MOC-EHPS.420 Endurance Demonstration - Comment Response Document

Nr	Section	Page	Author	Comment	EASA comment disposition	EASA Response
1	(General Comments)	0	UK CAA	Page No: All Paragraph No: General Comment: The UK CAA notes that primarily an "endurance test" is a "Non-stop test" which has not been explained in the EHPS 420 text, as such how this will be a "non-stop test" if batteries or other systems need replenishing/maintaining needs to be explained. Justification: Clarification on Intent Proposed Text: none	Partially Accepted	The objective of endurance demonstration is to complete a series of cycles. This MOC and standard ED321 allow for pauses between cycles. The MOC, as currently written, focuses on testing electric engines. Batteries are not in the scope. The introductory text of the MOC has been updated for clarity.
2	(General Comments)	0	Luftfahrt-Bundesamt Germany	The LBA has no comments	Noted	
3	(General Comments)	0	Federal Aviation Administration	EHPS.420 Endurance Demonstration is called "Endurance Substantiation" in several places. Please stay consistent with SC E-19.	Accepted	
4	(General Comments)	0	AOPA Sweden	AOPA Sweden We do not have any comments on this proposal. Fredrik Brandel Member of the board AOPA Sweden	Noted	
5	(General Comments)	0	UK CAA	Page No: 1 Paragraph No: Statement of Issue Comment: The UK CAA notes that CS-E and CS-APU are currently only integrated into aircraft (ie with CS23 and CS-25), but changes to CS-E and CS-APU would be needed to integrate into a EHPS that is certified separately if credit is to be take for some of the existing certification. The UK CAA notes all engines and APU's are certified for an application (aircraft), even if already certified this would need to be repeated for a specific EHPS application. Then the EHPS would be certified for a specific aircraft application. Justification: Clarity Proposed Text: None	Noted	For the 1st part of the comment: No changes to CS-E or CS-APU since they are not used as certification bases of the EHPS. For the 2nd part: For integration of the new aircraft, changes on the existing TC will required substantiation, as per any other product.

6	(General Comments)	0	UK CAA	Page No: 1 Paragraph No: Statement of Issue Comment: The UK CAA notes that CS-23 existed "with AMC" before its current format "without prescriptive design solutions" and as such it was easier to convert the existing certification standard. The UK CAA notes that starting without any AMC in Sc E 19 and EHPS permits more technical innovation but requires the applicant to negotiate a specific AMC with the CA for EHPS, which may be higher risk and cost/time to certify for the applicant. Justification: Clarification on intent of "without prescriptive design solutions" approach for previously uncertified aircraft propulsion system types to SC E 19 and EHPS. Proposed Text: None	Noted	Similarly to CS-23 amended 6, the SC E 19 does not provide detailed and prescriptive certification requirements, but rather objective based and design-independent requirements. The intention of the MOC is to further detail the purpose of the SC E-19 standard requirements and propose details on how to comply with them.
7	(General Comments)	0	UK CAA	Page No: 1 Paragraph No: Statement of Issue Comment: The UK CAA notes that "APU with ETSO", should this be CS-APU rather than ETSO for an APU? Are APU's certified under EASA with ETSO's? Justification: Clarity Proposed Text: None	Partially Accepted	APUs are certified with ETSO in EASA. The Certification basis is CS-APU. Text changed to "certified APU" for clarity.
8	(General Comments)	0	UK CAA	Page No: All Paragraph No: General Comment: The UK CAA seeks to understand how the orientation of the electric engine or components is taken account in the endurance test, some of the electric engines operate at various orientations (tilt systems), this would need to be accounted for in the endurance demonstration.	Noted	MOC points that all CPAs should be considered during endurance demonstration, including the expected attitudes and the overall tilting effects. This is also covered in the ED321.

				Justification: Clarification on orientation of electric engine or EHPS during endurance demonstration Proposed Text: None		
9	(General Comments)	0	UK CAA	Page No: All Paragraph No: General Comment: The UK CAA seeks some clarification on what is proposed if Failures occur?, What about cooling or oil system failures or operating level (low oil/cooling or high oil/cooling) during the test? What condition are the test components prior to test? Deteriorated condition or as new?, and/ or with a run in period or not? Is intent to test a worst case or typical electric engine? Justification: Clarification on test conditions Proposed Text: None	Accepted	A case by case discussion will be needed depending on the nature of the failure. AMC E-740(h)(2) provide some guidance on this matter. Clarification added in the MOC.
10	1 List of Acronyms	4	UK CAA	Page No: 4 Paragraph No: List of Acronyms	Accepted	Acronyms list updated.

