionned. Recommending specific waveforms and not others without recommending proper selection based both on VTOL and wiring design may induce to mistakes	Categories and waveforms selection should be left to the airframer as it depends on both the aircraft and wiring type, as defined in ED-14 guidelines. Suggest remove specific categories and point to ED-14G for categories selection in order to encompasses the different wiring configuration and VTOL design			Accepted	See comment 33-04
33-27	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.4(d)(1)	66	Alternative MOC proposal	Could we also say that it is acceptable to add the lightning strike probability to the FTA and if the safety requirements are met, it is ok?	Yes	No	Not accepted	See Table 5, the probability is already taken into account for the applicability of the IEL Requirement according to A/C Group and System Level
33-28	THALES Avionics	MOC VTOL.2515	66-67	ED-14 section 22 cat J3 and K3 are for shielded bundle. should not be added section 22 cat G and H to cover the unshielded bundle?		Suggestion	Substantive	Accepted	See comment 33-04

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33-29	*Leonardo Helicopters*	MOC VTOL.2515, Section 4, item d. IEL Group I and II	66 and 67	Recommending specific equipment/system test levels for Level A systems, without controlling the aircraft design and verifying that the test levels are adequate, will expose to the risk of test levels not being adequate for aircraft with poor airframe/wiring protections.	If the intent of this MOC is is to relax for the need to determine ATL derivation for groups I and II (as compared to Level III), then minimum design requirements would need to be defined for the airframe and wiring.	YES	YES	Accepted	See comment 33-04
33-30	*GAMA*	MOC VTOL.2515(4)(a)(d)(2)(i)(B)(c)	66 & 67 for Group II Also applies to HIRF page 76 (C), 77(C)	If the Level A function is maintained (availability) or a Level A malfunction (erroneous operation) is prevented then that is all that should be needed, and place no additional requirements. This requirement is not proportionate similar to other areas of certification for different aircraft groups. This requirement would be the same as a Part 25 aircraft today. The text can also be misleading for a system that has a "function" whose erroneous operation might be CAT and availability might be MIN (eg, autopilot on fixed wing aircraft). The text implies that the function is required to recover after a Level A test level even if its availability is MIN.	Fail/Pass Criteria: Any upset should not exceed some predetermined amount that would be considered a loss of function or a malfunction (eg, erroneous operation) that would prevent continued safe flight and landing for Category Enhanced, or a controlled emergency landing for Category Basic.	No	Yes	Not accepted	The interpretation provided is wrong; the Level A function is maintained at A/C level, and the equipment performing the function, if perturbated during the threat, should be recovered afterwards.
33-31	*GAMA*	MOC VTOL.2515(4)(a)(d)(2)(ii)(C)	66 & Applies to Group II and III also Applies to Level B for HIRF also.	"Fail/Pass Criteria; when submitted to the Lightning Environment, it could be acceptable that redundant equipment is/are subject to adverse effect, provided that the Level B function is recovered manually or automatically, in a timely manner, after the threat." There is no guidance on primary prevention, only requirements for redundant equipment. Again this should state that the Level B function is maintained or level B malfunction prevented.	Fail/Pass Criteria: Any upset that is considered a loss of function or a malfunction (eg, erroneous operation) that would be considered a Level B failure, is required to recover normal operation of the function in a timely manner unless its availability is something less than Level B. No malfunction should occur that would result in a Level B failure.	No	Yes	Not accepted	The Fail/Pass criteria is in line with VTOL.2515(b) for which the loss/malfunction of the level B or C functions is allowed during the exposure.
33-32	*EUROCAE WG-31*	MOC VTOL.2515	66 and 67	MOC VTOL.2515, Section 4, item d. IEL Group I and II: Recommending specific equipment/system test levels for Level A systems, without controlling the aircraft design and verifying that the test levels are adequate, will expose to the risk of test levels not being adequate for aircraft with poor airframe/wiring protections.	If the intent of this MOC is is to relax for the need to determine ATL derivation for groups I and II (as compared to Level III). Asthe comment related to HIRF generic curves, the compliance should not be unconditionnally stated, minimum design requirements would need to be defined for the airframe and wirings			Accepted	See comment 33-04
33-33	*EUROCAE WG-31*	MOC VTOL.2515	67	For IEL Group III, for non level A display systems, the positive margin shall be verified but no instructions are given when the verification is not successful. Another bullet take corrective measures should be added as in the AMC20-136	"take corrective measure §" should be added in VTOL AMC consistently with AMC20.136			Accepted	The following text is added: "*If a positive margin is not established, corrective measures should be implemented in line with AMC 20-136*."

