European Union Aviation Safety Agency

# Comment-Response Document (CRD) 2023-06

RELATED NPA: 2023-06 — RELATED ED DECISION: 2025/003/R — RMT.0180

'TURBINE-ENGINE ENDURANCE AND INITIAL MAINTENANCE PROGRAMME TESTING, AND SUBSTANTIATION OF PISTON-ENGINE TIME BETWEEN OVERHAULS OR REPLACEMENTS'

08/04/2025

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**Disclaimer**

This document has not been subjected to linguistic/editorial review.

## 1. Summary of the outcome of the consultation

EASA received 147 unique comments on NPA 2023-06 (147 in total) made on 25 segments by 13 users.

Here after is the list of the commentators that contributed and their respective number of comments: CAA Netherlands (1), LBA Germany (1), DGAC France (1), FAA USA (15), Francis Fagegaltier Services (26), GE Aerospace (5), JCAB Aircraft Engineering and Certification Center (3), Rolls-Royce Deutschland (12), Rolls-Royce plc (60), Safran Helicopter Engines (9), MTU (under 'Steffen Friedrich') (7), TCCA Canada (2 users) (7).

The comments were distributed as follows on the different segments of the NPA:

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A summary of the most substantial comments is provided below, along with the EASA reaction to them. All individual comments are responded in paragraph 2 below.

**Issue 1: Turbofan-engine endurance test**

The FAA supported the introduction of an alternate endurance test. They made various comments aiming at clarifying the proposal.

Rolls-Royce plc considers the proposed text to amend CS-E 730 (calibration test) and the new proposed CS-E 740(h) (engine-rated performance demonstration) as not clear about the intent and not matching either AMC E 40 or FAA 14 CFR Part 33.87(a)(3). EASA accepted this comment and fully revised CS-E 740(h) to now address the engine performance target after the completion of the test. In addition, a new sub-paragraph (6) has been created in CS-E 740(b) in view of addressing an existing SSD related to FAA 14 CFR Part 33.87(a)(3): it stipulates that the thrust or power of the engine achieved throughout the endurance test must be at least 100 % of the value associated with the particular engine rating being tested, in order to substantiate the thrust or power ratings established under CS-E 40.

Rolls-Royce plc considers that the proposed amendment to CS-E 870(b)(1) (Exhaust Gas Over-Temperature Test), providing the possibility of performing a 5-minute test as part of an alternate endurance test in lieu of a 15-minute test at simultaneous over-temperature and speed redline condition, as required by the current CS-E 870, cannot provide an equivalent severity. Several commentators (e.g. Rolls Royce plc, FAA, MTU) asked for clarifications on the conditions of the proposed amendment to CS-E 870 regarding the 5-minute test that may be done as part of an alternate endurance test. EASA re-considered the proposed amendment and decided to withdraw it, as the 5-minute test proposal may be considered impractical. Applicant will therefore have to plan a dedicated test to show compliance with CS-E 870 if elected to do so (as this is optional). Furthermore, EASA decided to harmonise CS-E 920 (Over-temperature Test) with FAR 33.88.

Rolls-Royce plc, Rolls-Royce Deutschland, FAA asked for clarification of CS-E 690(a)(1)(i) and (a)(3)(i) on how bleed controls must be exercised during the endurance test. EASA then replaced the terms ‘equivalent level’ and ‘equivalent way’ by a quantified terms describing the number of times bleed controls must be exercised and the duration of the operation of the bleed(s).

GE Aerospace, Rolls-Royce plc, FAA asked for clarification of the new CS-E 740(f)(4)(iv) allowing 30 seconds transient EGT limits approval. This paragraph has been thoroughly reviewed and updated in light of these comments.

Rolls-Royce plc considers the text of the proposed AMC E 740(c) as scarce in description of EASA acceptable testing to ensure equal playing field in terms of failure modes and engine deterioration and associated effects on redline or other engine limits demonstration capability, for instance accumulation of Part 1, Part 5 like accelerations requirement before any portion of testing for redline limits or oil temperature demonstration. They asked for definitions in the AMC of acceptable cycles, minimum number of slam accelerations required prior redlines demonstration portions of test. EASA reminds that the proposed CS-E amendment reflects the ARAC report recommendations, and EASA does not intend to add prescriptive elements that have not been discussed and agreed within the ARAC group. CS-E 740(c)(4) includes some test specifications (e.g. minimum durations, minimum number of accelerations), and the applicant is also expected to perform a CPA to identify any required additional test conditions.

Rolls-Royce plc considers that the proposed CS and AMC E 740(c)(4)(2) and portion of CS-E 740(c)(4)(iii) significantly expand the purpose of the CPA as discussed by section 6.2 of the ARAC report. They suggested that EASA revise the proposed text so it does not conflict with the text of AMC

E 740(c)(4)(3) and (4), and define what is EASA understanding of critical component. EASA does not agree with this position The scope of the CPA proposed by EASA is consistent with the ARAC report section 6.2. The definition of 'critical component' proposed by EASA (within CS E 740(c)(4)(iii)) is the same as the one contained in the ARAC report Appendix J.

**Issue 2: Turbine-engine initial maintenance programme (IMP) test**

FAA supported the introduction of an IMP test as it will bring harmonisation with the equivalent FAR rule and Advisory Circular.

Several commentators ( e.g. Rolls-Royce plc, Francis Fagegaltier Services) asked clarification over the applicability of CS-E 930 (new TC vs change to TC or STC). EASA created a new paragraph (c) in AMC E 930 dealing with this topic, entitled 'applicability to changes to type certificate'.

Safran Helicopter Engines made several comments aiming at taking into account in AMC E 930 some helicopter engines specificities and to add clarifications on test conditions. EASA accepted these requests and made various changes in AMC E 930(d) to address these comments.

Rolls-Royce plc commented that EASA understanding or interpretation of difference between On Condition and Hard Time Maintenance may not be aligned with the rest of the aviation industry and regulators. They asked for clarification by EASA of the differences between the two methods. EASA agrees that an IMP may include hard time tasks (such as replacement, inspection) in addition to 'on-condition' maintenance instructions (e.g. a task is to be performed when some conditions are met).
The new AMC E 930 does not specify how an IMP is built and offers flexibility to the applicant in the way the IMP is defined and applied during the test. This has been clarified in a new sentence added at the end of the definition of IMP in paragraph (a) of AMC E 930.

**Issue 3: Substantiation of piston-engine TBO/TBR**

TCCA commented that they believe the TBR concept is not compatible with the engine ICA concept. EASA does not agree as CS-E 25(c)(5) includes 'the applicable serviceability limits' as part of the 'scheduling information for each part of the engine' to be considered for inclusion in the ICA manuals. Such serviceability limits may encompass an engine TBR although it is not specifically mentioned.
AMC E 25 had also no provision to demonstrate a TBR value for piston engines, hence the NPA proposal to create AMC E 25 section (6). The 'replacement' of the engine is a possible alternative to the use of an 'overhaul' maintenance action that some engine manufacturers may want to select.

TCCA also proposed to require the TBO/TBR demonstration in CS-E 25, by reference to a safety recommendation received from Austria. EASA however does not intend to mandate the establishment of a TBO or TBR. The applicants should decide if they wish to establish such recommended maintenance actions, and if so decided they can use the corresponding AMC E 25 provisions.

Francis Fagegaltier Services commented that EASA has no legal basis to approve a TBO or TBR. EASA agrees that ICA other than ALS items are not approved by EASA. However, they are reviewed to ensure that the applicant complies with CS-E 25(c)(5). The word 'agree' is used on purpose in AMC E 25, not 'approved'.

## 2. Individual comments and responses

In responding to comments, EASA states its position as follows:

(a) **Accepted** — EASA agrees with the comment and any proposed change is incorporated into the text.

(b) **Partially accepted** — EASA either partially agrees with the comment or agrees with it but the proposed change is partially incorporated into the text.

(c) **Noted** — EASA acknowledges the comment, but no change to the text is considered necessary.

(d) **Not accepted** — EASA does not agree with the comment or proposed change.

| **(General Comments)** | - |
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| comment | *1* comment by: *DE-LBA*<br>LBA has no comments. |
| response | Noted. |

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| comment | *6* comment by: *Francis Fagegaltier Services*<br>The third element of the executive summary ("ensure that EASA oversees IMP test") is highly questionable in the EASA's legal environment. Actions of EASA are controlled by Part 21 and associated EU regulations, not by CS-E.<br><br>For that very reason, other similar comments are made against other parts of the NPA. |
| response | Partially accepted.<br>What is meant by this point of the front-page summary is further explained in the Appendix 1 on impact assessment. The new certification specifications on IMP test will enable EASA to be involved in the approval of IMP tests compliance findings instead of relying on the FAA, also when a FAR 33 validation is requested by the applicant.<br>This will also:<br>• allow EASA to acquire knowledge on how the test was handled, and on the behaviour of the engine during the test,<br>• ease the EASA continued airworthiness oversight and the identification of corrective actions with the engine TC holder, in case of issues found after entry into service, which also benefits safety in the end. |

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| comment | *47* comment by: *Transport Canada Civil Aviation Standards Branch*<br>Reference is made to TBO in RMT.0180 ToR page 3 segment 1 issue 3 - Piston engine TBO substantiation, (including AUST-2009-011 safety recommendation); on page 4 Segment 1 Issue 3 - Piston engine TBO substantiation; on page 5 segment 2 |

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| | penultimate bullet ensure the robust and harmonised substantiation of the TBO ….; on page 6 Segment 3 Piston engine TBO substantiation.<br><br>but NPA 2023-06 page 8 segment 2.2 **Issue 3: Substantiation of piston-engine TBO/TBR** (and in subsequent segments/pages) introduce the expression "TBR" with the meaning of Time Between Replacement. Engine replacement may be an acceptable means to maintain the continued airworthiness of an aircraft at the aircraft level but is completely incompatible with ICA at the engine level, refer to the scope of activities in CS-E 25(c)(5). If an alternative word for overhaul is sought, "refurbishment" may be acceptable but "replacement" would not be acceptable. |
| response | Partially accepted.<br>CS-E 25(c)(5) includes 'serviceability limits', which may encompass TBR although not specifically mentioned.<br>AMC E 25 has also no provision to demonstrate a TBR value for piston engines, hence the NPA proposal to create AMC E 25 section (6). The intent of 'replacement' is not to be an equivalent term to 'refurbishment'. The 'replacement' of the engine is a possible alternative to the use of an 'overhaul' maintenance action that some engine manufacturers may want to select. |

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| comment | *50* comment by: *FAA*<br><br>FAA supports the proposed amended rule CS-E 740 including paragraph (c)(4), "Alternate Endurance Testing – Turbofan Engine". We note paragraph (c)(4) differs from the current 14 CFR 33.87 which does not allow alternate endurance methods. However, we acknowledge the proposed rule is consistent with the alternate endurance test ARAC EHWG recommendations, and that high-bypass turbofan engine TC programs may benefit from an alternate endurance test MoC option. |
| response | Noted. |

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| comment | *51* comment by: *FAA*<br><br>FAA supports the proposed new rule CS-E 930, "Initial Maintenance Programme Test", as it will form a close harmonization with 14 CFR 33.90. |
| response | Noted. |