				Comment: The UK CAA notes acronyms used in document, but not in the table - ETSO, FAR, LOP and acronyms that are in the table, but not used in the document - AC, A/C Justification: Consistency Proposed Text: None		
11	1 List of Acronyms	4	Chris Baczynski	Editorial: the Definition of EDPS as being 'Electrical Power Distribution' should be appended by adding the word 'System' at the end	Accepted	Acronyms list updated.
12	3 Scope	4	Federal Aviation Administration	"...the strategy on how to use..."There is a paragraph that references elements of the EHPS propulsion system that are not included in the scope, but the elements that are in the scope are not directly mentioned before them. "The sections of the SC E 19 where no appropriate means to demonstrate compliance (ie. Industry Standard) have not been published yet, and, consequently, have no Method of Compliance associated with them, are tagged as “Reserved”.	Accepted	MOC updated accordingly.
13	1 List of Acronyms	4	Federal Aviation Administration	Add ETSO to the list of acronyms. Add the word "system" to "electrical power distribution."	Accepted	Acronyms list updated.
14	o	4	Certification Manager, magniX	Discussion often uses the terms "Endurance Demonstration" and "Endurance Substantiation". Is EASA able to provide more detail on the difference between a Substantiation and a Demonstration? An applicant should have to substantiate all test parameters, as with any test, but using the term	Accepted	There are no official definitions at EASA. Substantiation is used with the meaning of providing evidence or poof to support the compliance statement, while demonstration refers to the

				Substantiation could imply that the focus is on analysis and not the actual test (demonstration).		activities carried out (analysis, testing, combinations) used to demonstrate correct functioning. MOC Text updated to be more consistent
15	3 Scope	4	Certification Manager, magniX	The first sentence refers to EHPS.420 as "Endurance Substantiation". In line with the title in SC E-19, the title should be "Endurance Demonstration". This should be carried throughout the document.	Accepted	MOC updated accordingly.
16	3 Scope	4	UK CAA	Page No: 4 Paragraph No: 3 Scope Comment: The UK CAA notes "Other elements of the EHPS propulsion system, such as the propulsion batteries and the distribution system, as well as their interaction with other regulations where necessary, are not included in the scope of this document." To demonstrate EHPS endurance, assumptions for these propulsion batteries and distribution system are needed and do they need to be tested with the system in an endurance demonstration or some ideal version to replicate them? e.g. what if the battery voltage varies over the endurance test, or battery life is just 20 minutes, how is that limitation included in endurance demonstration? Justification: Clarity Proposed Text: None	Noted	ED321 gives guidance about how to deal with HV Battery voltage levels and cycle times. The HV battery voltage limits must be established and cycles must be performed within the minimum and maximum voltage.
17	1 List of Acronyms	4	UK CAA	Page No: 4 Paragraph No: List of Acronyms	Accepted	Added.

				Comment: The UK CAA notes “EPDS - Electrical Power Distribution” term “System” is missing. Justification: Consistency Proposed Text: None		
18	4.1.2 EHPS.420 General information	5	UK CAA	Page No: 5 Paragraph No: 4.1.2.2 Rating definition of EHPS emergency electric engines and other paras Comment: The UK CAA notes that “electric engine” is used rather or as well as “EHPS” throughout document. Justification: Consistency Proposed Text: None	Noted	The scope of the MOC is limited to electric engines, as part of EHPS system. "EHPS emergency electric engines" refers to a specific use of an electric engine.
19	4.1.2 EHPS.420 General information	5	Safran	"The objective of endurance substantiation is to:• Establish the EHPS operating limitations,• Demonstrate engine durability and reliability ..."Demonstration of engine durability and reliability is understood to be the purpose of EHPS.430. Safran would propose the wording used in of §5.1 instead "demonstration of the engine durability and reliability under extreme usage"	Partially Accepted	Objective description improved for better clarity.
20	4.1.2 EHPS.420 General information	5	Airbus Helicopters	§4.1.2.2 Rationale for comment: The following sentence "EHPS systems intended for emergency and only used to provide additional power in the event of a LOP must also undergo an Endurance test demonstration." would be a significant constraint for pure emergency applications, such as EBS 30s.Defining such an endurance testing for an electrical engine that is almost never active (only once every 100 000 FH) seems over-constraining taking into account the intended function of such an engine. ED-321 does not cover the case of a unique rating.Proposal:AH would suggest adding the following sentence: "Exception could be granted on a case-by-case basis, depending on the application' specificities, upon agreement with the EASA".	Non Accepted	The need for endurance is established by the MOC. EASA agrees that the endurance test ratings and cycles may be adapted to the specific characteristics of the application.
21	4.1.2 EHPS.420 General information	5	Chris Baczynski	Section 4.1.2.1 allows credit to be taken for "performance, limitations and installation procedures" when certified turbine and reciprocating engines are used. Such credit is appreciated. However, this section should ideally provide some guidance for endurance demonstration of combined EHPS (electric + turbine/recip) systems. In particular, no explicit mention is made whether or not EASA expects in such cases the applicants to perform endurance demonstration using a fully integrated hybrid system (including turbine or recip) or not.	Noted	EASA acknowledge the need of further guidance material. Guidance will be considered for hybrid systems.