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33-34	*Leonardo Helicopters*	MOC VTOL.2515, Section 6, item d. IEL Group III, (i) (C), (a)&(b)	67	Step (a) and (b) propose defined ED-14G levels and categories, then proposes to verify compliance their compliance with TCL/ATL. The MOC shouldn't be prescriptive in defining equipment/system qualification levels, which might be demonstrated to be not adeguate for TCL/ATL of a specific design..	Replace (C), (a) and (b) text with: "Conduct Equipment/System testing using ED-14G Section Categories and levels commensurate with the aircraft TCLs: (a) ED-14G guidance on test levels selection can be used For VTOL aircraft with primarily metal structure, waveform sets for aperture coupling should be used. For VTOL aircraft with primarily carbon fiber, fiberglass or other low-conductivity or non-conductive material structure, waveform sets for aperture and resistive coupling should be used. "	NO	YES	Partially Accepted	See comment 33-04
33-35	*Airbus Helicopters* *(MM)*	MOC VTOL.2515 4.(d).(4).(i)	Page 67	Unless we are wrong, for level A non display systems, either we follow AMC20-136 (A) or we determine ATL (B)+we conduct test at minimum categories (C) and we verify compliance (positive margin) (ii) which should be (D). so it is not a full forfaitary approach which may be followed with (B), (C) and (D) because a verification shall be peformed (ETDL vs TCL) and so the benefit to apply (B), (C) and (D) instead (A) is very limited.	We propose that a usual forfaitary approach is allowed as alternative with (A), it means with removing (B) and (D) but with some modifications of categories in line with AH experience and lightning levels definition as AMC20-136. It leads to distinguish different levels for electrical system (equipment and its wiring) installed internally/outside the fuselage: (a) For VTOL aircraft with primarily metal structure, EUROCAE ED14G section 22 category A3J3L3 for internal installation and A4J4L4 for outside installation (b) For VTOL aircraft with primarily carbone fiber… structure, EUROCAE ED14G section 22 category B3K3L3 for internal installation and B4K4L4 for outside installation Then these modifications lead: 1) to increase the level for external instalallation in a metal structure because level 3 is sometimes not enough when cabling is not routed against a ground plane 2) to reduce to a level 3 tests for cabling routed internally to composite structure For an outside installation with wirings routed near a metallic ground plane or a metallized composite panel, the inside level should be applied. An accurate definition of inside/outside should be added in order to clarify the applicability of level ¾ based on AMC 20-136 And for forfaitary compliance route, require lightning functional testing on actual harness (content and length) would be relevant also.	No	yes	Partially accepted	The MOC has been reworded as follows: *"(4) IEL Group III* *(i) For Level A Non-Display Systems:* *(A) Follow the AMC 20-136; or* *(B) Determine the aircraft Actual Transient Level (ATL) (by test, analysis, combination of both or by similarity); and* *(C) Conduct Equipment/System testing using the following categories:* (a) *According to the VTOL aircraft primary structure and wiring type, choose the appropriate Category/Waveform at Level 3 or 4 in EUROCAE ED-14G section 22.* (b) *Fail/Pass Criteria; when submitted to the Lightning Environment, it could be acceptable that equipment is/are subject to adverse effect, provided that the Level A function is maintained at the aircraft level and all the Equipment/Systems that are required in normal operation, recover manually or automatically, in a timely manner, this function after the threat.* (c) *Verify the positive margin between the default levels applied during the Equipment/System testing (EDTL as defined in i. or ii.) and the Transient Control Level (TCL, maximum expected aircraft ATLs). If a positive margin is not established, corrective measures should be implemented in line with AMC 20-136."*

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33-36	*Pipistrel*	MOC VTOL.2515(4)(d)(4)	67	For DAL A non-display systems on a non-conductive aircraft, category B4K4L4 must be met. The B (pin injection) category for this seems quite high given that the cable bundling (K4L4) levels are also high.	Reduce the pin injection level to 3 and leave the bundling levels at 4: B3K4L4.	No	Yes	Partially accepted	See comment 33-04
33-37	Lilium GmbH	MOC VTOL.2515	67	Item 4 (d) (4) (i) the rules to be followed are ambiguous. It is not clear if it should be [(A) or (B)] AND (C) or (A) OR [(B) and (C)]. In summary, it is unclear if AMC 20-136 could be used as the only AMC or if item 4 (d) (4) (i) (C) must always be complied with.	Please clarify per comment	no	yes	Not accepted	The text in Section 4(d)(4)(i) clearly asks to follow [A] or [B and C].
33-38	*Airbus Helicopters (MM)*	MOC VTOL.2515 4.(d).(4)	Page 67	I assume (ii) should be (D)	Layout correction for consistency	yes	No	Accepted	Numbering corrected
33-39	*Airbus Helicopters (MM)*	MOC VTOL.2515 4.(d).(4)	Page 67 and 68	I assume (5),(6),(7) should be respectively (ii),(iii),(iv).	Layout correction for consistency	yes	No	Accepted	Numbering corrected
33-40	THALES Avionics	MOC VTOL.2515	68	" the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should be considered to be as a level B system (Level 2)." The notion of level is replaced by IEL group in this MOC	Replace level ¾ or 2 by correct IEL group …	Suggestion	Objection	Not accepted	IEL Group should be identified by using Table 1 depending on the VTOL aircraft category; the relevant Group will determine the IEL Compliance Verification method given in paragraph (d). Table 2 provides the Failure Condition classification and the Lightning Certification Level (LCL) classification assigned to the system and functions, which can be different from the Design Assurance Levels assigned for equipment function and/or item (software, and complex electronic hardware). Levels 2, 3, 4 are applicable to the qualification of the back-up channel.
33-41	*Leonardo Helicopters*	MOC VTOL.2515, Section 4.(d).(9)	68	It is stated that "if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should be considered to be as a level B system (Level 2)." Back-up channel should be assigned IEL Criticality appropriate to the specific Safety assessment, which might be lower than B if demonstrated by specific safety assessment.	Poposed to remove the part ", however this back-up channel should be considered to be as a level B system (Level 2)." and replace with "in this case the backup channel should be qualified to a level appropriate wth its own functional failures criticalities as determined through a specific safety assessment"	NO	YES	Not accepted	See comment 34-42
33-42	*GAMA*	MOC VTOL.2515(4)(d)(7)	68	"Fail/Pass Criteria; when submitted to the Lightning Environment, it could be acceptable that redundant equipment is/are subject to adverse effect, provided that the Level C function is recovered manually or automatically, in a timely manner, after the threat." There is no guidance on primary prevention, only requirements for redundant equipment. Again this should state that the Level C function is maintained or level C malfunction prevented.	Fail/Pass Criteria: Any upset that is considered a loss of function or a malfunction (eg, erroneous operation) that would be considered a Level C failure, is required to recover normal operation of the function in a timely manner unless its availability is something less than Level C. No malfunction should occur that would result in a Level C failure.	No	Yes	Not accepted	See comment 33-31

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33-43	*GAMA*	MOC VTOL.2515(4)(d)(9)	68	"…for instance if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should be considered to be as a level B system (Level 2)…." The criticality should be based on safety assessment for the backup system alone if the primary channel is shown to work.	Change to: "…for instance if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should meet the requirement based on the lightning certification level based on the failures of the backup channel alone."	No	Yes	Not accepted	See comment 34-42
33-44	*EUROCAE WG-31*	MOC VTOL.2515	68	ED-158A/ ARP5415B ""User's Manual for Certification of Aircraft Electrical/Electronic Systems for the Indirect Effects of Lightning"" is not referenced. It would be helpful to refer to this document for example when dealing of equipment testing in d) (8). 1) the subsection 5.6.1 is explaining differences between equipment and system testing. 2) because for equipment testing, 8.3 provides some conditions and guidances for equipment tests to ensure that the demonstrated performance during equipment test is effective when the equipment is mounted on Aircraft	A reference to ED-158A regarding equipment/ system tests definition would be helpful for the applicant. It is also missing in HIRF AMC.			Not accepted	The MOC includes testing consideration for a simplified method for VTOL aircraft, whereas the ED-158A deals with the general method. An applicant can use AMC 20-136, which is consistent with ED-158A, instead of the simplified method offered in this MOC.
33-45	*Boeing*	MOC VTOL.2515 4.(d)(9)	68	The proposed text states: (9) Level A System architecture consideration: when a level A system is composed of redundant channels/equipment that perform the same level A function, it is permitted to limit the system to the channels/equipment that are required in normal operation provided that they are not susceptible when they comply with VTOL.2515(a); for instance if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should be considered to be as a level B system (Level 2). REQUESTED CHANGE: We recommend edits to the highlighted text as follows: …for instance if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel ~~should be considered to be as a level B system (Level 2)~~ **qualified in accordance with the failure classification of that channel's failure.**	JUSTIFICATION: The rigor of lightning testing should be commensurate with the failure effect of the equipment/system. Backup system failure conditions may be less than Hazardous.		yes	Not accepted	See comment 34-42