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| comment | *138* comment by: *DGAC FR (Mireille Chabroux)*<br><br>DGAC France thanks EASA for the consultation.<br>DGAC France has no specific comment on the document |
| response | Noted. |

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| comment | *147* comment by: *Civil Aviation Authority the Netherlands* |

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| | The Netherlands Civil Aviation Authorities do not have comments on this Notice of Proposed Amendments. |
| response | Noted. |

**2.2. Description of the issues** p. 6

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| comment | *7* comment by: *Francis Fagegaltier Services*<br>In the explanation found in paragraph 2.2 of this NPA, the last sentence of the first sub-paragraph of the "issue1" adds a consideration not found in the ARAC report (see first sub-paragraph of §2.2 in the ARAC report) and misses one fundamental aspect. Indeed, the engine may be operated below and up to the certified speed and temperature redlines without any other restriction than the duration of the associated rating. This means that the engine is allowed to run on all these limits simultaneously without imposing a pilot or maintenance action. It would seem that the initial intent of the test was to provide a safety margin over such a "legal" possibility. Then the wording "undeniably conservative" in the justification of the NPA is not appropriate to the test objective that seems to simply be to validate the certified red lines. |
| response | Accepted.<br>This sentence is not included in the EN to EDD. |

**2.3. Assessment of the issues** p. 9

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| comment | *2* comment by: *JCAB Aircraft Engineering and Certification Center*<br>Question regarding issue 2: Turbine-engine initial maintenance programme (IMP) test<br><br>Regarding the turbofan engines already certified by the EASA (not FAA) before this proposal including IPM test, the evaluation of potential failure modes may not be sufficient because of these are not performed IMI Test according to 14CFR §33.90. Is there any possibility that those turbofan engines, identified based on the Service History Cycles/Hours etc., will be requested IMP test? |
| response | Noted.<br>The proposal to amend CS-E has no retroactive effects on already type certificated engines that are in operation. |
| comment | *4* comment by: *JCAB Aircraft Engineering and Certification Center*<br>Question regarding Issue 3: Substantiation of engine TBO/TBR<br><br>In accordance the explanation, since the substantiation process of the TBO/TBR for piston engines is not found in the CS-E, and the certification application of the TBO/TBR is optional, there is a possibility that those TBO/TBR are not suitable to the engines. JCAB could understand that the existing engine models would be taken the |

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| | action, however we recommend to revise CS-E 440 (Endurance Test) to add a duty of TBO/TBR setting and modify the endurance test time. (It is explained that the failure detection are not sufficient by the 150 hours of the endurance test time.) |
| response | Not accepted.<br>EASA does not consider it appropriate to modify the current endurance test specifications to mandate additional testing time to all type certification applicants. If the credit that can be taken from the CS-E 440 endurance test is not sufficient to substantiate an applicants' targeted TBO/TBR, then the applicant must propose additional testing based on a representative engine cycle profile, as explained in the AMC E 25 section (6). However, this remains an option to be decided by the applicant. |

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| comment | *52* comment by: *FAA*<br><br>Page 7, 9<br><br>Referenced Text: "During this test, the engine is run under representative service conditions and also unbalance vibrations."<br><br>Comment: Note that the IMI regulation does not explicitly mention vibrations. The IMI AC says the test may be run at sea-level conditions if those conditions realistically address unbalance vibration. There is no FAA IMI test requirement to deliberately unbalance the engine during the IMI test (unlike the Early ETOPS test, which explicitly requires unbalancing all rotors to at least 90% of the operating unbalance limits).<br><br>Proposed Resolution: Revise text to harmonize with FAA guidance<br><br>Comment Type: Conceptual |
| response | Noted.<br>EASA understands that the wording used in section 2.2 of the explanatory note of the NPA may have created some mis-understanding.<br>However, the FAA AC 33.90-1A, section 2.1.3 'Test Parameters' states that the test conditions should 'effectively represent the conditions expected during an engine flight cycle, including:<br>(…)<br>• Unbalance vibration.'<br>The commented sentence of the EASA NPA intended to refer to these test conditions. Applicants may indeed also use Early ETOPS test conditions.<br>The new EASA AMC E 930 section (3) on 'Test parameters' is similar to the above-mentioned FAA AC section and therefore no change is required to harmonise with FAA. |

**2.7. How we want to achieve it - overview of the proposed amendments** p. 10

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| comment | *3* comment by: *JCAB Aircraft Engineering and Certification Center*<br><br>Question regarding Issue 2: Turbine-engine initial maintenance programme (IMP) test |

There is discrioption "This AMC is based on the FAA AC 33.90-1A", however the proposed IMP Test and AC 33.90-1A requirements are seemed to be not exactly same. Is there any plan IMP and IMI will be harmonized? Or, if the IMP test is conducted, will it consider as the IMI has also been performed?

response

Noted.
CS-E 930 and AMC E 930 allows applicants to use an on-condition based maintenance programming method, in addition to the historical hard time maintenance approach that is at the origin of FAR 33.90. The EASA's intent, by this approach, was to produce a rule harmonised with FAA but also reflecting common industry practice in maintenance programming.
EASA cannot guarantee that the FAA will accept IMP approaches other than IMI intervals substantiation. The FAA may harmonise with CS-E 930 in the future to reflect applicants needs to use on-condition based maintenance programming methods.

comment

*8* comment by: *Francis Fagegaltier Services*

Although there is reference to EHWG in the ARAC report, this document is dominated by FAR33 considerations and it seems that harmonisation of CS-E and FAR33 was not really addressed. Indeed, various specificities of CS-E are not correctly dealt with.

For example, on page 72 of 161 of the ARAC report, 33.88 and CS-E 830 are associated under the subject "over-speed test and analysis" when 33.88 is " Engine overtemperature test" and CS-E 830 is "maximum engine over-speed", i.e. a requirement for accepting 20 second speed transients over the redline without maintenance action.
Similarly, 33.88 and CS-E 870 are associated under the subject "over temperature" but the intent is significantly different. CS-E 870 is a means to validate 20-second temperature transients over the redline without maintenance action. There is no equivalent in FAR33 for approval of 20 seconds transients (CS-E 830 for speed transients and CS-E 870 for temperature transients).

This is illustrated by the comment in the NPA's paragraph 2.7 related to the (new) CS-E 740(f)(4)(iv). Why is a new 30 seconds transient created "as included in the EHWG report", when CS-E deals with 20-second temperature transients under CS-E 870 ?

It is suggested to completely rework the subject of CS-E 740 by addressing all related specifications in CS-E so that a coherent set of texts is proposed for CS-E, consistent with the European legal system.

response

Partially accepted.
As explained in the NPA, CS-E 740(f)(4)(iv) has been amended to include the possibility to obtain an approval for a transient gas temperature limit up to '30 seconds', in addition to the already existing '2 minutes' option. This reflects what has been performed on some certification projects using special conditions (SCs) and harmonises with the related content of FAA AC 33.87-1. The purpose is to substantiate routine exhaust gas temperature 'transient overshoots' that may happen during an engine acceleration from cold conditions.

CS-E 870 has a different purpose, which is to demonstrate the 'maximum exhaust gas over-temperature' that is defined under CS-Definitions (Issue 2) as the maximum engine exhaust gas temperature, inadvertent use of which for periods of up to 20 seconds has been agreed not to require rejection of the engine from service or maintenance action (other than to correct the cause). The demonstration itself has a duration of 15 minutes. EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement will have to plan a dedicated test, independently from whether they opt for the alternate endurance test or not. These specifications are not considered contradictory.

comment

*70* comment by: *Safran Helicopter Engines*

CS-E 870 (Exhaust Gas Over-temperature Test) - Considering that alternate endurance test has to be demonstrated at least as severe as the standard endurance test, what is the reason to allow the 5 minutes exhaust gas temperature test requirement (instead of 15min) only when included within alternate endurance test and not also during standard endurance test ?
Proposal of resolution : Include the possibility for the 5min exhaust gas temperature test for both, standard and alternate endurance tests.

response

Not accepted.
EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not.

comment

*79* comment by: *Steffen FRIEDRICH*

*page 11*
*2.7. How we want to achieve it — overview of the proposed amendments*
*Issue 1: Turbofan-engine endurance test*

Note (same CS-E 870 Exhaust Gas Over-temperature Test (b)1)
There is a potential additional risk for the project/applicant due to the combination of two tests; if the overtemp test fails also the previous endurance test will be compromised?
As the endurance test simulates 100% of life consumption on some the Hot-End parts, it is a risk to run after that with the same hardware another test which is also very ambitius to the engine hardware.

response

Noted.
EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not.

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| comment | *88* comment by: *Rolls-Royce plc*<br><br>**Pages 11,15&24 Section 2.7, issue 1, Section 4, Issue 1, CS-E 730 and CS-E 740(h)**<br><br>**Comment summary**<br>Objective established in the section 2.7 for calibration test and revised 740(h) is not achieved. Proposed text is not clear about intent and does not seem to match either AMC E 40 or 14 CFR Part 33.87(a)(3).<br><br>**Suggested resolution**<br>Either remove proposed amendment to the text or revise it with clear wording on purpose of calibration test and endurance test acceptance criteria, that on completion of the test engine must demonstrate it provides rated thrust without exceeding operating limitations |
| response | Accepted.<br>The suggested wording has been adopted in CS E 740(h). |

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| comment | *102* comment by: *Rolls-Royce plc*<br><br>**Page 11 Section 2.7, issue 1 Section 4, issue 1, CS-E 870**<br><br>**Comment summary**<br>Proposed amendment to E 870(b)(1) with 5 minute test in lieu of 15 minute test at simultaneous over-temperature and speed redline condition, as required by current airworthiness standard, can't provide equivalent severity. In addition, as there is no exemption clause in proposed amendment, a requirement for concurrent over-temp and redline speed condition on all shafts, where applicable, will require test vehicle with enabling modifications to meet provisions of the E 870. As a result the impact assessment (appendix 1, 3.d., issue 1) should state that additional development engine may be required to comply with E 870 should applicant select alternative endurance test option.<br><br>**Suggested resolution**<br>Clarify on test severity equivalency and its demonstration. Revise text of E 870 by adding exemption clause allowing to run over-temperature test on development engine without enabling modifications as part of an alternative endurance test. |
| response | Partially accepted.<br>EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not.<br>As compliance with CS-E 870 is optional and unchanged, the impact assessment does not need to mention an economic impact. |

**2.8. What are the stakeholders' views** p. 12

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| comment | *32* comment by: *Transport Canada Civil Aviation Standards Branch* |

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| | Suggest to revise CS-E 25 to add TBO/TBR requirement, and AMC E 25 to say that applicants "must" substantiate a TBO/TBR not "may".<br><br>Rationale: The Safety recommendation by the Austrian Federal Safety Investigation Authority states 'Amend the certification requirements for piston engines, CS-E:…failures". The proposed language in AMC E 25 alone may not address the Austrian Authority recommendation. |
| response | Not accepted.<br>EASA does not intend to mandate the establishment of a TBO or TBR. The applicants decide if they wish to establish such recommended maintenance actions, and if so decided they can use the corresponding AMC E 25 provisions. |