22	4.1.2 EHPS.420 General information	5	Chris Baczynski	It is recommended the wording describing the objective of the endurance demonstration is revised to be harmonized with the objectives stated in ED321. In addition, wording of FAA AC 33.87-1A, sec 3-1.a. may be useful: "The endurance test is not a simulation of expected in-service operation, but an accelerated severity test intended to demonstrate a minimum level of engine operability and durability within the approved engine ratings and operating limitations."	Accepted	The MOCs share the same objectives that the ones defined in the ED321 standard. Text added to precise and incorporate this comment.
23	4.1.2 EHPS.420 General information	5	Chris Baczynski	The wording of 'endurance substantiation' should be changed to 'endurance demonstration' as testing is mandatory. The wording 'demonstration' would be in line with the title of the document and the text of the Special Condition SC E-19.	Accepted	Agreed. Text updated.
24	4.1.3 Associated Interpretative Material / Means of Compliance of SC E-19	5	Federal Aviation Administration	Why are there no references to CS-E 740 Endurance Tests or CS-E 670 Contaminated Fuel?Is the first group of MOC for all of EHPS.420 or is it supposed to be for EHPS.420(a) only? The subsequent groups of MOCs are for individual paragraphs. Under EUROCAE ED-321, change the word "intend" to "intent" and change "electrical engine" to "electric engine."	Accepted	MOC updated to correct the typos. MOC is intended to cover all paragraphs of the SC. MOC updated to include the CS E-740 and to delete the reference to contaminated fuels (CS-E 470, CS-E 670). SC E-19 will be also updated accordingly.
25	4.1.3 Associated Interpretative Material / Means of Compliance of SC E-19	5	Certification Manager, magniX	EUROCAE ED-321 is not to a level of maturity to provide the guidance for which it is intended. This document lacks consistency and does not recognize existing guidance and practice used within the industry. This document would create an unequal compliance standard depending on an applicant's design decisions and certification strategy. Consideration as a MOC by EASA should be withheld for a time at which the document establishes reaches the appropriate level of maturity. Several specific comments presented separately within this tool. Full comments provided via email.	Non Accepted	ED321 is considered a mature standard by EUROCADE and EASA. However evolutions of the standard will be continued. Other means of compliance are not excluded.
26	4.1.2 EHPS.420 General information	5	Certification Manager, magniX	The listed objectives of the endurance demonstration should be revisited to provide additional clarity.Bullet 3 should consider the following:The statement 'Demonstrate the capability to deliver the declared ratings' should be revised to state 'Demonstrate the capability of the EHPS to deliver the declared ratings within the declared operating conditions.	Partially Accepted	Objective description improved for better clarity.
27	4.1.2 EHPS.420 General information	5	Certification Manager, magniX	The listed objectives of the endurance demonstration should be revisited to provide additional clarity.Bullet 2 should consider the following:1. 'Demonstrate engine durability and reliability' should be revised or expanded upon. This listing implies compliance to EHPS.430, Durability Demonstration. Understanding that the language of demonstrating 'durability within the approved engine ratings and operating limitations' (ref. AC 33.87-1A), the introduction of EHPS.430 should necessitate the use of	Partially Accepted	Objective description improved for better clarity.