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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33-46	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.5(b), Fig1&2	69	Figure 1: "It can be seen from this figure that this mainly occurs when the aircraft is in clouds where intra-clouds flashes are intercepted by the Aircraft" – this is not necessarily true when you look at the chart because there is a large number of unknown cases with "no information". Figure 2: "It can be seen from this figure that Lightning Strike mainly occurs under rain or hail conditions but in 30% of the cases there was no precipitation" – this is not necessarily true when you look at the chart because there is a large number of unknown cases with "no information".	We should add the implicit assumption that the "no information" events consist of the other stated scenarios in a ratio that does not alter the relative numbers	Yes	No	Noted	Noted but no need of further update.
33-47	UK CAA	MOC VTOL.2515 5. Rate of Lightning strike to small aircraft and Failure Condition Likelihood Para (b) Environmental Condition and Aircraft Position	69	Figure 1 - Data shows 45-50 lightning strikes with "No Information" for aircraft position. This is a significant amount of the overall data. The data does not substantiate the decision regarding limitation to day VFR.	Better substantiating data required.	No	Yes	Not accepted	See comment 33-46 and 33-48
33-48	*EUROCAE WG-31*	MOC VTOL.2515	69	Appendix 1 Page 69- Rates of Lightning strikes on Rotorcrafts should be considered as well, as possibly representing operational conditions of VTOLs more closely than general aviation. EUROCAE ED91-A Section A.4 provides minimum data; more data could be asked to EUROCAE WG-31.	EUROCAE can be asked to provide figures for rates of lightning strikes on Rotorcraft, to be implemented in Appendix 1 and to be considered if there is an impact to the rest of the MOC.			Noted	Additional information has been received from the Eurocae WG and no real impact on the data provided in Appendix 1 could be identified.
33-49	*Leonardo Helicopters*	MOC VTOL.2515, Appendix 1	69	Rates of Lightning strikes on Rotorcrafts should be considered as well, as possibly representing operational conditions of VTOLs more closely than general aviation. EUROCAE ED91-A Section A.4 provides minimum data; more data could be asked to EUROCAE WG-31.	Ask EUROCAE to provide data for rates of lightning strikes on Rotorcraft, implement Appendix 1, and consider impacts to the rest of the MOC.	NO	YES	Noted	See comment 33-48

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
33-50	UK CAA	MOC VTOL.2515 5. Rate of Lightning strike to small aircraft and Failure Condition Likelihood Para (b) Environmental Condition and Aircraft Position	70	Figure 2 - Data shows no precipitation with approx. 25 lightning strikes and over 30 lightning strikes with no information. This equates to more than the rain, hail or snow. This data does not substantiate that a lightning detection system will adequately reduce risk of a lightning strike. Is the data set presented based on US data or is it world data? The data should be representative of world wide data or at least ensure that European data is considered (if not already).	Better substantiating data required.	No	Yes	Noted	See comment 33-48
33-51	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2515, Sect.5(c), Table 3	70	I find this misleading because the likelihood is relative. For each A/C group, the "likelihood" (in general English) does not change, e.g. 1E-4 for Group III IFR. No matter what name it is given, how does it sit with the requirement to show "exposure is unlikely"?	Can we change to say "LS hazard factor" and then low/medium/high instead of unlikely/likely/very unlikely? Add clarification for demonstrating “unlikely”	No	Yes	Not accepted	The “likelihood” of the Hazard in this Section is the ratio between the Rate of lightning strike for a given group and the safety objective, as described below the table. This “likelihood” of Hazard is different from the “unlikely exposure” mentioned in Section 1 of the MOC.
33-52	*Leonardo Helicopters*	MOC VTOL.2515, Appendix 1, Table 2	70, 71	An example should be provided to show how Table 2 data were numerically derived.	Provide an example for numerical derivation of Tables at page 70.	YES	NO	Noted	It is not deemed necessary to provide additional explanations in the MOC, as the results of the calculation are already provided in Table 4. Examples of calculation of Rate of Lightning Strike (RLS) in Table 4 (always rounding to the next higher integer): 1) For Group I: Corresponds to Class I (Column 2 in Table 3): (a) $RLS_{Group\ I} = 0,1\ RLS_{IFR} + 0,9\ RLS_{VFR}$ (Row 2 in Table 3) (b) $RLS_{Group\ I} = 10^{-5}$ (Row 5 in Table 3) (c) $RLS_{IFR} = 10\ RLS_{VFR}$ (Note 2 under Table 4) Solving the system (a)(b)(c): $RLS_{VFR} = 5\ 10^{-6}$; $RLS_{IFR} = 5\ 10^{-5}$ 2) For Group II: Corresponds to Class II (Column 3 in Table 3): (a) $RLS_{Group\ II} = 0,3\ RLS_{IFR} + 0,7\ RLS_{VFR}$ (Row 2 in Table 3: 27% rounded to 30% for this example) (b) $RLS_{Group\ II} = 3\ 10^{-5}$ (Row 5 in Table 3) (c) $RLS_{IFR} = 10\ RLS_{VFR}$ (Note 2 under Table 4) Solving the system (a)(b)(c): $RLS_{VFR} = 8\ 10^{-6}$; $RLS_{IFR} = 8\ 10^{-5}$