**4. Proposed regulatory material** p. 14

**Issue 1: Turbofan-engine endurance test**

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| comment | *86* comment by: *Rolls-Royce plc*<br><br>**Page 14 Section 4, Issue 1, CS-E 690**<br><br>**Comment summary**<br><br>Text in (a)(1)(i) 'must be exercised to an equivalent level' is vague.<br><br>**Suggested resolution**<br><br>Clarify in airworthiness standard or AMC if the Agency expects bleed controls to be exercised 25 times per whole test in evenly distributed intervals or other EASA acceptable approach. |
| response | Partially accepted.<br>The proposed change is accepted and applied to CS-E 690(a)(1)(i), except the statement 'or other EASA acceptable approach'. |

**CS-E 690 Engine Bleed** p. 14

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| comment | *36* comment by: *Rolls-Royce Deutschland*<br><br>Text in (a)(1)(i) 'must be exercised to an equivalent level' is vague.<br><br>Clarify in airworthiness standard or AMC how the Agency expects equvalency to be assessed. E.g. should bleed controls to be exercised 25 times per whole test in evenly distributed intervals ? |
| response | Accepted.<br>CS-E 690(a)(1)(i) has been amended to require exercising the bleed controls 25 times in evenly distributed intervals. |

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| comment | *54* comment by: *FAA*<br><br>Page 14<br>Paragraph: CS-E 690<br>Referenced Text: Requires equivalent bleed demonstration as current part 33 test<br>Comment: How will equivalence be determined for the alternate test? Same minimum total number of cycles or percentage of cycles relative to current rule?<br>Proposed Resolution:Specify number or percentage of cycles requiring bleed demonstration<br>Comment Type: Conceptual |
| response | Accepted.<br>CS-E 690 has been amended. CS-E 690(a)(1) specifies that, when using an alternate endurance, the bleed controls must be exercised 25 times in evenly distributed intervals. Also, CS-E 690(a)(3) specifies that the bleed(s) must be in operation for one fifth of the test during all the conditions of running for which they are intended to be approved for use. |

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| comment | *80* comment by: *Steffen FRIEDRICH*<br><br>*page 14*<br>*4. Proposed regulatory material*<br>*Issue 1: Turbofan-engine endurance test CS-E 690 Engine Bleed*<br><br>please specify:<br>the air bleed system shall be representative (volume etc.) to production standard design, to cover risk of potential air/cavitiy driven resonances (e.g. Helmholtz effect) |
| response | Partially accepted.<br>This subject is addressed by point 21.A.33 of Part 21 that deals with the conformity of the tests used to demonstrate compliance with certification basis. |

**AMC E 690 Engine bleed** p. 15

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| comment | *35* comment by: *Rolls-Royce Deutschland*<br><br>Text in (a)(3)(i) 'must be exercised in an equivalent way' is unclear with respect of the intent of the test.<br><br>Clarify in airworthiness standard or AMC the intent i.e., 1/5 of alternate test to be run with the bleeds in operations, and required shares (time at T/O, MCT, EGT redline, stairstep test, etc.). |
| response | Partially accepted.<br>The CS-E 690(a)(3)(i) text has been amended to mention bleed(s) operation during 1/5 of the test during all the conditions of running for which they are intended to be approved for use. |

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| comment | *87* comment by: *Rolls-Royce plc* |

**Page 15 Section 4, Issue 1, CS-E 690**

**Comment summary**
Text in (a)(3)(i) 'must be exercised in an equivalent way' is vague with respect of the intent of the test.

**Suggested resolution**
Clarify in airworthiness standard or AMC the intent i.e., 1/5 of alternate test to be run with the bleeds in operations, and required shares (time at T/O, MCT, EGT redline, stairstep test, etc.).

response
Partially accepted.
CS-E 690(a)(3)(i) has been amended to mention bleed(s) operation during 1/5 of the test during all the conditions of running for which they are intended to be approved for use.

comment *119* comment by: *Rolls-Royce plc*

**Page 15 Section 4, Issue 1, CS-E 690**

**Comment summary**
Text in (a)(3)(i) 'must be exercised to an equivalent level' is vague.

**Suggested resolution**
Clarify in airworthiness standard or AMC if the Agency expects bleed flows to be taken for 1/5th of the Endurance Test, or a total of 30 Hours, or subject to the agreement of the Agency.

response
Partially accepted.
CS-E 690(a)(3)(i) has been amended to mention bleed(s) operation during 1/5 of the test during all the conditions of running for which they are intended to be approved for use.

**CS-E 730 Engine Calibration Test** p. 15

comment *89* comment by: *Rolls-Royce plc*

**Pages 11,15&24 Section 2.7, issue 1, Section 4, Issue 1, CS-E 730 and CS-E 740(h)**

**Comment summary**
Objective established in the section 2.7 for calibration test and revised 740(h) is not achieved. Proposed text is not clear about intent and does not seem to match either AMC E 40 or 14 CFR Part 33.87(a)(3).

**Suggested resolution**
Either remove proposed amendment to the text or revise it with clear wording on purpose of calibration test and endurance test acceptance criteria, that on completion of the test engine must demonstrate it provides rated thrust without exceeding operating limitations

response | Accepted.
The suggested wording has been adopted in CS E 740(h).

comment | *120* comment by: *Rolls-Royce plc*

**Page 15 Section 4, Issue 1, CS-E 730**

**Comment summary**
My understanding of the CS-E 730 requirement is that it needs to demonstrate that Rated Thrust can be achieved (at beginning and end of test) with the engine operating within the intended operating limits for speed, EGT, etc.

**Suggested resolution**
The phrasing of "performance targets" is too vague, and test purpose could be clarified.

response | Accepted.
CS-E 740(h) (referenced in the commented sentence) has been amended to state that after completion of the endurance test, the engine must be able to provide the rated thrust or power levels without exceeding operating limitations.

**CS-E 740 Endurance Tests** p. 16

comment | *9* comment by: *Francis Fagegaltier Services*

There is no real justification for the 30 seconds transient added to the new CS-E 740(f)(4)(iv). The rationale “as included in the EHWG report” found in §2.7 of the NPA is not adequate when CS-E contains approval of 20-second temperature transients under CS-E 870. There is no equivalent to CS-E 870 in FAR33.

Changes to CS-E should be made in relation to the whole content of CS-E for consistency and should not be based on proposals for changes to a foreign text published in a different legal system.

response | Please refer to response to comment 8.

comment | *10* comment by: *Francis Fagegaltier Services*

It is suggested to completely rework the subject of CS-E 740 by addressing all related specifications in CS-E so that a coherent set of texts is proposed for CS-E, consistent with the European legal system.

Harmonisation of 33.87 and JAR-E 740 (nowadays CS-E 740) was discussed in the EHWG before 2000. See for example the minutes of 16, 17, 18 February 1999 Engine Harmonization Working Group Meeting. The text of one discussion paper proposing a radical change is copied below. The subject was stopped because the authorities had not enough resources to work on this subject, which was not noted at that time as a significant regulatory difference.

*Discussion Paper*

*150-hour endurance test.*

*This discussion paper is proposing a complete re-writing of JAR-E 740 based on a totally new basic concept.*

*It has been recognised that almost all engine manufacturers have experienced difficulty in trying to perform the current 150-hour test as it is specified in the rule. This is particularly true for large turbofan engines. The engine has to be made significantly out of its type design in order to achieve the required conditions.*

*Therefore, the engine manufacturers have requested many deviations from the published rules. This creates a burden for the manufacturers which are obliged to justify their request and their proposal for equivalent safety findings. This also creates a burden for the authorities which must review the proposals from the manufacturers.*

*The proposal presented below tries to define an objective for the rule and allows for flexibility in the execution of the test.*

*It has been considered that the most common reason for failing the 150-hour test has been failures in the hot section of the engine (especially turbine blades) : therefore, it is proposed to concentrate the rule on this aspect, i.e. creep phenomenon in the turbine area.*

*It is also considered that independent limits on rotor speed and gas temperature, as usually published in engine TC data sheets, provide allowance for operation in the "corner point" (max speed at max temperature). Then it is necessary to cover this combination in the endurance test, although this might require making the engine out of its type design in order to be able to achieve the required test conditions.*

*This would now become an acceptable situation because the new objective of the test would not be the endurance testing of all elements of the engine but the endurance testing of the hot section. Of course, the other parts of the engine would be submitted to the full test and that would provide additional useful information on the endurance capability of the engine.*

*Thrust would be checked by calibration before and after the endurance test. It would not be necessary to measure it during the 150 hour test.*

*The proposal below is very preliminary and should not considered as a mature proposal. In particular, it does not address the testing for validation of torque limits.*

*Proposal*

*JAR-E 740 Endurance Test*
*See ACJ E 740*

*(a) Objective*

*The objective of JAR-E 740 is to validate the operating limitations considered under JAR-E 40 (e) by means of endurance testing. The main considered phenomenon is creep due to combined effects of rotational speed and temperature.*

*The following operating limitations are addressed :*
*(1) Rotor speed*
*(2) Exhaust gas temperature*
*(3) Oil temperature*

*(a) Test*

*An Engine test shall be performed, except as specified under JAR-E 740 (f). The test duration must not be less than 150 hours of running time for each engine part.*

*(1) Test schedule*

*The test schedule must include as many of the periods defined below as necessary for the ratings to be approved and as appropriate for the specific engine design. These periods may be run continuously or split in sub-periods of shorter duration but with a specified minimum duration. The test may be run in cycles and the engine may be shut down in between cycles. The order of periods may be adapted to facilitate the execution of the test.*

*(i) Twenty hours at the rotor speed(s) and exhaust gas temperature limits for the Take-off rating. The minimum duration of any sub-period is 5 minutes.*

*(ii) One hundred and twenty five hours at the rotor speed(s) and exhaust gas temperature limits for Maximum Continuous rating. The minimum duration of any sub-period is 10 minutes.*

*(iii) X hours at the rotor speed(s) and exhaust gas temperature limits for the Maximum Continuous OEI rating. The minimum duration of any sub-period is 10 minutes.*

*(iv) Y hours at the rotor speed(s) and exhaust gas temperature limits for the 2 ½ Min OEI rating. The minimum duration of any sub-period is 2 ½ minutes.*

*(v) Four minutes at the rotor speed(s) and exhaust gas temperature limits for the 30-Minute OEI rating. The minimum duration of any sub-period is 30 seconds.*

*(vi) Five hours in 25 incremental steps of equal duration between idle and Take-off. The minimum duration of any sub-period is 60 minutes, with 25 incremental steps of 4 minutes duration.*

*(vii) The time spent in conditions (iii), (iv) and (v) will be deducted from the time spend in conditions of (ii).*

*(c) Oil temperature. During the entire test, the oil temperature must at the maximum to be approved for continuous use.*

*(d) Engine accessories will be fully loaded during the entire test, together with the maximum permissible bleed air extraction (if allowed).*

*(e) For engines having 30-Second and 2-Minute OEI ratings, at the end of the test schedule of JAR-E 740 (b), an additional test will be added as follows (see NPA-E-19).*

*(f) In some cases, an analysis of tests performed on engine(s) of sufficiently similar design may be substituted to the engine test. (derivative engines)*

*(g) Pass / fail criteria. After the testing required by Jar-E 740 (b) the engine parts must be in satisfactory condition for further use without limitation. At the end of the additional testing of JAR-E 740(e), the engine parts may be no longer serviceable.*