				other verbiage as not to imply compliance with EHPS.430 through the endurance demonstration. Further, reliability has a specific meaning within the context of the engine. Recommend replacing the term 'reliability' with 'operability' in alignment with FAA AC 33.87-1A.		
28	4.1.2 EHPS.420 General information	5	Certification Manager, magniX	The listed objectives of the endurance demonstration should be revisited to provide additional clarity.Bullet 1 should consider the following: 'Establish the EHPS operating limitations' should be removed from the list of objectives. Operating limitations are an input to the endurance test. Whereas the operating limitations are demonstrated during the endurance demonstration, they are not established during the endurance demonstration. Additionally, this requirement would inherently tie the compliance finding to EHPS.40, Ratings and Operating Limitations, to the endurance demonstration. Ratings and operating limitations are established in EHPS.40 and demonstrated during EHPS.420.	Noted	Establishing the ratings and limitation requires also the justification, not only the declaration.
29	4.1.2 EHPS.420 General information	5	MTU Aero Engines AG	EASA SC E-11 Transient over-temperature, over-speed and over-torque limit approval is available as proposed Special condition only. Proposed Special Condition - Transient over-temperature, over-speed and over-torque limit approval | EASAIs there a approved version?	Noted	The SC-11 will be updated on the website with the status of closed.
30	4.1.2 EHPS.420 General information	5	H55	Suggest to change to "Verify the EHPS operating limitations", since they are established in EHPS.40.	Accepted	Added.
31	4.1.3 Associated Interpretative Material / Means of Compliance of SC E-19	5	H55	Not clear why EHPS.480(c) is listed here as MOC for EHPS.420	Accepted	Deleted. See rational on CRD of MOC EHPS.40
32	4.1.3 Associated Interpretative Material / Means of Compliance of SC E-19	5	H55	It would be appreciated to clarify whether the "steady state" mentioned in this paragraph includes short-term ratings like MTOP operation, or only real stady state (continuous) operation like MCP. Is the operation during the e.g 2.5 min MTOP limitation considered transient in the sense of SC E-11 or not?	Noted	Declared ratings are not limitations. The Ratings are the minimum guaranteed power, to be delivered within the declared limitations. SC E-11 addresses short overshoots of these limitations (i.e. due to control system).
33	4.1.3 Associated Interpretative Material / Means of Compliance of SC E-19	5	AIRBUS	1. PAGE / PARAGRAPH / SECTION : MoC-EHPS.420 Endurance Demonstration, Section 4.1.3. Associated Interpretative Material / Means of Compliance of SC E-19. EUROCAE ED-321 Guidance Material for Endurance Substantiation of Electric-Hybrid Propulsion:	Accepted	Included.

				2. PROPOSED TEXT / COMMENT: We propose to add the following wording in italic: At this stage the scope of the Methods of Compliance within ED-321 is limited to the EHPS' electrical engine. The battery and electrical Power distribution is considered out of the scope for the endurance test. The influence of elements driven by the electric engine such as propeller, propeller gearbox, fan, rotor and rotor tilting mechanism on the potential damaging mechanism have to be properly taken into account in the definition of the test. They may have to be included in the endurance testing or their effect properly simulated. 3. RATIONALE /REASON / JUSTIFICATION : Guidance and rationale are given for electric components other than the electric engine that are potentially involved in an EHPS. It is also important to provide the same level of information for the involved hydromechanical components especially since ED-321 appears to have unclear or contradictory wording related to this topic.		
34	4.1.2 EHPS.420 General information	5	AIRBUS	1. PAGE / PARAGRAPH / SECTION : MoC-EHPS.420 Endurance Demonstration, Section 4.1.2 EHPS.420 General information 2. PROPOSED TEXT / COMMENT : We propose to replace the wording: "The objective of endurance substantiation is to: · Establish the EHPS operating limitations, · Demonstrate engine durability and reliability, · Demonstrate the capability to deliver the declared ratings." By : "The objective of endurance substantiation is to: · Establish the EHPS operating limitations Demonstrate the capability to deliver the declared ratings at those operating limitations · Perform an accelerated severity test intended to demonstrate anacceptable level of operability and durability at those extreme operatingconditions"	Partially Accepted	Objective description improved for better clarity.