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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33-53	*GAMA*	MOC VTOL.2515(6)	71	Green Box → "**For Level C System (Except IEL Group III IFR) and Level B System for IEL**" The above implies requiring assessment for Level C Group III but not for Level B for all groups. The flow chart requires group II to be assessed. This would be easier if the rule was for each hazard classification CAT thru MAJ; it would automatically rule out MAJ for Groups I and II; and should not need to be considered in the flow.	Change to: **"No Hazard related to lightning – No assessment needed** **For all Systems on VTOL Aircraft A/C flying with CAVOK/NSC conditions or Group I VFR**."	No	Yes	Partially accepted	The Box was incomplete due to an editing mistake and is now enlarged showing the full content: "**No Hazard related to lightning – No assessment needed** For all Systems on VTOL Aircraft A/C flying with CAVOK/NSC conditions or For Level C System (Except IEL Group III IFR) and Level B System for IEL Group I VFR".
33-54	*Vertical Aerospace*	MOC VTOL.2515 Equipment, systems, and installations 4. Definitions	69	Typo: 'Bellow' instead of 'below'		Yes	No	Accepted	Typo corrected

34. MOC VTOL.2520 HIGH-INTENSITY RADIATED FIELDS (HIRF) PROTECTION

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
34-01	*Leonardo Helicopters*	MOC VTOL.2520, Section 4	Several pages	Reference is made to HIRF "generic transfer function for helicopter" and "generic attenuation curves" with no specific definition and without mentioning that they are defined into AMC20-158. AMC20-158 does not cover generic transfer functions for VTOL.	Specific VTOL "generic transfer function" and "generic attenuation curves" need to be defined and included into VTOL-AMC, or included into AMC 20-158 and referenced into VTOL-AMC	NO	YES	Partially accepted	Reference to "for Helicopter" is replaced by reference to "aircraft (according to VTOL shape and size)". Considering the variety of VTOL Design, it is deemed that it is only possible to consider generic transfer functions and attenuation curves from AMC 20-158 is without being too descriptive.
34-02	*Leonardo Helicopters*	MOC VTOL.2520, Section 4	Several pages	Reference is made to testing categories from EUROCAE ED-14E version. ED-14E is an old standard (the most recent issue to date is ED-14G) with old and should not be receommended by this MOC.	Reference need to be made to ED-14G standard, with properly selected categories; where test levels do not match with the ED-14E levels then alternative categories can be proposed, or test level adjustment can be proposed.	NO	YES	Accepted	Reference is updated as proposed to the latest standard, typo errors are corrected.
34-03	*Leonardo Helicopters*	MOC VTOL.2520, Section 4.(a)	73	Section 4.(a) addresses only electrical bonding, which is not a sufficient minimum design consideration.	Significantly implement this section to cover all aspects in EUROCAE ED-107A Section 4, or just refer to EUROCAE ED-107A Section 4.	NO	YES	Partially accepted	Additional considerations for low impedance electrical conductors is added in a new point under Section 4 (a)(2). Further elements are not deemed necessary.
34-04	EUROCAE WG-31	MOC VTOL.2520	73	§4.a - "Minimum design considerations" too short. More elements in the LIE AMC	The ED107 should be referenced and quidances can be developed in this guide to be in line with VTOL need.			Partially Accepted	Additional considerations for low impedance electrical conductors is added in a new point under Section 4 (a)(2).
34-05	Boeing	MOC VTOL.2520 4.(c)(1)	74	The proposed text states: (1) The VTOL aircraft systems that require a HIRF Safety Assessment should be identified. <u>The elements of the system that performing a function should be defined…</u> REQUESTED CHANGE: …The elements of the system(s) that ~~performing~~ <u>perform</u> a function should be defined…	JUSTIFICATION: Syntax correction. The correction additionally indicates that multiple systems may perform a particular function.	yes		Accepted	Corrected as suggested
34-06	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2520, Sect.4(c), Table 2	75	Scope of requirements could be better defined	In (a) of 1st cell, I would write "…could lead to a potentially Catastrophic Failure Condition…" rather than "…would prevent continued safe flight and landing for Category Enhanced, or a controlled emergency landing for Category Basic…"	Yes	No	Not accepted	The requirement is in the SC VTOL
34-07	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2520, Sect.4(c), Table 2	75	Scope of requirements could be better defined	In note (b) of bottom left cell, I would write "…could lead to a potentially Hazardous or Major Failure Condition…" rather than "…would reduce the capability of the aircraft or the ability of the flight crew to respond to an adverse operating condition…"	Yes	No	Not accepted	The requirement is in the SC VTOL
34-08	*Delta System Solutions GmbH (Stuart Baskcomb)*	MOC VTOL.2520, Sect.4(c), Table 2	75	Note (4) needs clarification regarding how deep we should go with the analysis.	Should we consider multiple Minor FC's that when added up could be CAT/HAZ, for example? Do we run the risk of saying that any HIRF will be CAT for a small VTOL and, if so, is that ok?	Yes	No	Not accepted	The requirements are clear and the assessment is only at the system/function level. Therefore, combination of multiple FCs is not necessary.