*(i) The duration of each specified period is calculated when the temperature is at or above the temperature to be certified.*

*JAR-E 920 Turbine entry temperature*

*When the temperature tested under JAR-E 740 is not the turbine entry temperature, an additional test will be performed for 5 minutes on an Engine running at 20°C above the exhaust gas temperature limit for ratings of duration longer than 2 ½ minutes.*

*See also text of NPA-E-19 for engines with 30-Second OEI rating.*

*ACJ E 740Endurance test*
*See JAR-E 740*

*An engine may be composed of more than one rotor spool. As required under JAR-E 740 (b), each turbine disk, together with its blading, should be tested to the combined speed and temperature limits for the total duration of 150 hours.*

*If the engine cannot be run so that each rotor would be simultaneously tested, then, under JAR-E 740 (b)(1), test periods should be added to achieve the goal. This would result in a test significantly above the 150 hour duration.*

*For example, in a two spool engine, the low pressure turbine could be first tested at max speed and max temp, while the high pressure turbine would be at the condition which is imposed by the engine functioning. Then, the high pressure turbine would be tested at max speed and max temp, while the low pressure turbine would be at some condition imposed by the engine.*

*Case of a two spool turbofan. The two ratings to be considered would be Take-off and Max continuous. The low pressure turbine rotor should be tested as follows : 20 hours at Take-off speed and temp limits (test called block 1), 125 hours at Max. Cont. Speed (called block 2) and temp limits, 5 hours in incremental steps (called block 3). The same would be true for the high pressure turbine (blocks respectively called 4, 5 and 6).*

*If the applicant has a means to run all rotors at the specified conditions (simultaneously), then the total duration of the test would be 150 hours (blocks 1 and*

*4 simultaneously performed, blocks 2 and 5 simultaneously performed, blocks 3 and 6 simultaneously performed).*

*If there is no such means, then we would need 300 hours of testing (worst case). The applicant would need to run all 6 blocks which would be all different.*

*We might have some intermediate cases. For example, when running block 1, it might occur that the high pressure turbine is at or above conditions of block 5. Then the total duration would only be 280 hours (block 5 partially covered by block 1).*

response

Not accepted.
The proposed amendment has been based on ARAC recommendations that EASA has used in view of harmonisation with other Authorities and with the participation of Industry. EASA is not in favour of putting into question these ARAC recommendations.

comment

*25* comment by: *Francis Fagegaltier Services*

In CS-E 740 (b)(1), the reference to an agreement by EASA (agreed with EASA when paragraph (c)(4) below is used) is not consitent with the role of the Agency according to PART 21. See another general comment on this legal issue.

response

Not accepted.
The words used in CS-E 740 (b)(1) are consistent with what is specified under CS-E 740(c)(4).
The need to get an agreement with EASA also already exists in various other paragraphs in CS-E.
Part 21 does not prevent EASA to require a test plan proposal for agreement. For instance, AMC 21.A.15(b), dealing with the content of the certification programme required to be submitted in the frame of application for a (restricted) type certificate, mentions that 'The applicant should provide detailed information about the proposed means of compliance with the applicable requirements (…)' and 'when the compliance demonstration involves testing, a description of the ground and flight test article(s), test method(s), test location(s), test schedule, test house(s), test conditions (e.g. limit load, ultimate load), as well as of the intent/objective(s) of the testing'. EASA can comment any aspect of the proposed testing in view of reaching an agreement with the applicant. The proposed testing must obviously comply with any corresponding certification specification that is part of the type certification basis established and notified to the applicant per point 21.B.80.

comment

*37* comment by: *Rolls-Royce Deutschland*

CPA required is described too generically as to what types of damage need to be considered such that expectations are likely to creep over time - wording needs to be more positive of the purpose of the test such that it does nöt become expected to test every possible failure mode - other regs cover these - eg cyclic more appropriate to be covered under CS-E930 and 1040.

CPA should be performance focussed - damage consideration topics should be defined more clearly toward the original intent of this benchmark test.

response | Not accepted.
The description of the CPA is based on the ARAC report together with some clarifications deemed necessary. The identification of the damage mechanisms is part of the severity comparison, as explained in AMC E 740(c)(4). Creep is considered as the primary damage mechanism, but other damage mechanisms may also be relevant and should be assessed by the applicant. This approach was selected to be compatible with the evolution of engine designs.

comment | *38* comment by: *Rolls-Royce Deutschland*

CS-E 740 (c)(4)(viii) Ancillary TCDS Limits Demonstration
The alternate test must comply with CS-E 690(a)(3), CS-E 140(d)(1) and (2), CS-E 170, CS-E 740(e) and (f), and CS-E 750.

(c)(4)(viii) requires complying with CS-E 140(d)(1) (requirement for calibration test under E 730), E 140(d)(2) (requirements for rotorcraft engines under E 740(c)(3) test schedule) and E 170 (requirements for additional testing that can't be covered under E 740).

Not all requirements apply in all circumstances. EASA to reflect this in regulation, for example by adding "as appropriate". Note that if testing for CS-E 170 were required as part of CS-E 740, CS-E 170 would not be applicable for such testing.

response | Accepted.
The wording of the sentence has been changed to specify that the alternate test must take into account the quoted specifications. Also, the references to CS-E 140(d)(1) and (2) (respectively applicable to calibration tests and rotorcraft engines that are out of the scope of the alternate endurance test) and CS-E 170 (applicable in addition to the endurance test) have been deleted.

comment | *92* comment by: *Rolls-Royce plc*

**Page 20 Section 4, issue 1, CS-E 740(c)(4)**

**Comment summary**
(c)(4)(viii) requires complying with CS-E 140(d)(1) (requirement for calibration test under E 730), E 140(d)(2) (requirements for rotorcraft engines under E 740(c)(3) test schedule) and E 170 (requirements for additional testing that can't be covered under E 740), but turbofan engines are not able to comply with these airworthiness standards during endurance testing either standard or alternate.

**Suggested resolution**
Delete CS-E 140(d)(1), (d)(2) and E 170 from proposed text of the E 740(c)(4(viii)

response | Accepted.

comment | *40* comment by: *Rolls-Royce Deutschland*

Text in (c)(4)(i)(C), but also elsewhere.

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| | The phrase "Redline" is imprecise, and not defined in CS-Definitions, nor CS-E 15 Terminology. Its use may lead to differences in understanding (such as whether it includes Max Continuous Conditions).<br><br>Replace "Engine Redline Limit Demonstration" with "Engine Operating Limit Demonstration" |
| response | Accepted. |

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| comment | *41* comment by: *Rolls-Royce Deutschland*<br><br>Text in (c)(4)(iv)(3). "Three snap/burst accelerations (1 second or shorter) from idle to the MTO EGT redline (hold redline for a duration of 90 seconds each) must also be demonstrated."<br><br>Reword to "Three snap/burst accelerations (**throttle movement of** 1 second or shorter) from idle…" |
| response | Accepted. |

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| comment | *43* comment by: *Rolls-Royce Deutschland*<br><br>CS-E 740(c)(4)<br><br>MTO / MCT fan speed redline demonstration in (c)(4)(iv)(2) requires a minimum of 30 / 90 minutes, which appears to be an arbitrary value. Is this what EASA considers a sensible minimum, or is there an engine characteristic or behaviour detemining these values ? |
| response | Noted.<br>The ARAC report (Engine Harmonization Working Group (EHWG) report Revision A, dated 31 March 2021), section 6.4.2, provides some explanations: 'The 30 minute MTO demonstration is justified based on the typical time required for a takeoff and climb to cruise conditions. The 90 minute MCT demonstration is related to a typical non-ETOPS diversion scenario'. |

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| comment | *44* comment by: *Rolls-Royce Deutschland*<br><br>CS-E 740 (c)(4)(iv)(3). CS-Definitions defines as "'Exhaust Gas Temperature' means the average temperature of the exhaust gas stream." This means, the gas temperatures downstream of the LP Turbine. The regulations should allow the use of other controlling temperatures, such as TIT or ITT.<br><br>Add discussion of "Other turbine temperature locations may be used, depending upon the design of the engine and instrumentation." |
| response | Accepted.<br>The first sentence of CS-E 740 (c)(4)(iv)(3) has been amended to refer to the conditions necessary to demonstrate the MTO EGT operating limit. This leaves the possibility for the applicant to consider the turbine entry temperature as a parameter to be used during the demonstration test. |

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| comment | *45* comment by: *Rolls-Royce Deutschland*<br><br>CS-E 740 (c)(4)(vii) Incremental Cruise Power and Thrust<br><br>The proposed text of (c)(4)(vii) when read in conjunction with the current E 740(g) does not allow dwell testing to demonstrate compliance with E 650(f).<br><br>Either revise proposed (c)(4)(vii) appropriately or include E 740(g)(1) into proposed amendment by revising text referring to incremental periods of Part 4s. |
| response | The text used in the proposed CS-E 740 (c)(4)(vii) paragraph is similar to the existing text of CS-E 740(c)(1) part 4.<br>CS-E 740(g) is applicable to both the classic and the alternate endurance test, hence there is no need to specifically. CS-E 740(g)(1) has been amended, as proposed in the NPA, with the adequate paragraphs references to read: Part 4 in CS-E 740(c)(1), (2) or (3) of the endurance test, or CS-E 740(c)(4)(vii) of the alternate endurance test, if applicable. |

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| comment | *46* comment by: *Rolls-Royce Deutschland*<br><br>CS-E 740 (c)(4)(v) Test Severity Demonstration over extended operating periods<br><br>The text "...as would be achieved by the 18.75 hours at MTO and 45 hours at MCT conditions prescribed in CS-E 740(c)(1)…" does not consider the "derated take-off" conditions permitted by CS-E 740(c)(1)(C)(D) and (E).<br><br>EASA should explain what the criteria are for such operating conditions. |
| response | Accepted.<br>The quote of the '18.75 hours at MTO and 45 hours at MCT conditions' has been deleted as the reference to CS-E 740(c)(1) is sufficient. The applicant can then select the adequate option to establish the reference severity. |

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| comment | *55* comment by: *FAA*<br><br>Page: 16<br>Paragraph: CS-E 740(c)(4)<br><br>Comment: Acceleration and deceleration runs, Part 5s (Part E in figure 3.1 of the ARAC report), requirement not specified for the alternate endurance test. CS-E 740(f)(4)(iv) does mention that for EGT transients of 30 sec, 50% of the prescribed periods at Take-off Power or Thrust conditions are required and 100% for 2 min transients, therefore it's implied that it should be applicable.<br><br>Proposed Resolution: Add Acceleration and deceleration runs, Part 5s (Part E in figure 3.1 of the ARAC report) similar to how Part 4s (Part D in figue 3.1 of the ARAC report) were included in CS-E 740(c)(4)(vii). "The following accelerations and decelerations must be completed 25 times: "30 minutes of accelerations and decelerations consisting of 6 cycles from Ground Idling to Take-off Power or Thrust, maintaining |