				3. RATIONALE / REASON / JUSTIFICATION : Section 5.1 rightly describes the difference between the endurance and the durability demonstration. It is therefore considered possibly confusing to simply state in this section 4.1.2 that the objective of the endurance substantiation is to demonstrate engine durability and reliability.		
35	4.1.2 EHPS.420 General information	5	UK CAA	Page No: 5 Paragraph No: 4.1.2 Comment: The UK CAA notes "The SC E-19 has been created having in mind that certified turbines and reciprocating engines or APU's certified as ETSO could be installed within an EHPS." The UK CAA notes this could include non-reciprocating engines too (Wankel)…and fuel cells could be included as an "electricity generating system" Justification: Clarity Proposed Text: None	Noted	The MOC does not exclude them.
36	4.1.2 EHPS.420 General information	5	UK CAA	Page No: 5 Paragraph No: 4.1.2.1 Comment: The UK CAA notes that no explanation of "how" credit will be taken for already certified turbines and engines. The UK CAA believes that all engines will need re-certifying for use in an EHPS application much as they are recertified for a new aircraft application. Otherwise, the existing turbine and engine certification may be invalidated by its use in	Noted	The current MOC only clarifies that when the EHPS is combined with a certified turbine, piston engine, or APU, some certification credit may be obtained. However, additional guidelines will be considered for hybrid systems.

				the EHPS application. UK CAA believes this would apply to all non-TSO equipment, TSO equipment is simple and under EASA rules an APU is not certified as a TSO but to CS-APU. Justification: Clarity and consistency Proposed Text: None		
37	4.1.2 EHPS.420 General information	5	UK CAA	Page No: 5 Paragraph No: 4.1.2.1 Comment: The UK CAA notes that the TC DO of a certified turbine, reciprocating engine or APU would need to agree to its "already certified" product being utilised in an EHPS. It is not something that can be completed by the EHPS applicant in isolation by reference only to public data ie TCDS or an installation manual. Justification: Clarity and consistency Proposed Text: None	Noted	The actual MOC only clarifies that in case of combination with certified turbine, piston engine for APU credit can be taken. The actual MOC on such architecture is still "Reserved" and will be addressed in a future update.
38	4.1.3 Associated Interpretative Material / Means of Compliance of SC E-19	5	UK CAA	Page No: 5/6 Paragraph No: 4.1.3 EASA SC E-11 Transient over-temperature, over-speed and over-torque limit approval Comment: The UK CAA notes that for a motor in isolation (not integrated to the system, no prop, power supply, flight controls etc) the UK CAA agrees these are predictable overshoot, but when integrated to an entire aircraft or wider EHPS they are more unpredictable. How will that integration unpredictability be taken into account in the EHPS? Justification: Clarity Proposed Text: None	Noted	The overshoots induced in the engine are part of its internal control. The defined limits are to be respected during aircraft installation. In this sense effects induced by the installation (ie. due to cooling flow) are to be addressed by aircraft installation.
39	4.2.1 Link with CS-E 440, E 470, E 690, E 820, E 830 and E 870	6	H55	CS-E 740 Endurance Tests for turbine engines is missing	Accepted	MOC updated to include the CS E-740

40	4.2 CS - E	6	Safran	"CS-E 479 CS-E 670 should stablish the capability of the EHPS" : typos -> CS-E 470 and established	Accepted	MOC updated accordingly.
41	4.2 CS - E	6	Safran	CS-E 740 reference is missing	Accepted	MOC updated to include the CS E-740
42	4.2 CS - E	6	Olivier GOGUET	There is specificity of EHPS Hybrid system to manage properly the electrical regeneration (valid for emotor with permanent magnet) with propeller in windmilling condition or during emotor spool down phase (shutdown) This may drive specific condition and test cycle in terms of characterisation and would be part of Critical Point of Analysis	Noted	Agree. Feedback currents in operation due to windmilling or rotor braking are to be considered in the rating structure.
43	4.2.1 Link with CS-E 440, E 470, E 690, E 820, E 830 and E 870	6	Chris Baczynski	The text 'CS-E 479 CS E-670 should..' ought to be corrected to 'CS-E 470 or CS-E 670, as applicable, should...'	Accepted	Typos corrected.
44	4.2.1 Link with CS-E 440, E 470, E 690, E 820, E 830 and E 870	6	Federal Aviation Administration	Change "intend" to "intent"Why is the endurance test for turbine engines (CS-E 740) not included in the CS-E Turbine Engines list?"CS-E 479 and CS-E 670 should establish..." The word "and" is not in there, and the word "establish" is missing its "e."Change "...with fuel containing contamination" to "...with contaminated fuel."A hybrid system can include a reciprocating engine instead of a turbine engine. Here is my suggestion on how the following sentence should read: "A comparable treatment should be considered for an EHPS when it includes turbine engines or turbogenerators.""CS-E 820, CS-E 830, and CS-E870..."	Partially Accepted	Typos corrected / MOC updated accordingly. The intent of CS-E 820/830/870 also applies to electric engines, in which unintended transients above the limit must not compromise the ability to achieve the declared rating. MOC updated to include the CS E-740.
45	5.1 Methodology 1	8	UK CAA	Page No: 8 Paragraph No: 5.1 Comment: The UK CAA notes Only 1 method of compliance ED-321 is explained, will other methods be added? Or is this the only MoC to be specifically expanded. Justification: Clarity Proposed Text: None	Noted	No other methods are planned. The 1 in the title deleted for better clarity.
46	5.1 Methodology 1	8	Chris Baczynski	The MOC document should allow for alternatives to the specific CPA process described in ED321 and referred to on page 9 of the MOC. the applicant may be able to show the critical condition for endurance testing via simpler means, especially if the electric engine is able to operated at a triple-redline. Furthermore, the specific "CPA tool" should not be made mandatory.	Noted	MOC EHPS.420 is an acceptable means of compliance. All applicants can propose alternative means and will be analysed case by case.
47	5.1 Methodology 1	8	Chris Baczynski	ED321 should not be made the only viable path for compliance as applicants may be able to propose alternative approaches for their designs. At this time, the MOC contains only 1 methodology. Hence, it is suggested the wording of "The EuroCAE ED321 provides "Method of Compliance" for demonstrating compliance to EHPS.420" is revised to: "The EuroCAE ED321	Noted	This is always the case with MOCs. Alternative means of compliance will be considered by EASA case by case.