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NR	Author	Section, table, figure	Page						
34-09	*Airbus Helicopters (SB)*	2520.4	75	Table 2 (HIRF) offers a mean to allocate a HCL at system level. Nevertheless it does not provide guidance to allocate at equipment level. For example with CS29.1316/1317, it is wished to have table 2 objectives fulfilled, even after a single random failure.	To indicate in an additional column, how many equipment belonging to the system and contributing to the Failure Condition, need to be qualified. To indicate also qualification levels to be reached.	Yes	no	Not accepted	It is not considered necessary to include additional precisions: in Section 6 tests are proposed at system or equipment level.
34-10	*Airbus Helicopters (SB)*	2520.4	75	(6): approach is similar, but technical solutions may be different. Therefore, the system level objectives should be identical between IEL and HIRF, but objectives may be different at equipment level.	To indicate in an additional column, how many equipment belonging to the system and contributing to the Failure Condition, need to be qualified. To indicate also qualification levels to be reached.	yes	no	Not accepted	See comment 34-09 and 33-25.
34-11	*Airbus Helicopters (MM)*	MOC VTOL.2520 4.(d).(1)	Page 75	"*By applying the safety continuum policy*" reference to a § or another document would be helpful for reader understanding	Add reference to a § or a document.	yes	No	Partially accepted	"Safety continuum policy" replaced by "net safety benefit approach" For additional information, refer to the EASA Certification Memorandum CM-SA-001 published in the EASA Website: Proposed Certification Memorandum CM-SA-001 - Net Safety Benefit - Issue 01 | EASA (europa.eu)
34-12	*Leonardo Helicopters*	MOC VTOL.2520, Section 4.(d)	75	Reference is made to "Safety Continuum Policy", which appears as not defined in the document	Add "Safety Continuum Policy" definition, or delete reference to it	YES	NO	Partially accepted	See comment 34-11
34-13	*Pipistrel*	MOC VTOL.2520 4 (d) (2)(i)(B)(a)	75	In the HIRF section, ED-14E is being referenced. ED-14G is the latest. Other references within this document are to ED-14G.	Recommend consistency within SC-VTOL referencing ED-14G/DO-160G.	No	Yes	Accepted	See comment 34-02
34-14	*GAMA*	MOC VTOL.2520 4 (d) (2)(i)(B)(a)	75	In the HIRF section, ED-14E is being referenced. ED-14G is the latest. Other references within this document are to ED-14G.	Recommend consistency within SC-VTOL referencing ED-14G/DO-160G.	No	Yes	Accepted	See comment 34-02
34-15	THALES Avionics	MOC VTOL.2520 - §4(d)(2)(i)	75	For Non level A Display Systems should be updated by ''For Level A Non-Display Systems ''		Suggestion	Substantive	Accepted	Text changed as suggested
34-16	THALES Avionics	MOC VTOL.2520 -§4	75	Conducted scuceptibility test category (ED-14 section 2 Cat H is same for HIRF Group III and HIRF Group I and II. should not it be updated by CAT Y for HIRF Group III and W for HIRF Group I and II?		Observation	Substantive	Accepted	Text updated with the categories of ED14G

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NR	Author	Section, table, figure	Page						
34-17	*GAMA*	MOC VTOL.2520(4)(d)(2)(i) and MOC VTOL.2520(4)(d)(3)(i)	75 and 76	Should MOC VTOL.2520(4)(d)(2)(i) be "For Level A Non-Display Systems" like MOC VTOL.2515(4)(d)(4)(i)? Should MOC VTOL.2520(4)(d)(3)(i) be "For Level A Non-Display Systems" like MOC VTOL.2515(4)(d)(4)(i)? If the text is correct as written, then the HIRF section does not have clear MOC definition for DAL A non-display systems.	Correct the HIRF section to clearly define MOC for DAL A Non-Display systems.	Yes	No	Accepted	See comment 34-15 Sections (4)(d)(2)(i) and (4)(d)(3)(i) changed to "For Level A Non-Display Systems"
34-18	Boeing	MOC VTOL.2520 4.(d)(2)(i) & VTOL.2520 4.(d)(3)(i),	75 & 76	The proposed text states: (i) For Non level A Display Systems REQUESTED CHANGE: (i) ~~For Non level A Display Systems~~For Level A Non-Display Systems:	JUSTIFICATION: Syntax correction. This paragraph is intended for systems that are Level A, but are non-display in nature. .	yes		Accepted	See comments 34-15, 34-17. Corrected as proposed.
34-19	*GAMA*	MOC VTOL.2520(4)(c)(4)	75	"Additionally, the inherent immunity of mechanical systems with no electrical circuitry should also be considered " A mechanical system may have electrical circuit but may still be considered inherently immune if the electrical circuit portion has MIN functionality.	Mechanical systems can be considered inherently immune to HIRF and may be used in the safety assessment. Any reliance of the electrical monitoring for a mechanical system to reliably perform its function should also be considered in the safety assessment.	No	Yes	Partially accepted	The MOC has been modified by incorporating the suggested wording: "*Mechanical systems can be considered inherently immune to HIRF and may be used in the safety assessment*." The second part of the suggested statement for resolution is considered to address a concern which is outside of this Note (4).
34-20	*GAMA*	MOC VTOL.2520(4)(d)(3)(i)	76	"Conduct Equipment/System testing using the following default levels" The subsequent text is for aircraft level test data and not default levels.	Change to: "Conduct Equipment/System testing using data based on aircraft test or simulation."	No	Yes	Not accepted	Default levels proposed are Equipment/System levels using ED14G Categories
34-21	*Pipistrel*	MOC VTOL.2520 4 (d)(2)(i)(B)(a)	76	There is not a Conducted Susceptibility Category G. HIRF Environment Level III is equivalent to Category L in DO-160G.	Use Cat W for conducted susceptibility	No	Yes	Partially accepted	See comment 34-16. "Category G" replaced by "categories Y or W".
34-22	*GAMA*	MOC VTOL.2520 4 (d)(2)(i)(B)(a)	76	There is not a Conducted Susceptibility Category G. HIRF Environment Level III is equivalent to Category L in DO-160G.	Use Cat W for conducted susceptibility	No	Yes	Accepted	See comment 34-21

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
34-23	EUROCAE WG-31	MOC VTOL.2520	76	The generic curves proposed for VTOL are based on H/C curves	"VTOL can be very different of an usual H/C and it is difficult to anticipate the different shape/architecture of products proposed by future applicants. Anyway, for external routings a CAT G is likely to be not enough for external routings especially when wirings are not routed near a conductive part (evidenced by experience on H/C). Then, the cat G should not be unconditionally considered as MoC, for exposed wirings an additional overshield may be required to be compliant with ENV III. Moreover, an analysis should be performed by the applicant to demonstrate that relying on generic curves are enough. It means that a similarity should be applied with the kind of platform for which the generic curves are associated. Specific VTOL "generic transfer function" and "generic attenuation curves" need to be defined and included into VTOL-AMC, or included into AMC 20-158 and referenced into VTOL-AMC"			Partially accepted	The wording has been modified to rely on generic transfer function/attenuation curves, the choice should be representative and consistent with ED14-G Categories Refer also to comments 34-01, 34-02, 34-21.
34-24	*GAMA*	MOC VTOL.2520 4 (d)(2)(i)(B)(b)	76	Categories K and J are not present in DO-160G.	Based on mission profile of the vehicle, Environment III Levels may be too extreme. Recommend using category F instead There are no Cat K and J	No	Yes	Accepted	See comment 34-16. "Categories L (0 dB), K (-6 dB) or J (-12dB)" is replaced by "categories L, G or F"
34-25	*Pipistrel*	MOC VTOL.2520 4 (d)(2)(i)(B)(b)	76	Categories K and J are not present in DO-160G.	Based on mission profile of the vehicle, Environment III Levels may be too extreme. Recommend using category F instead There are no Cat K and J	No	Yes	Accepted	See comment 34-24
34-26	*GAMA*	MOC VTOL.2520 4 (d)(2)(ii)(B)(a)	76	Should reference DO-160G.	There are no Cat H for conducted Susceptability	No	Yes	Accepted	See comment 34-16. "Category H" replaced by "categories O or M".
34-27	*Pipistrel*	MOC VTOL.2520 4 (d)(2)(ii)(B)(a)	76	Should reference DO-160G.	There are no Cat H for conducted Susceptibility	No	Yes	Accepted	See comment 34-26
34-28	*Airbus Helicopters (MM)*	MOC VTOL.2520 4.(d).(2) (ii)(B	Page 76	Typography error only in (a) and (b): 2 "?" to be removed	Typography correction	yes	No	Accepted	Spurious "?" deleted.
34-29	*Leonardo Helicopters*	MOC VTOL.2520, Section 4.(d).(3)	76	Point (i) appears wrongly worded	Replace "For Non- Level A Display Systems" with "For Level A Non-Display systems"	YES	YES	Accepted	See comment 34-18. Changed as suggested