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| | Take-off Power or Thrust for a period of 30 seconds, the remaining time being at Ground Idling.”” <br><br> Comment Type: Conceptual |
| response | Noted. <br> The ARAC identified the cyclic content as a key factor in the endurance test demonstration. <br> Consequently, the proposed alternate endurance test is intended to contain a significantly increase of cyclic content. For this reason, the Part 5s were not retained. <br> CS-E 740(c)(4)(v) specifies that the applicant must determine the mix of cycles and cycle durations that best represent the Engine design and operation. A methodology showing how creep damage, and other damage, to critical components accumulates is necessary for a comparative severity assessment to the intent of the test schedule specified in CS-E 740(c)(1). <br> AMC E 740(c)(4) section 6 on ‘Number of cycles to reach equivalent severity’ states that it is expected that a cyclic accumulation of approximately 500–750 cycles is needed for the equivalent severity demonstration in order to also expose any potential incipient LCF, SPLCF, and TMF type damage to aerofoil components. A cycle is defined as a rapid acceleration (throttle move in 1 second or shorter) from ground idle to at least maximum rated thrust and a rapid deceleration back to ground idle. <br> The commented reference to the 30-second periods at Take-off Power or Thrust for transient EGT limit approval are only applicable to the case where the applicant uses the classic test. |

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| comment | *58* comment by: *FAA* <br><br> Page 18 <br> Para:CS-E 740(c)(4)(iv) <br> Comment: Both 740(c)(iv)(1) and (c)(iv)(2) provide clarification on how the core and fan speed limits will be established, so the paragraph in (c)(iv) appears to be repetitive and may conflict. <br><br> Does this imply that temperature and speed redlines will be demonstrated and determined differently. Would they both be subject to the requirements in 740(f)? <br><br> Proposed Resolution: Clarify paragraph. <br><br> Type of Comment: Conceptual |
| response | Noted. <br> The comment is not fully understood. CS-E740(c)(4)(iv)(1) addresses only the core speed and CS-E740(c)(4)(iv)(2) addresses only the fan speed, reflecting the ARAC proposal, so there is no redundancy. Also, both paragraphs include a hook to CS-E 740(f): ‘this demonstration comprises the appropriate period of the test for establishing the TCDS MTO- and MCT-declared core (or fan) speed limits in accordance with CS-E 740(f)’. |

The EGT operating limit demonstration is subject to a separate paragraph CS-E740(c)(4)(iv)(3).
Each paragraph provides its own set of demonstration requirements. However, it does not prevent the applicant from planning concurrent testing demonstration as far as the requirements are fulfilled (e.g. MTO Fan speed and MTO EGT limits demonstration).

comment *59* comment by: *FAA*

Page: 19
Paragraph: CS-E 740(c)(4)(v)
Referenced Text: CS-E sates “The duration and the split between MTO and MCT operation are to be determined and justified by the applicant.”

Comment: The current rule requires 18.75 hours at MTO and 45 hours at MCT, i.e., 42% of run time to be completed at MTO operation. Allowing applicants to a run much higher percentage at MCT could miss other potential failure modes. Should rule or guidance expect same ratio unless applicant shows the severity is the same and the additional running at MCT will better challenge other failure modes? Running the endurance test close to IMI conditions may diminish the benefits of performing both for certification.

Proposed Resolution: Require MTO and MCT to be run at the same ratio as in the current rule, or provide justification why the alternate endurance test should not require that.

Comment Type: Conceptual

response Partially accepted.
The ratio between MTO and MCT running time was not considered by the ARAC as a primary factor indicating the severity of the test. Rather, the total time spent at a given condition was considered most significant, this has been reflected in the proposal by the equivalent severity concept.
The alternate endurance test must provide a severity at least equivalent to the intent of the classic endurance test prescribed by CS-E 740(c)(1) (see proposed CS-E 740(c)(4) first paragraph). This principle is reflected in more details in the proposed CS-E 740(c)(4)(v) on ‘Test Severity Demonstration over extended operating periods’ and the corresponding AMC E 740(c)(4) section (3). The severity equivalence of the alternate endurance test should be assessed on the basis of accelerated creep life usage as compared to the intent of the classic test. In addition, the alternate endurance test should demonstrate equal or more damage accumulation in the other damage mechanisms.
It will be the responsibility of the applicant to demonstrate the severity equivalence.

comment *65* comment by: GE Aerospace

The proposed CS-E 740(c)(4)(v) states that “Limiting temperature must be demonstrated for extended periods to achieve the equivalent cumulative creep severity for the critical component as would be achieved by the 18.75 hours at MTO and 45 hours at MCT conditions prescribed in CS-E 740(c)(1) (also referred to as the

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| | reference severity)." We recommend removing "creep" from this sentence as creep and other damage mechanisms need to be considered in the reference severity. Identification and use of creep and other damage mechanisms is discussed in other sections of the proposed rule and AMC, and is included in the subject paragraph where the methodology to demonstrate accumulation is discussed. |
| response | Not accepted.<br>The ARAC recommendation is that creep damage is the primary parameter to evaluate the test severity. However, other damage mechanisms must be considered as well. This is captured in CS-E 740(c)(4)(vi) on additional severity testing. |
| comment | *60* comment by: *FAA*<br><br>Page: 22<br>Paragraph: CS-E 740(f)(4)(iii)<br><br>Referenced Text: This paragraph seems to be focused on method 2 (Tmetal)<br><br>Comment: How about method 3 (EGT)? Is the plan to rely on the same requirement for method 3 as current CS-E 740(f)(4)(ii)<br><br>Proposed Resolution: Clarify/explain whether method 3 will use the same requirement as current CS-E 740(f)(4)(ii)<br><br>Comment Type: Conceptual |
| response | Partially accepted.<br>The CS-E 740(f)(4)(iii) paragraph is applicable to both method 2 and method 3, it addresses 'the conditions necessary to demonstrate the MTO EGT operating limit'.<br>For method 2 the conditions would be those allowing to produce the target Tmetal, which corresponds to a known EGT.<br>For method 3 the conditions would be those allowing to produce the EGT itself. In this way, the paragraph is applicable to both methods.<br>CS-E 740(f)(4)(ii) is still applicable for the 2 methods. To avoid any confusion, the order of the two paragraphs has been reversed. |
| comment | *61* comment by: *FAA*<br><br>Page: 22<br><br>Paragraph:CS-E 740(f)(4)(iii)<br><br>Referenced Text: The subparagraphs about EGT determination are a duplicate of 740(c)(4)(iii)(3) (A) & (B)<br><br>Proposed Resolution: Recommend deleting sub-paragraphs from one or the other<br><br>Comment Type: Editorial |
| response | Accepted. |

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| | The commented text has been retained in CS-E 740(f)(4)(ii). |

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| comment | *62* comment by: *FAA*<br><br>Page: 22<br><br>Paragraph: CS-E740(f)(4)(iv)<br><br>Referenced Text: The additional paragraph at the end of CS-E740(f)(4)(iv) for demonstration of transients in the alternate endurance may cause confusion that a different standard is expected than the traditional 50% for 30 seconds and 100% for 2 minute EGT transients<br><br>Comment: Is the expectation to require running to the same percentage or just to the min number of 155 and 310 cycles as expected for current test prescribed in 740(c)(1)?<br><br>Proposed Resolution: Clarify requirement.<br><br>Comment Type: Conceptual |
| response | Accepted.<br>The commented text has been clarified by clearly splitting what applies to the classic endurance test and what applies to the alternate endurance test. For the alternate endurance test, the expectation is to run the engine at the required temperature for at least 155 of the accelerations to MTO or for least 310 of the accelerations to MTO. |

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| comment | *66* comment by: *GE Aerospace*<br><br>The proposed CS-E 740(f)(iv) adds a mechanism for approval of a 30 second transient EGT limit. As proposed, it requires running the required temperature for the first 30 seconds of a prescribed stabilization.<br>Each engine type design will have some transient EGT characteristic where temperature will maximize following an acceleration. This may or may not occur at the same time that thrust and speeds maximize. In order to conduct the test as specified, the transient characteristic of the type design may need to be altered with test enabling systems to counteract that natural characteristic and achieve limiting transient EGT for the first 30 seconds of the stabilization.<br>To allow the engine to operate closer to the type design, GE recommends that the wording of the rule be changed to “Transient EGT limits up to 30 seconds may be approved by running at the required temperature for 30 seconds of 50 % of the prescribed periods at Take-off Power or Thrust conditions following an acceleration.”. This approach maintains demonstration of exposure to the limiting temperatures and would preserve, as much as possible, the type design transient characteristics. |
| response | Accepted. |

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| comment | *97* comment by: *Rolls-Royce plc*<br><br>**Pages 21-22 Section 4, issue 1, CS-E 740(f)(4)(iv)**<br><br>**Comment summary**<br>By placing 30 second transient to section E 740(f) the transient limit is only applicable to temperatures and does not cover rotational speed and torque transients as 14 CFR Part 33.87(a)(8) covers. In addition, proposed wording 'by running at required temperature' does not allow using averages as provided by opening para for E 740(f).<br><br>**Suggested resolution**<br>Harmonise text related to 30 sec transient limit with 33.87(a)(8) to also include 30 sec over-speed and over-torque limits. AMC text regarding 30 second limit seem inevitable to clarify: (a) which accelerations are suitable to perform demonstration under regular endurance test due to duration affecting engine stabilisation on condition and bleed air effects on acceptability of rotational speed (Part 5, Part 2E and 5 bleed air stages affecting required speeds may not allow achieve required number of accelerations);<br>(b) requirements for simultaneous triple redline condition when run as part of regular endurance test and effect of non-standard cold/hot nozzle size on thrust of high bypass turbofan engines; and<br>(c) when to start clock for 30 sec window and associated effects on determination of mean values (at throttle move, when engine is at required limit value, when T/O thrust is achieved or when engine meets E 740(b)(3) or maybe 740(d)(2)(i)?). |
| response | Partially accepted.<br>EASA did not intend to address over-speed and over-torque transients in this paragraph, which already limited to over-temperature in the current CS-E amendment.<br>The current text applicable to 2-minute transients already uses the term 'by running at required temperature' and EASA is not aware of a particular concern related to it. It can therefore also be used for a 30-second transient. Furthermore, this text does not go against the first paragraph of CS- E 740(f) that reads: 'The normal Engine operating limitations of power, rotational speed, turbine entry temperature, oil temperature, etc., to be established under CS-E 40(d) and CS-E 40(g), will be based on the mean values obtained during the appropriate periods of the endurance test(…)'.<br>Question (a) on the accelerations that are suitable to perform demonstration under regular endurance test: the rule requires performing 50% of the prescribed period at max take-off power or thrust. This means 50% of Part 1s, 50% of Part 2s, and 50% of Part 5s of the schedules in CS-E 740(c).<br>Question (b) on requirements for simultaneous triple redline condition when run as part of regular endurance test and effect of non-standard cold/hot nozzle size on thrust of high bypass turbofan engines: the requirements for concurrent conditions are not altered as is the case for the pre-existing 2-minute transient demonstration.<br>Question (c) on when to start clock for 30 sec window and associated effects: the clock should start when the required temperature has been reached (allowances for Part 5s as described in CS-E 740(f)(4)(iii)).<br>EASA clarified the text in CS-E 740(f)(4)(iv) taking into this comment and others. |

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| comment | *81* comment by: *Steffen FRIEDRICH*<br><br>page 23<br>CS-E 740 Endurance Tests<br>(g) Incremental Periods (1)<br><br>For the alternate endurance test the vibration value/limit has to be specified for each spool.<br>(e.g. max / factor 2 of pass-off limit prod. engines / as is - random?) |
| response | Noted.<br>CS-E 740 (g)(1) specifies the speed to be used during the Part 4s, but not the vibration level. The intention is to maximise the level of vibrations. This aspect is not altered by the introduction of the alternate endurance test. |