				provides an acceptable, but not the only possible "Method of Compliance" for demonstrating compliance to EHPS.420".		
48	5.1 Methodology 1	8	Certification Manager, magniX	Is the FAA able to elaborate of the pass/fail criteria of of being in a condition for safe operation as a pass/fail criteria as defined in Section 9.5 in ED-321. Does EASA mean airworthy such that the part has to conform to type design and be in a condition for safe operation? Or is a part allowed be outside of the prescribed limits but still be substantiated to be in a condition for safe operation in order to satisfy this criteria? With respect to options for parts that are not found within to pass the teardown inspection, ED-321 section 9.5 states that parts failing to meet limits can be replaced or repaired. This is a more limited subset of what is described in Paragraph 4-1(e) of AC 33.87-1A. Is it EASA's intention to allow for a more narrow set of options for parts that are found out of limits?	Noted	When limit established in the ICA are exceeded then re-evaluation will be required. ED321 - REQ:046 specifically refers to FAA AC 33.87-1A, 4.1(b)(2)€ so options remain valid.
49	5 Means of compliance for electric engines	8	Certification Manager, magniX	Can EASA elaborate on the details of ED-321 with respect to the emergency rating testing? Specifically, the sequence defined by REQ:043 through REQ:045 for on-shot emergency ratings requires completing a standard endurance flow (pre-test calibration, endurance test, post-test calibration, teardown inspection) and then requires a post-teardown inspection and engine re-assembly.Does EASA support re-assembly of the engine after teardown inspection? This seems like a very risky approach. Some questions around the current proposal:1. What if some parts need to be replaced during the teardown? What parts are allowed to be replaced?2. What if a part is damaged or needs to be destructively tested during the teardown inspection such that it can't be put back together?3. Is a calibration test performed after the engine is reconstructed (after the teardown inspection)?4. What happens if the calibration test after the reconstruction is different than the pre-teardown inspection results?5. Why is no calibration test or teardown required after the one-shot' demonstration?	Partially Accepted	In the case of having one-short rating refer to NOTE after REQ:48. The calibration and tear down inspection strategies will be considered case by case.
50	5 Means of compliance for electric engines	8	Certification Manager, magniX	Critical Point Analysis, defined in ED-321, is a familiar name (Critical Point Analysis), but is not the same as the existing use of the Critical Point Analysis within the aviation industry. Critical Point Analysis is a numerical analysis that is used to evaluate an envelope of identified test parameters and condense the number of test points to be demonstrated while covering the envelope. This is used within icing analysis and within the EHWG Alternate to Endurance test.The CPA presented in ED-321 utilizes the same name but is not the same process. It is a qualitative analysis, not numerically analytical nor does it reduce existing points. It is proposed to be used for a variety of things from defining operating limitations to defining inspections, in addition to helping identify test points. The objectives of ED-321's CPA are listed as identifying the following: Damaging modes, pertinent parameters, component limits, damaging scenarios, pass-fail criteria, operating limitations, and operating limits. CPA is introduced as "a possible approach to determine suitabile engine test conditions. . . " but then is directly tied to	Partially Accepted	MOC updated to also refer to the DME as the working document of the EROCAE/SAE durability standard.