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34-30	*Pipistrel*	MOC VTOL.2520 4 (d)(3)(ii)(A)	76	Should reference DO-160G.	There are no Cat H for conducted Susceptibility	No	Yes	Accepted	See comment 34-16. "Category H" replaced by "Category O or M".
34-31	*GAMA*	MOC VTOL.2520 4 (d)(3)(ii)(A)	76	Should reference DO-160G.	There are no Cat H for conducted Susceptability	No	Yes	Accepted	See comment 34-30
34-32	*GAMA*	MOC VTOL.2520 4 (d)(3)(ii)(B)	76	Should reference DO-160G.	There are no Cat K or J. The mission profile should be taken into account for each case to determine the radiated test levels.	No	Yes	Accepted	See comment 34-16. "Categories L (0 dB), K (-6 dB) or J (-12dB)" replaced by "categories G, F or D".
34-33	*Pipistrel*	MOC VTOL.2520 4 (d)(3)(ii)(B)	76	Should reference DO-160G.	There are no Cat K or J. The mission profile should be taken into account for each case to determine the radiated test levels.	No	Yes	Accepted	See comment 34-32
34-34	*Airbus Helicopters (MM)*	MOC VTOL.2520 4.(d).(3) (i)	Page 76 and 77	"(i)for non- level A Display system:" Shall be rephrased in: (i)for Level A non display systems:	To be rephrased	No	Yes	Accepted	See comment 34-29
34-35	*Airbus Helicopters (MM)*	MOC VTOL.2520 4.(d).(3) (i)	Page 76 and 77	For Level A non display systems, (A) , (B) correspond to follow the AMC 20-158	Replacement of (A) …& (B)… by (A) Follow the AMC 20-158 (by using HIRF Environment III)	Yes	No	Accepted	Text is modified as follows: *"(3) HIRF Group III* *(i) For Level A Non-Display Systems:* *(A) Follow the AMC 20-158; or* *(B) Conduct Equipment/System testing using the following default levels:"*
34-36	THALES Avionics	MOC VTOL.2520 -	76-77	ED-14 rev E should be updated by ED-14 rev G that is the last revision.		Suggestion	Substantive	Accepted	See comment 34-02

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
34-37	*Airbus Helicopters (MM/MG)*	MOC VTOL.2520 4.(d).(3)(i)	Page 76/77	The applicability of HIRF (High Intensity Radiated Fields) Environment III for operations in an urban environment is questionable for VTOLs of the Enhanced Category, it means flights above dense unhabitants areas. Indeed, the estimated HIRF urban environment as highlighted in the study performed by Eurocae is reduced by 12dB compared to environment III in some frequency sizing for HIRF protection at VTOL and equipment levels. This makes sense for flying urban taxis because of the reduced flight range allowed by electric propulsion which will limit the capability to go outside the city where more powerful emitters can be present. And many operations should be limited to predefined route in urban/periurban areas with flying urban taxis. On the other hand, ENV III would impact significantly the design as evidenced on helicopter and therefore would be detrimental for business development in the frame of the urban mobility. Moreover, if the VTOL is not protected to the lightning because relying on weather forecasting or onboard lightning detection system, the HIRF protection will be the sizing electromagnetic protection and then any relaxation of HIRF environnment would be a direct benefit on the weight.	**To create a specific Group IV for VTOLs of the Enhanced Category as an alternative to Group III for missions limited to urban areas and based on the reduced levels identified by EUROCAE.** In case the pre-study performed by EUROCAE is considered not enough for the elaboration and the definition of this new urban environment, we suggest that a more in depth study is launched with a larger working group, for exemple with experts of WG-31. As an alternative, a first step would be to consider environment I (because available) which covers with margins the urban HIRF environment proposal in Eurocae report even if, in a second step, a more relevant environment should be proposed for these operations (radar environment defined for airport area –ENV II - should be the maximum encountered by this kind of platforms).	No	Yes	Not accepted	The category Enhanced is expected to follow a consistent rigorous approach. EASA considers that at this stage borders cannot be precisely described in the operational limitations. Consequently, well established stringent limits should be considered for this category. In case of dedicated request at project level, specific MOC could be discussed.