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| comment | *91* comment by: *Rolls-Royce plc*<br><br>**Pages 16-20 Section 4, issue 1, CS-E 740(c)(4)**<br><br>**Comment summary**<br>While the proposed text more or less follows section 7 of the ARAC report it seems it mixes requirements with advisory or interpretative material. For instance, test vehicle definition ((4)(ii)) is already covered by requirements in other specifications (E 140, 150 & 600) and proposed text is AMC. In addition, applicability is limited to turbofan engines, but these engines for aeroplanes can have also additional ratings such as 2.5 min OEI for instance to support ATTCS/APR aircraft approval. The ARAC report does not cover these aeroplane engines because 14 CFR Part 33 does not other ratings than T/o and MCT. Why EASA excluded these engines is not clear from the NPA?<br><br>**Suggested resolution**<br>Revise text of E 740(c)(4) to identify minimum performance standards and move remaining text to associated AMC, similar to E 780 which was build on ARAC report too, yet provisions of E 780 is very brief and clear. Explain why alternate schedule can't be used in lieu of E 740(c)(2) schedule for aeroplane engines, with more ratings than T/O and MCT. |
| response | Noted.<br>EASA considers that the balance between the certification specifications and the AMC material is adequate and is in line with the ARAC report recommendations.<br>The ARAC report has been scoped for application to turbofan engines. Hence, the corresponding scope in the EASA proposal.<br>The ARAC report also included the following recommendation:<br>'Follow-on work needs to be performed to develop an alternate test for turboshaft and turboprop engines, including the case where an OEI rating may be desired.'<br>In case where an applicant would like to apply for certification with a 2.5 min OEI rating, EASA and the applicant would address it using a Special Condition. |

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| comment | *93* comment by: *Rolls-Royce plc*<br><br>**Page 20 Section 4, issue 1, CS-E 740(c)(4)**<br><br>**Comment summary**<br>The proposed text of (c)(4)(vii) when read in conjunction with the current E 740(g) does not allow dwell testing to demonstrate compliance with E 650(f).<br><br>**Suggested resolution**<br>Either revise proposed (c)(4)(vii) appropriately or include E 740(g)(1) into proposed amendment by revising text referring to incremental periods of Part 4s. |
| response | Noted.<br>CS-E 740(c)(4)(vii) requires incremental steps. The NPA proposal also includes an amendment of CS-E 740(g)(1) with a reference to CS-E 740(c)(4) (if applicable). So, EASA does not find the need to make additional changes. |

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| comment | *94* comment by: *Rolls-Royce plc*<br><br>**Page 17 Section 4, issue 1, CS-E 740(c)(4)**<br><br>**Comment summary**<br>According to the ARAC report CPA, while important part of compliance demonstration, is not test definition. The proposed texts of (c)(4)(i) and (iii) do not match section 7.2.6. of the ARAC report covering Engine Rated Performance Demonstration. It is not clear why the last para refers to CS- E 170, which is not related to demonstration of failure modes engine is exposed during endurance testing.<br><br>**Suggested resolution**<br>The proposed text of (c)(4)(iii) belongs to associated AMC and the last sentenced in brackets to be deleted. Revise the text to align it with sections 7.2 and 7.2.6 of the ARAC report. |
| response | Not accepted.<br>CS-E 740(c)(i) lists the element to be considered for the definition of the alternate endurance test, and it has been adapted compared to the ARAC report.<br>The ARAC report does not prescribe that the CPA element must be included in an AMC. The CPA is used to define the test, hence it is listed as an element of the alternate test definition.<br>Furthermore, the last paragraph of CS-E 740(c)(4)(iii) refers to CS-E 170 in a way to provide a reminder to the applicant of the possibility to run additional test beyond the endurance test; it is however not written as a mandatory statement. |

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| comment | *95* comment by: *Rolls-Royce plc*<br><br>**Page 18 Section 4, issue 1, CS-E 740(c)(4)**<br><br>**Comment summary** |

MCT fan speed redline demonstration in (c)(4)(iv)(2) requires a minimum of 90 minutes. Maximum allowed diversion time at OEI condition without ETOPS approval depending on maximum seating configuration and take-off mass is either 60 or 180 minutes. Proposed 90-minute demonstration therefore does not appropriately address the potential worst in service period.

**Suggested resolution**
Consider keeping 90 minutes for engines that are going to seek ETOPS approval as the general rationale in the ARAC report makes sense. For those engines that are not seeking ETOPS approval consider prescribing 180 minutes, possible 3x60mins or 2x90mins.

response

Not accepted.
The proposed 90 minutes duration is consistent with the ARAC report recommendation and also the classic endurance test specifications per CS-E 740(c)(1) that includes a 'Part 3 1 hour and 30 minutes at Maximum Continuous Power or Thrust'.

comment *96* comment by: *Rolls-Royce plc*

**Page 21 Section 4, issue 1, CS-E 740(f)**

**Comment summary**
Wording of the proposed second para in E 740(f) can be interpreted that turbine entry temperature is a new limit, as it is not specified in AMC to E 40(d), and that it can be derived solely by analysis when using alternate type test, which also conflict with proposed E 740(f)(4)(iii).

**Suggested resolution**
Clarification needed or delete. The ARAC and E 740(f)(4)(iii) stipulates that EGT redline declared is lower of either average temperature demonstrated during EGT redline runs or EGT for which severity demonstrated during test is shown to be at least equivalent to a reference severity.

response

Accepted.
At the beginning of CS-E 740(f), as well as in the new created second paragraph, the words 'turbine entry temperature' are replaced by 'EGT'. In CS-E 740(f)(4)(i) the word 'declared' is deleted.
The proposed CS-E 740(f)(4)(iii) has been modified and moved up, now as CS-E 740(f)(4)(ii). A reference to this paragraph has been added at the end of the new second paragraph of CS-E 740(f).

comment *98* comment by: *Rolls-Royce plc*

**Pages 24-44 Section 4, issue 1, AMC E 740(c)**

**Comment summary**
The text of proposed AMC is scarce in description of EASA acceptable testing to ensure equal playing field in terms of failure modes and engine deterioration and associated effects on redline or other engine limits demonstration capability, for

instance accumulation of Part 1, Part 5 like accels requirement before any portion of testing for redline limits or oil temperature demonstration.

**Suggested resolution**
Revise proposed AMC to define acceptable cycles, minimum number of slam accelerations required prior redlines demonstration portions of test.

response

Noted.
The proposed CS-E amendment reflects the ARAC report recommendations, and EASA does not intend to add prescriptive elements that have not been discussed and agreed within the ARAC group. CS-E 740(c)(4) includes some test specifications (e.g. minimum durations, minimum number of accelerations), and the applicant is also expected to perform a CPA to identify any required additional test conditions.
The EGT redline is established as the lower of two values as described in CS-E 740(f)(4)(ii) (the EGT values demonstrated in the EGT operating limit demonstration, and the derived EGT values for MTO and MCT for which the severity demonstration for the entire test can be shown to have cumulative severity, for the critical component, greater than or equal to the reference severity). As such, the effect of the test order on the outcome is minimised.
Regarding shaft speed redlines, it would seem appropriate to take advantage of engine deterioration conditions which maximise the speed as this would reflect the conditions where there might be a risk of exceedance during in-service operations.

comment *121* comment by: *Rolls-Royce plc*

**Page 16 onward Section 4, Issue 1, CS-E 740**

**Comment summary**
The alternate test format has been taken from the ARAC document defining an alternative to 14CFR33.87, and applied to CS-E 740. I can see no assessments of the differences between CS-E 740 and 14CFR33.87.

**Suggested resolution**
There are differences relating to Average-vs-Minimum conditions, Max/Min Fuel Pressure, and the need for Derated Take-off conditions ("Part 2 Es"), etc. I would suggest some clarity on whether this NPA is proposing the same Alternate Endurance Test format as the ARAC conclusion.

response

Noted.
An analysis of the differences was done by the ARAC group as mentioned in the report.
With regard to oil/fuel pressure specifications, EASA did not identify the need to create new specifications compared to the existing content of CS-E 740.
Derated thrust or power conditions are already addressed in the classic endurance test for standard ratings per CS-E 740(c)(1) Part 2, section (B). Hence, the applicant will have the possibility to use equivalent test conditions if the engine is used with derates.
EASA confirms that the intent is to use the same alternate endurance test as in the ARAC report.

comment *122* comment by: *Rolls-Royce plc*

**Page 17 Section 4, Issue 1, CS-E 740**

**Comment summary**
Text in (c)(4)(i)(C). The phrase "Redline" is imprecise, and not defined in CS-Definitions, nor CS-E 15 Terminology. It's use may lead to differences in understanding (such as whether it includes Max Continuous Conditions).

**Suggested resolution**
Replace "Engine Redline Limit Demonstration" with "Engine **Operating** Limit Demonstration"

response: Accepted.

comment *123* comment by: *Rolls-Royce plc*

**Page 17 onwards Section 4, Issue 1, CS-E 740**

**Comment summary**
"Redline" is used extensively in this document, but is imprecise.

**Suggested resolution**
Rewording as appropriate

response: Accepted.

comment *124* comment by: *Rolls-Royce plc*

**Page 18 Section 4, Issue 1, CS-E 740**

**Comment summary**
Text in (c)(4)(iv). The phrase "temperature" is imprecise, and could be referring to measured oil temperature, turbine inlet temperature, exhaust gas temperature, interturbine temperature, or something else. It is also unclear if "physical" applies to just speeds or both speeds and temperatures.