				requirements (i.e. REQ:006) stating that the optional process is actually required. The term CPA, referring to the process within ED-321, should be avoided as it conflicts with the current industry understanding of the term. Additionally, Critical Point Analysis is presented as a tool within ED-321 without recognizing the process steps being served by the tool. For instance, ED-321 REQ:007 states that the CPA shall establish the damaging modes with regards to the materials and technologies used. There is no more discussion on these damaging modes or how to assess them other than using the tool provided. ED-321 is missing the thoroughness and conciseness that would allow the CPA to be an effective, standardized tool for the endurance demonstration.ED-321 also prescribes the CPA to the durability demonstration, EHPS.430, within Section 4.2. This section also requires completion of the durability test to satisfy REQ:005.These examples support the assertion that ED-321 and the proposed Critical Point Analysis are not to the level of maturity necessary to be an accepted MOC.		
51	5.1 Methodology 1	8	Certification Manager, magniX	This MOC should expand more on how ratings play into the profiles selected. ED-321 does not explore ratings other than standard ratings and emergency ratings. There could be other ratings that, depending on the interpretation of emergency ratings within SC E-19, could exist and need to be demonstrated. This standard should not assume or assign aircraft impact or operations, such as an emergency condition. The determination of that event should be left entirely up to the aircraft. The engine applicant should only define the power that is available within that operating regime.ED-321 also introduces nuances of emergency power in use cases that is not introduced elsewhere in the document, including but not limited to one-shot and multiple shot emergency ratings, MCT, MTO, MCTRL, and MEM. Use cases should clarify application of the content introduced in the standard, not introduce new topics.	Non Accepted	Th ED321 in req:021 and req:022 provide information in this regard. The examples provided should cover the most common CS-23 CTOL configurations. For specific cases, the proposal should be submitted to EASA.
52	5.1 Methodology 1	8	Certification Manager, magniX	Discussion under the bolded text Compliance Strategy Endurance test by ED-321 states that ratings and operating limitations are defined by the Endurance Demonstration. These ratings and operating limitations should be defined by EHPS.40 and verified by EHPS.420.	Accepted	Text changed accordingly.
53	5 Means of compliance for electric engines	8	Certification Manager, magniX	Traditional engines utilize AC 33.87-1A to demonstrate endurance based on demonstrating a triple redline point. ED-321 states that it is to be used for products that cannot demonstrate this triple redline approach, a CPA may be required. The standard then only presents a path forward using the CPA. Is EASA considering a more traditional approach, in line with AC 33.87-1A for those engines that can demonstrate endurance in a manner similar to existing reciprocating and turbine engines? Or is it EASAs opinion that this demonstration must be accompanied by a CPA as defined in ED-321?	Noted	MOC EHPS.420 is an acceptable means of compliance. All applicants can propose alternative means and will be analysed case by case.
54	5.1 Methodology 1	8	Certification Manager, magniX	The first paragraph states that the endurance demonstration verifies the performance at "any time between overhauls and/or large maintenance actions." ED-321 does not discuss any ageing aspects or end-of-life	Partially Accepted	Text of the MOC revised for clarity. Extend of aging during the endurance is limited by the test conditions.