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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34-38	*Airbus Helicopters*	MOC VTOL.2520 4.(d).(3)(i)	Page 76/77	The applicability of HIRF (High Intensity Radiated Fields) Environment III for operations in an urban environment is questionable for VTOLs of the Enhanced Category, it means flights above dense unhabitants areas. Indeed, the estimated HIRF urban environment as highlighted in the study performed by Eurocae is reduced by 12dB compared to environment III in some frequency sizing for HIRF protection at VTOL and equipment levels. This makes sense for flying urban taxis because of the reduced flight range allowed by electric propulsion which will limit the capability to go outside the city where more powerful emitters can be present. And many operations should be limited to predefined route in urban/periurban areas with flying urban taxis. On the other hand, ENV III would impact significantly the design as evidenced on helicopter and therefore would be detrimental for business development in the frame of the urban mobility. Moreover, if the VTOL is not protected to the lightning because relying on weather forecasting or onboard lightning detection system, the HIRF protection will be the sizing electromagnetic protection and then any relaxation of HIRF environnment would be a direct benefit on the weight.	**To create a specific Group IV for VTOLs of the Enhanced Category as an alternative to Group III for missions limited to urban areas and based on the reduced levels identified by EUROCAE.** In case the pre-study performed by EUROCAE is considered not enough for the elaboration and the definition of this new urban environment, we suggest that a more in depth study is launched with a larger working group, for exemple with experts of WG-31. As an alternative, a first step would be to consider environment I (because available) which covers with margins the urban HIRF environment proposal in Eurocae report even if, in a second step, a more relevant environment should be proposed for these operations (radar environment defined for airport area –ENV II - should be the maximum encountered by this kind of platforms).	no	yes	Not accepted	See comment 34-37
34-39	*GAMA*	MOC VTOL.2520(4)(d)(3)(ii)(B)	77	" Radiated Susceptibility with Generic attenuation curves (depending on equipment location) applied HIRF Environment III (as defined in Section 5) corresponding to the EUROCAE ED-14E section 20 categories L (0 dB), K (-6 dB) or J (-12dB). " The envrironment used should be consistent with CS in (A) which states to use Env I. Should not use different external environment for CS and RS for the same system.	Change to: "Radiated Susceptibility with Generic attenuation curves (depending on equipment location) applied HIRF Environment I (as defined in Section 5) corresponding to the EUROCAE ED-14E section 20 categories G (0 dB), F (-6 dB) or D (-12dB)."	No	Yes	Partially accepted	"Environment III" is replaced by "Environment I". See comments 34-02, 34-32 regarding the Eurocae ED-14 version. See comment 34-16 regarding the categories.
34-40	*Airbus Helicopters (MM)*	MOC VTOL.2520 4.(d).(3) (ii)(B)	Page 77	We assume it is a mistake in (B): Environment for ratiated susceptibility tests for level A display systems should be environment I and not III to be consistent with (A)	Typography correction	No	Yes	Accepted	See comment 34-39

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
NR	Author	Section, table, figure	Page						
34-41	*Leonardo Helicopters*	MOC VTOL.2520, Section 5	78-80	HIRF Environment I, II and III are proposed as applicable to VTOL. However these environment were derived for specific operative conditions (as explained into ED-107A Section 3 tailored to fixed aircrafts and helicopter. Specific VTOL HIRF environment should be studied and defined.	Specific VTOL HIRF environment should be studied, defined and used in Section 5.	YES	YES	Noted	The research performed by EUROCAE (refer to Eurocae SC 004-2016) confirmed that there is no need to update the HIRF Environments for VTOL aircraft.
34-42	*EUROCAE WG-31*	Common to HIRF & LIE 2515 and 2520 MoC	78	It is stated that "if it is demonstrated that the primary channels comply with VTOL.2515(a) without the support of the back-up channel, the equipment of this channel is/are not required to be qualified to Level 3/4, however this back-up channel should be considered to be as a level B system." Back-up channel should be assigned IEL Criticality appropriate to the specific Safety assessment, which might be lower than B if demonstrated by specific safety assessment.	Proposed to remove the part ", however this back-up channel should be considered to be as a level B system." and replace with "in this case the back-up channel should be qualified in accordance with the failure classification of that channel's failure"			Not accepted	There is no direct correspondence between HCL (which also considers possible common cause failures) and FDAL (which is resulting from an SSA of the system)
34-43	*Leonardo Helicopters*	MOC VTOL.2520, Section 4.(d).(5)	78	It is stated that "if it is demonstrated that the primary channels comply with VTOL.2520(a) without the support of the back-up channel, this channel is not requested to be exposed to the HIRF Environment I/III, however this back-up channel should be considered to be a level B system." Back-up channel should be assigned HIRF Criticality appropriate to the specific Safety assessment, which might be lower than B if demonstrated by specific safety assessment.	Poposed to remove the part "however this back-up channel should be considered to be a level B system." and replace with "in this case the backup channel should be exposed to a HIRF Environment based on its own functional failures criticalities as determined through a specific safety assessment"	NO	YES	Not accepted	See comment 34-42

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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34-44	Boeing	MOC VTOL.2520 4.(d)(5)	78	(5) Level A System architecture consideration; when a Level A system comprises redundant channels/equipment that perform the same level A function, it is permitted to limit the system to the channels/equipment that are required in normal operation provided that they are not susceptible when they comply with VTOL.2520(a); for instance if it is demonstrated that the primary channels comply with VTOL.2520(a) without the support of the back-up channel, this channel is not requested to be exposed to the HIRF Environment I/III, however this back-up channel should be considered to be a level B system. REQUESTED CHANGE: We recommend edits to the highlighted text as follows: …for instance if it is demonstrated that the primary channels comply with VTOL.2520(a) without the support of the back-up channel, this channel is not requested to be exposed to the HIRF Environment I/III, however this back-up channel ~~should be considered to be as a level B system (Level 2)~~ qualified in accordance with the failure classification of that channel's failure.	JUSTIFICATION: The rigor of lightning testing should be commensurate with the failure effect of the equipment/system. Backup system failure conditions may be less than Hazardous.		yes	Not accepted	See comment 34-42
34-45	EUROCAE WG-31	MOC VTOL.2520	79-80	Environment III not relevant for operations limited to urban area	The applicant should be able to certify in the limited flight domain of urban/suburban area and then only comply with the actual HIRF environment which may be encountered in urban/suburban environment. It makes senses for flying urban taxi VTOL which will operate in a limited range because of the battery autonomy. This oeprating limitation shall be assumed by the applicant of course and the openening of the flight domain to all operations on countryside would need to comply with ENV III as a rotorcraft. The environement in urban area is limited especially for HERP purpose whereas most powerful emitters which drive the envelope of the ENV III are far from the city. And In the exceptional case that a powerful emiter would be present, an exclusion area may be defined to forbid flight near of these emitters. A specific HIRF urban/suburbanEnvironment should be defined in the VTOL-AMC			Not accepted	See comment 34-37
34-46	*GAMA*	MOC VTOL.2520(5)(d) and (f)	80	Allow ED-14E Cat R & Cat T testing to avoid having to re-test previously qualified equipment. The levels and the method of testing should be considered similar overall given we are not using these levels for CAT cases. The AC21-16G allows E for Level B and Level C systems.	Change to: "ED-14E (or later Revision)"	No	Yes	Not accepted	EASA does not deem it necessary to change to "ED-14E (or later revision)". It is expected that ED-14G is used as reference in this MOC. In principle, equipment that has been already qualified according to ED-14E Cat R and T would not need to be re-qualified according with ED-14G if similarity could be claimed.