**Suggested resolution**
Replace "Engine Redline Demonstrations (TCDS physical speeds and temperatures)" with "Engine **Operating Limit** Demonstrations (TCDS **turbine controlling temperatures and** physical speeds.)

response: Accepted.
The word ‘rotor’ has also been added in front of ‘speeds’.

comment *125* comment by: *Rolls-Royce plc*

**Page 18 Section 4, Issue 1, CS-E 740**

**Comment summary**
Text in (c)(4)(iv)(3). CS-Definitions defines as "‘Exhaust Gas Temperature’ means the average temperature of the exhaust gas stream." This means, the gas temperatures

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| | downstream of the LPTurbine. The regulations should allow the use of other controlling temperatures, such as TIT or ITT.<br><br>**Suggested resolution**<br>Add discussion of "**Other turbine temperature locations may be used, depending upon the design of the engine and instrumentation**." |
| response | Please refer to response to comment 44. |

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| comment | *126* comment by: *Rolls-Royce plc*<br><br>**Page 18 Section 4, Issue 1, CS-E 740**<br><br>**Comment summary**<br>Text in (c)(4)(iv)(3). "Three snap/burst accelerations (1 second or shorter) from idle to the MTO EGT redline (hold redline for a duration of 90 seconds each) must also be demonstrated." I suspect no engine can achieve that rate of change of EGT, and is not as intended by 740/33.87.<br><br>**Suggested resolution**<br>Reword to "Three snap/burst accelerations (**throttle movement of** 1 second or shorter) from idle…" |
| response | Please refer to response to comment 41. |

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| comment | *127* comment by: *Rolls-Royce plc*<br><br>**Page 19 Section 4, Issue 1, CS-E 740**<br><br>**Comment summary**<br>Text in (c)(4)(iv)(3). "...to justify unlimited operation up to the EGT redline,...". Unlimited operation is not consistent with a "redline" limit for 5/10 Minutes at MTO.<br><br>**Suggested resolution**<br>Reword to clarify intent. |
| response | Accepted.<br>The sentence has been re-worded. The portion in the middle is deleted so it does not refer to 'unlimited operation' anymore. |

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| comment | *128* comment by: *Rolls-Royce plc*<br><br>**Page 19 Section 4, Issue 1, CS-E 740**<br><br>**Comment summary**<br>Text in (c)(4)(iv)(3). "...values no greater than the EGT values derived in accordance with CS-E 740(f) where EGTs…" This links the Operating limits to the AVERAGE conditions achieved. Will this become a SSD with the FAA, who use a "minimal value" approach? |

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| | **Suggested resolution**<br>Observation |
| response | Noted.<br>EASA intends to maintain consistency with the current application of CS-E 740(f). This topic was discussed within the ARAC group and consequently the ARAC report reflects an averages based approach.<br>The FAA will need to decide if an harmonisation with CS-E 740(f) is suitable. |

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| comment | *129* comment by: *Rolls-Royce plc*<br>**Page 19 Section 4, Issue 1, CS-E 740**<br>**Comment summary**<br>Text in (c)(4)(v). "...as would be achieved by the 18.75 hours at MTO and 45 hours at MCT conditions prescribed in CS-E 740(c)(1)…". These numbers ignore the "derated take-off" conditions permitted by CS-E 740(c)(1)(C)(D) and (E).<br>**Suggested resolution**<br>EASA should explain what the criteria are for such operating conditions. |
| response | Please refer to response to comment 46. |

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| comment | *130* comment by: *Rolls-Royce plc*<br>**Page 20 Section 4, Issue 1, CS-E 740**<br>**Comment summary**<br>Text in (c)(4)(viii). "The alternate test must comply with CS-E 690(a)(3), CS-E 140(d)(1) and (2), CS-E 170, CS-E 740(e) and (f), and CS-E 750. This includes testing at...oil temperature, fuel minimum and maximum pressure, transient, and start limits…" CS-E 740 does not call for test and min/max fuel pressure. It is unclear what the "transient, and start limits" relate to.<br>**Suggested resolution**<br>Reword to "oil temperature **and oil** minimum and maximum pressure." |
| response | Partially accepted.<br>The commented sentence has been deleted. This sentence was included in the ARAC report but was written in the context of FAR 33.87 requirements. The CS-E specifications references in the sentence above (note: amended compared to the NPA proposal) are adequate. |

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| comment | *131* comment by: *Rolls-Royce plc*<br>**Page 21 Section 4, Issue 1, CS-E 740**<br>**Comment summary**<br>Text in (f). It has never been very clear if the Bleed Flow Limits are based upon the Average flows achieved or the minimum flow achieved. |

**Suggested resolution**
Reword to "The normal Engine operating limitations of power, rotational speed, **bleed,** turbine entry temperature, oil temperature, etc.,"

response | Accepted.

comment | *132* comment by: *Rolls-Royce plc*

**Page 24 Section 4, Issue 1, CS-E 740**

**Comment summary**
Text in (h)."Engine-rated Performance Demonstration. Power or thrust of the Engine must be at least 100 % of the value associated with the particular Engine operation being tested." It is unclear whether this apples to every period at MTO or MCT, or over the course of the whole test.

**Suggested resolution**
Reword to "Engine-rated Performance Demonstration. **Over the course of the whole endurance test, the average** power or thrust of the Engine must be at least 100 % of the value associated with the particular Engine operation being tested."

response | Partially accepted.
This paragraph has been amended to focus on the capability of the engine after the endurance test completion. It now specifies that after completion of the endurance test, the engine must be able to provide the rated thrust or power levels without exceeding operating limitations.
Furthermore, a new CS-E 740(b)(6) has been created to specify that the thrust or power of the Engine achieved throughout the endurance test must be at least 100% of the value associated with the particular Engine rating being tested, in order to substantiate the thrust or power ratings established under CS-E 40.

comment | *141* comment by: *Rolls-Royce plc*

**Page 16 onwards Section 4, Issue 1, CS-E 740**

**Comment summary**
CPA required is written in woolly way as to what types of damage need to be considered such that expectations are likely to creep over time - wording needs to be more positive of the purpose of the test such that it doesn't become expected to test every possible failure mode - other regs cover these - eg cyclic more appropriate to be covered under CS-E930 and 1040

**Suggested resolution**
CPA should be performance focussed - damage considerations topics should be defined more clearly to avoid test intent drift from original intent of this benchmark test

response | Partially accepted.
The CPA just identifies damage mechanisms, it is the comparative severity analysis which determines the extent of the substantiation required.

It is expected that the extent of the substantiation during the alternate endurance test, to achieve equivalent severity compared to the classic endurance test, will not be significantly different.
Nevertheless, a new paragraph has been added in AMC E 740(c)(4), section (5)(v), to provide that when a damage mechanism is identified in the CPA (other than creep) that cannot be substantiated by the endurance test without unreasonable modifications to test schedules, further substantiation may be provided under CS-E 170.

comment *145* comment by: *Rolls-Royce plc*

**Page 19 CS-E 740 (c)(4)(iv)**

**Comment summary**
"Reference severity" is mentioned at the end of this section in (B). This term isn't defined anywhere.

**Suggested resolution**
Consider changing to equivalent severity as the classic endurance test and leaving the reference test to the AMC.

response Noted.
The commented text has been deleted as the result of other comments, and the term 'reference severity' is not used anymore in CS-E 740(c)(4)(iv).
This term is nevertheless defined in the first paragraph of CS-E 740(c)(4)(v) and AMC E 740(c)(4), section (5)(b).

comment *146* comment by: *Rolls-Royce plc*

**Page 19 CS-E 740 (c)(4)(v)**

**Comment summary**
This paragraph doesn't state that the MTO and MCT running need to be at the limiting temperature condition. Should it? If not, how far below the limiting temperature condition is acceptable?

**Suggested resolution**
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response Accepted.
The first sentence of the first paragraph has been amended to clarify that the limiting temperature for MTO and MCT must be demonstrated for extended periods. The second paragraph defines the limiting temperature.

**AMC E 740(c)(4) Alternate endurance testing - Turbofan Engine** p. 25

comment *11* comment by: *Francis Fagegaltier Services*

In the proposed CS-E 740 (c)(4) (as well as in many other places in this NPA), there is reference to "the classic endurance test prescribed by CS-E 740(c)(1)". What is the

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| | meaning of “classic” in this context ? It seems to be more a comment than a certification specification.<br><br>A clear reference should be given. |
| response | Noted.<br>The reference to CS-E 740(c)(1) is provided in the first instance where the term ‘classic endurance test’ is used in CS-E 740(c)(4) first paragraph. It has been further clarified. ‘Classic’ refers to the endurance test to be performed before the amendment introducing the possibility to run an ‘alternate’ endurance test. |

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| comment | *12* comment by: *Francis Fagegaltier Services*<br><br>In the first sub-paragraph of the proposed CS-E 740 (c)(4), the last sentence (“a test plan ….”) is questionable in the EASA legal structure of texts. Indeed, when FAR21 and FAR33 are at same legal level in the USA, it must be noted that, in Europe, the specifications of CS-E are only “agency measures” when Part 21 is at the level of a Commission regulation.<br><br>Is this sentence appropriate with regard to the principles behind 21.B.100 level of involvement (*of the Agency*), 21.A.15 (b) (*certification programme*) and 21.A.20 (a) (*demonstration of compliance*) ?<br><br>Part 21 has been changed to eliminate the strong wording “the Agency shall accept without further verification” of 21.A.263 (b), replaced by the 21.B.100 requirement, but the basic principles are still there : the applicant should be capable of providing the complete demonstration of compliance by itself without asking permission from the authority.<br><br>Therefore, it seems that the proposed wording is not legal in the European system. |
| response | Please refer to response to comment 25. |

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| comment | *13* comment by: *Francis Fagegaltier Services*<br><br>In the proposed CS-E 740 (c)(4)(ii), the first sentence (“*the test should be performed …*”)uses the word “*substantially*” and we find the word “*minimised*” in the next sentence. This seems to be inappropriate because the subject is addressed with a different wording in 21.A.33 (b) (“adequately”) : may an agency measure (CS-E) add something to or modify a commission regulation (Part 21) ? The whole (ii) sub-paragraph is then legally questionable. |
| response | Partial agreement.<br>The word ‘minimised’ aims at highlighting the notion of ‘exceptions’ to make it clear that any hardware modification must be avoided as far as practicable.<br>Please note that the word ‘should’ in the first sentence has been replaced by ‘must’.<br>There is no contradiction with point 21.A.33. ‘Adequately’ provides some flexibility. Nevertheless, we have replaced the word ‘substantially’ by ‘adequately’ in CS-E 740(c)(4)(ii), CS-E 930/AMC E 930 to be consistent with point 21.A.33(b). |

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| | Please note that in the past years, the 'classic' endurance test requirements led to concerns with regard to the representativeness of the engine configuration as explained in NPA 2023-06, which we aim to address with the use of an alternate endurance test. |
| comment | *26* comment by: *Francis Fagegaltier Services*<br><br>In the § (8)(d) of the proposed AMC E 740(c)(4), there is reference to an integral equation ! In almost 40 years of experience with engine certification, before this NPA, I had seen only once an integral equation (it was a triple integral !!) in a document related to engine certification : it was at the end of USSR, in a conference on engine certification in 1990 in (then) Zagorsk by a Russian speaker !<br><br>This AMC is too much complex. Simplicity would be welcome in a complete re-writing of CS-E 740 as suggested years ago in the EHWG (see another comment). |
| response | Noted.<br>Other CS and AMC contain equations of various nature.<br>In the present case, these equations have been provided as mathematical background. |
| comment | *56* comment by: *FAA*<br><br>Page: 29<br>Paragraph:<br>CS-E 740(c)(4)(vii) and 740(c)(1) Part 4<br><br>Comment: In addition to equal speed increments the time at each increment should also be equal. Proposed AMC E 740(c)(4)(7), (page 29) does state the prescribed duration of 10 minutes which implies the intent if for equal intervals.<br><br>Proposed Resolution: Add "and time" to 740(c)(4)(vii) to harmonize with FAA 33.87(b)(4).<br><br>Comment Type: Conceptual |
| response | Not accepted.<br>EASA prefers to maintain consistency with CS-E 740(c)(1) Part 4. Furthermore, CS-E 740(g) actually addresses incremental periods. |
| comment | *57* comment by: *FAA*<br><br>Page:30<br>Paragraph:CS-E 740(c)(4)(vii) and 740(c)(1) Part 5<br>Referenced Text: EASA NPA uses increasing from ground idle up to MCT power or thrust. The FAA uses decreasing from MCT to ground idle.<br><br>Comment: ARAC report figure 7.3, "Severity Usage for Part D Stair Step Cycles," in decreasing order from MCT to ground idle. |