				conditions of the engines. Is EASA able to expand on the expectation for ageing or end-of-life conditions of an EHPS?		
55	5.1 Methodology 1	8	Certification Manager, magniX	The objective of the endurance demonstration should be revised. In accordance with FAA AC 33.87-1, the purpose is "to demonstrate a minimum level of engine operability and within the approved engine ratings and operability."The objective, as currently listed, states that the endurance demonstration is what is used to establish the operating limitations. The operating limitations should be established along with the ratings, and are verified during the endurance demonstration. Figure 1 shows that the Operating Limitations are established as part of EHPS.40 compliance.Note that the proposed verbiage removed the term 'durability' as not to conflate with EHPS.430.	Partially Accepted	Objective description improved for better clarity.
56	5.1 Methodology 1	8	H55	Suggest to change "The objective of endurance substantiation is to establish the EHPS limitations"to "The objective of endurance substantiation is to verify the EHPS operating limitations" since they are established in EHPS.40.	Partially Accepted	Objective description improved for better clarity.
57	5.1 Methodology 1	8	H55	Is a methodology 2 expected? If not, suggestion is to remove the 1, If yes, suggestion is to indicate that.	Accepted	Document updated accordingly.
58	5.1 Methodology 1	8	AIRBUS	1. PAGE / PARAGRAPH / SECTION : MoC-EHPS.420 Endurance Demonstration, Section 5.1 Methodology 1 Paragraph ED-321 2. PROPOSED TEXT / COMMENT: We propose to add the following wording in italic: Chapter 2 defines the possible EHPS architectures and associated subsystems. However, it limits its scope to the endurance demonstration of electric engines. Energy storage device (ESD) is considered outside the scope of endurance under this guidance material. Similarly, electrical power distribution (EPDS) is also considered outside the scope of endurance testing. The influence of elements driven by the electric engine such as propeller, propeller gearbox, fan, rotor and rotor tilting mechanism on the potential damaging mechanism have to be properly taken into account in the definition of the test. They may have to be included in the endurance testing or their effect properly simulated. 3. RATIONALE / REASON / JUSTIFICATION : Guidance and rationale are given for electric components other than the electric engine that	Accepted	Included.

				are potentially involved in an EHPS. It is also important to provide the same level of information for the involved hydromechanical components especially since ED-321 appears to have unclear or contradictory wording related to this topic.		
59	5.1 Methodology 1	8	DENSO CORPORATION	When considering the actual operation of electric propulsion systems for eVTOL, applying the maximum emergency case (MEM) can cause significant damage mainly due to thermal effect on resin and insulation systems, making further operation impossible. Therefore, inspection and/or replacement should be mandatory after a MEM event, and this should be documented in ICA documents. If the intention of ED-321 is to demonstrate "reliable rating" by passing an endurance test that includes multiple emergency cases in the profile, it may be an excessive requirement that does not align with actual usage.While it is not impossible to conduct multiple tests with multiple component replacements after each MEM event in the test profile, this approach may also diminish the purpose of the endurance test and is not a practical test procedure.For example, defining severe conditions that include variations and degradation as "Most Adverse Combination" through appropriate assessments such as CPA and evaluating a single MEM case in the test can be considered a reliable demonstration. A more practical test example would be to conduct a single MEM case after a relatively long period of normal mission under stringent test conditions.We propose that such an approach, which aligns with actual operational conditions, should be explicitly stated in the proposed MOC as it complies with the endurance requirements of EHPS.Compliance Strategy Endurance test by ED-321 The strategy to show compliance is to perform a Critical Point Analysis to determine the suitable EHPS test conditions and test cycles based on the identified damaging modes and scenarios, considering the operating conditions of the aircraft in which the EHPS will be installed. By this, Ratings and limitations can be defined and confirmed.	Noted	The MOC provides a Means of Compliance by using the ED-321 as Method of Compliance. Section 8.1.1 proposes a general strategy for Maximum Emergency case. Particular cases will be discussed case by case.
60	5.1 Methodology 1	8	UK CAA	Page No: 8 Paragraph No: Figure 1 Comment: The UK CAA notes that applicants submitting to a certification endurance test have a high confidence that the defined test, limitations and ratings can be achieved under the non-stop endurance test conditions. The test is a pass or fail test (not a performance development test) and would need to be repeated if the endurance cycle defined before the test was not completed satisfactorily. The Figure 1 does not represent any cycling in any aspect.	Noted	The MOC refers to ED-321, where cycling is addressed in chapter 6.

				Justification: Clarity Proposed Text: None		
61	5.1 Methodology 1	8	UK CAA	Page No: 8/9 Paragraph No: 5.1 Comment: The UK CAA notes that second to last paragraph states "By this, Ratings and limitations can be defined and confirmed". The UK CAA disagree that ratings can be defined by this test, they may be validated by this test. Ratings definition is covered under EHPS.40. Justification: Consistency Proposed Text: None	Accepted	ok to change "defined" into "validated"
62	6 Means of compliance to EHPS.420 for turbine engines	9	UK CAA	Page No: 9 Paragraph No: 6 Means of compliance to EHPS.420 for turbine engines and 7 Means of compliance to EHPS.420 for piston engines Comment: The UK CAA queries are sections 6 and 7 the same as CS-E and CS-APU or something new? Justification: Clarity Proposed Text: None	Noted	In principle yes, but it is a reserved space in case we see gaps in certification needs.