35. MOC VTOL.2555 INSTALLATION OF RECORDERS

Comment				Comment summary	Suggested resolution	Comment is an observation or is a suggestion*	Comment is substantive or is an objection**	EASA comment disposition	EASA response
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35-01	*Boeing*	MOC VTOL.2555	80	The proposed text states: This MOC is applicable to each recorder installed to comply with VTOL.2555. (a) General: The recorder should be approved in accordance with ETSO-2C197, or TSO-C197, or meet the requirements laid down in: EUROCAE Document No ED-155 'MOPS for Lightweight Flight Recording Systems'; or EUROCAE Document No ED-112 'MOPS for Crash Protected Airborne Recorder Systems'. REQUESTED CHANGE: The MOC should provide an avenue for downlink data with many of this parameters using telemetry	JUSTIFICATION: Syntax correction. The correction additionally indicates that multiple systems may perform a particular function.		yes	Noted	This is in principle accepted but will be addressed in a future phase. The means of compliance for downlinking and recording data on the ground will be investigated. The MOC to the SC will only address the airborne segment.
35-02	Collins Aerospace	MOC VTOL.2555 (d) (1)	81	Typo in reference ".. Not Found .."	Add reference if one was intended (else delete)	No	Yes	Accepted	It should read 'The minimum list of flight parameters to be recorded is provided in paragraphs (h) and (i)'. This paragraph is moved to a different section dedicated to flight parameters and audio recording in the updated MOC.
35-03	*Vertical Aerospace*	MOC VTOL.2555 (d)(1)	81	"**Error! Reference source ot found.**		Yes	No	Accepted	See Comment 35-02
35-04	*Leonardo Helicopters*	MOC.VTOL2555 Par (d)(1)	81	Missing reference	/	YES	NO	Accepted	See Comment 35-02
35-05	UK CAA	MOC VTOL.2555 Installation of Recorders, Data Recording Para (d)(1)	81	There is an "Error! Reference source not found." In para (d)(1).	Typo.	Yes	No	Accepted	See Comment 35-02
35-06	*Volocopter*	2555	81	(d) Data recording: (1) broken link		yes	no	Accepted	See Comment 35-02
35-07	*Rolls Royce (Adam Newman)*	MOC VTOL.2555 subpart (d) (1)	81	*"…provided in paragraphs (h) Error! Reference source not found".*	Complete the broken cross-reference	Yes	No	Accepted	See Comment 35-02

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35-08	*Leonardo Helicopters*	MOC.VTOL2555 Par (d)(4)	81	Is this statement indirectly requiring an independent battery (power source in general) instead of the propulsion battery?	Please clarify	YES	NO	Noted	(d)(4): "The recorder should […] Automatically start to record as early as possible after power-on and in any case prior to the aircraft being capable of moving under its own power." Answer: No, this statement in itself does not require an independent battery instead of the propulsion battery.
35-09	*Volocopter*	2555 Section (d)(7)	81	"Have a means for the flight crew to stop the recording upon completion of the flight in such a way that re-enabling the recording is only possible by a dedicated manual action." Such requirements usually apply to the Cockpit Voice Recording function. In the MoC proposed they are applied to the flight data recording in general.	EASA is asked to clarify if this was implemented intentionally and what might be the reasoning behind this. Clear request is to change this back to the Cockpit Voice Recording function.	yes	yes	Partially accepted	This was intentional, however the text is now modified so that this provision only applies if the duration of the recording is less than 25 hours. If that is the case of the CVR function only, then this provision will only apply to CVR.
35-10	*Rolls Royce (Adam Newman)*	MOC VTOL.2555 subpart (h) (19) and (30)	82	"…if electric motors are used…" Does motor controller also include the power electronics health state or is that covered in (28) "…if thermal motors are used…" Thermal motor is not a term previously or commonly used – consider if it needs to be defined Subpart (v) should electrical generators and their controller (and power electronics) be defined in an unique subpart as electric motors have been where they are applicable to the specific application Thermal motors in a VTOL application may provide electrical power for propulsion and also for airframe electrical networks – be clear if you mean electrical current generation for propulsion or all sources		Yes	No	Noted	EASA confirms that point (19) (ii) also includes the powers electronics health state. A clarification is introduced in the text. "Thermal motors" replaced by "combustion engines". A clarification is introduced that for combustion engines any current generation has to be recorded.
35-11	*Leonardo Helicopters*	MOC.VTOL2555 Par (h)(19)(iii)	82	(iii) Motors: temperature of each motor Controller temperature may be a limiting factor and be the cause of failures. To be added.	(iii) Motors: temperature of each motor and associated controller	YES	NO	Accepted	The item (as "electric engines") has been added in the list.
35-12	*Airbus Helicopters (FXG)*	MOC VTOL.2555	82	flight parameters should as a minimum be recorded : additional signals / data to be recorded	(19) if electric motors are used: - measured electrical motor current - commanded electrical voltage or PWM ratio for liquid cooled electric motors: - pressure and temperature of cooling liquid	X		Partially Accepted	Current and cooling liquid parameters have been added in the list. Commanded RPM is already covered under item 20 (flight controls).
35-13	*Airbus Helicopters (FXG)*	MOC VTOL.2555	82	flight parameters should as a minimum be recorded : additional signals / data to be recorded	(20) flight controls: for variable pitch propellers: pitch of propeller	X		Accepted	The flight controls output list is non exhaustive, so the propeller pitch **command** is already covered under this item. However, the **actual** propeller pitch may have to be recorded. New item "(24) Propeller pitch (for each variable pitch propeller)"

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35-14	UK CAA	MOC VTOL.2555 Installation of Recorders Para (h)	82	MOC VTOL.2555 Installation of Recorders, para (h) (11) reads: “Pitch Attitude or nick angle”. Should it read “Pitch Attitude or Pitch Angle”?	Typo.	Yes	No	Partially accepted	Text simplified & “nick angle” is removed (as well as “roll angle”).