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| | Proposed Resolution: Request EASA to use the same decreasing stair step cycles to harmonize with FAA and consistent with ARAC report.<br><br>Comment Type: Conceptual |
| response | Not accepted.<br>This incremental profile is consistent with the content of CS-E 740(c)(1) Part 4 of the 'classic' endurance test specifications. |

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| comment | *63* comment by: *FAA*<br><br>Pages: 25-44 Para: AMC E 740(c)(4)<br><br>Comment: Consider harmonizing with FAA<br><br>Proposed Resolution: Recommend referencing FAA comments to CS-E 740(c)(4) and update AMC accordingly<br><br>Comment Type: Conceptual |
| response | Noted.<br>Please refer to previous responses, no AMC changes is needed. |

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| comment | *67* comment by: *GE Aerospace*<br><br>Figures 8.4 and 8.5: Add the word "be" in the take-away box text - "The same Performance Model, Design Model and Damage Model will {be} used for the …". |
| response | Accepted. |

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| comment | *68* comment by: *GE Aerospace*<br><br>Figures 8.10 and 8.11: Add the word "be" in the take-away box text - "The same Proxies and Damage Model will {be} used for the …". |
| response | Accepted. |

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| comment | *69* comment by: *GE Aerospace*<br><br>In the proposed AMC E 740(c)(4), beginning with paragraph 8(d), paragraph identification is not consecutive. Paragraph 8(d) – "Mathematical Background / Basis" on page 35 is followed by (e) – "Main Tmetal method flow charts" on page 36. Paragraph indicators (d) – "EGT as a proxy for Tmetal" and (e) – "Main EGT method flow charts" are repeated on pages 40 and 41 respectively. |
| response | Accepted.<br>Thank you, the numbering has been corrected. |

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| comment | *99* comment by: *Rolls-Royce plc*<br><br>**Pages 32-33 Section 4, issue 1, AMC E 740(c)(4)(8)(b)** |

**Comment summary**
The proposed text of (8)(b) is confusing and can lead to misinterpretations. Subclauses (i) through (iii) seems to confuse process steps required to establish alternate test severity equivalence with assessment and determination of EGT from the alternate test.

**Suggested resolution**
Avoid discussion rather focus on acceptable alternative test and revise the proposed text of (8)(b) that for alternate test there are actually two methods to determine test severity equivalence and associated declared EGT redline limit (Tmetal, and red line EGT method).

response
Accepted.
The commented paragraph has been simplified to focus on the description of the 2 available methods.

comment *100* comment by: *Rolls-Royce plc*

**Page 26 Section 4, issue 1, AMC E 740(c)(4)(2)**

**Comment summary**
The second bullet of the proposed text of AMC E 740(c)(4)(2), but also portion of text in CS-E 740(c)(4)(iii) on page 17, significantly expands purpose of the CPA as discussed by section 6.2 of the ARAC report. This conflicts with texts provided in AMC E 740(c)(4)(3) and (4) see also Appendix J of the ARAC report. In addition, while ARAC report (Appendix J) has a definition of critical component, proposed AMC does not provide EASA definition.

**Suggested resolution**
CPA (performance team) can only determine engine operating conditions. Determination of critical components and associated damage mechanism (hardware teams) for engine condition is a part of severity assessment analysis. Revise proposed text so it does not conflict with text of clause (3) and (4). Define what is EASA understanding of critical component.

response
Not accepted.
The scope of the CPA proposed by EASA is consistent with the ARAC report section 6.2.
The definition of 'critical component' proposed by EASA (within CS E 740(c)(4)(iii)) is the same as the one contained in the ARAC report Appendix J.

comment *143* comment by: *Rolls-Royce plc*

**CS-E 740 (c)(4)(v)**

**Comment summary**
There is a risk of SSD with 14 CFR Part 33.87 alternate test as this rulemaking is ahead of FAA rulemaking.

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| | **Suggested resolution**<br>FAA and EASA coordinate rule making timescales to converge on equivalent rules |
| response | Noted.<br>EASA and FAA have regular rulemaking cooperation exchanges to optimise resources and harmonise as far as possible. However, it is not possible to conduct all rulemaking tasks in parallel. FAA should however conduct a rulemaking action equivalent to RMT.0180.<br>The potential for a new SSD is not reason for EASA not moving forward. |

**AMC E 740(c)(2)(i) Endurance Tests - 30-Minute Power Rating** p. 25

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| comment | *90* comment by: *Rolls-Royce plc*<br>**Pages 11,15&24 Section 2.7, issue 1, Section 4, Issue 1, CS-E 730 and CS-E 740(h)**<br><br>**Comment summary**<br>Objective established in the section 2.7 for calibration test and revised 740(h) is not achieved. Proposed text is not clear about intent and does not seem to match either AMC E 40 or 14 CFR Part 33.87(a)(3).<br><br>**Suggested resolution**<br>Either remove proposed amendment to the text or revise it with clear wording on purpose of calibration test and endurance test acceptance criteria, that on completion of the test engine must demonstrate it provides rated thrust without exceeding operating limitations |
| response | Accepted. |

**AMC E 740(h)(2) Endurance tests - Inspection checks** p. 44

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| comment | *5* comment by: *Transport Canada*<br>Suggest to change title "AMC E 740(h)(2)" to read "AMC E 740 (i)(2)"<br><br>Rationale: Section (h) is renamed to new section (i) *Inspection Checks*; hence, the AMC is now applicable to section (i). New section (h) is now titled *Engine-rated Performance Demonstration.* |
| response | Accepted. |

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| comment | *33* comment by: *Transport Canada Civil Aviation Standards Branch*<br>Suggest to change title “AMC E 740(h)(2)” to read “AMC E 740(i)(2)”<br><br>Rationale: Section (h) is renamed to new section (i) *Inspection Checks*; hence, the AMC is now applicable to section (i). New section (h) is now titled *Engine-rated Performance Demonstration.* |
| response | Accepted. |

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| comment | *39* comment by: *Rolls-Royce Deutschland*<br>Revise the title of the AMC E 740(h)(2) to (i)(2). |
| response | Accepted. |

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| comment | *82* comment by: *Steffen FRIEDRICH*<br>page 44 /45<br>AMC E 740(h)(2) Endurance tests — Inspection checks<br>(2)<br><br>This needs to be specified more in detail:<br>What kind of inspections are necessary ?<br>Critical features and dimensions for critical parts shall be defined prior to the test (incl. predicted values based on critical part analysis). Definition of necessary inspection activities: measurements for identified critical features and comparison to analytical predictions, Overall inspection against established manual limits? |
| response | Noted.<br>The commented paragraphs were not subject to a change of their content in the scope of RMT.0180. EASA has not identified a problem with their application, hence no change has been performed. |

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| comment | *101* comment by: *Rolls-Royce plc*<br>**Page Section 4, issue 1, AMC E 740(h)(2)**<br><br>**Comment summary**<br>Endurance test – inspection checks of CS-E 740(h) is proposed to be moved to new section (i) hence title AMC E 740(h)(2) does not match provisions of the airworthiness standard (E 740 (i) inspection and checks) it intends to provide AMC to.<br><br>**Suggested resolution**<br>Revise the title of the AMC E 740(h)(2) to (i)(2). |
| response | Accepted. |

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| comment | *133* comment by: *Rolls-Royce plc*<br>**Page 44 Section 4, Issue 1, CS-E 740**<br><br>**Comment summary**<br>Incorrect section heading<br><br>**Suggested resolution**<br>Reword to "AMC E 740(**i**)(2) Endurance tests — Inspection checks" |
| response | Accepted. |

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| comment | *140* comment by: *Rolls-Royce plc*<br><br>**Page 44 AMC 740(c )(4) 8(F)**<br><br>**Comment summary**<br>"If during the testing there is test data that requires an update to one of the modelling methodologies, then SeverityRef would need to be recalculated with the new methodology as well." implies that using the alternate test is no longer a bench mark test. This has unintended downstream consequences when looking to revise models or take benefit of certification endurance tests for changes etc. DOA would need to consider sensitivity to changes and include margin to cover potential differences due to modelling development , in service learning etc<br><br>**Suggested resolution**<br>RR awareness of potential downstream impact of adopting the alternate test |
| response | Noted. |

**CS-E 870 Exhaust Gas Over-temperature Test** p. 45

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| comment | *135* comment by: *Rolls-Royce plc*<br><br>**Page 45 Section 4, Issue 1, CS-E 870**<br><br>**Comment summary**<br>It is unclear if this 5 minute test still require shaft speed/speeds to be at/above the MTO limit.<br><br>**Suggested resolution**<br>Consider stating that there is no requirement for shaft speeds at the limit. |
| response | Noted.<br>The comment is not applicable anymore because EASA decided to withdraw the proposed amendment of CS-E 870. The reason is that further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not. |

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| comment | *64* comment by: *FAA*<br><br>Page:45<br>Para:CS-E 870<br><br>Referenced Text: CS-E 740(c)(4)<br><br>Comment: It is not clear why the proposed allowance to run for 5 minutes instead of the current 15 minutes is only applicable to the proposed alternate endurance test defined in CS-E 740(c)(4). Is this attempting to harmonize with FAA 14 CFR 33.88? Is |

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| | the Maximum Exhaust Gas Over-Temperature selected by the applicant or will a predefined safety margin be defined as in 33.88<br><br>Proposed Resolution: Clarify overtemperature requirement when performing alternate endurance test, and ensure the resultng rule is harmonized with FAA 14 CFR 33.88.<br><br>Comment Type: Conceptual |
| response | Accepted.<br>EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not.<br>Furthermore, EASA decided to harmonise CS-E 920 with FAR 33.88. New paragraphs (a) and (c) have therefore been introduced that are identical to FAR 33.88(a) and (c). Nevertheless, in paragraph (a) we add the clarification on the need to take account of the 2-minute transient EGT limit (per CS-E 740(f)(4)(iv)) if applicable, which reflects a provision contained in FAA AC 33.87-1A. |

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| comment | *83* comment by: *Steffen FRIEDRICH*<br><br>page 45<br>CS-E 870 Exhaust Gas Over-temperature Test<br>(b)1<br><br>Ok, but should be clarified for the potential risk of combined tests; If the overtemp. test will fail, also the previous endurance test may be not passed. In case of seperate tests only the failed test needs to be repeated. |
| response | Please refer to response to comment 79. |

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| comment | *134* comment by: *Rolls-Royce plc*<br><br>**Page 45 Section 4, Issue 1, CS-E 870**<br><br>**Comment summary**<br>The change also opens the possibility of the 14CFR33.88 test (if performed on the Alt End test) providing the Maximum Exhaust Overtemperature evidence.<br><br>**Suggested resolution**<br>Add specific mention of the possibility of combining CS-E 870 and 14CFR33.88 testing |
| response | Partially accepted.<br>EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not. |

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| | Furthermore, EASA decided to harmonise CS-E 920 with FAR 33.88. New paragraphs (a) and (c) have therefore been introduced that are identical to FAR 33.88(a) and (c). Nevertheless, in paragraph (a) we add the clarification on the need to take account of the 2-minute transient EGT limit (per CS-E 740(f)(4)(iv)) if applicable, which reflects a provision contained in FAA AC 33.87-1A. |

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| comment | *144* comment by: *Rolls-Royce plc*<br><br>**Page 45 CS-E 870**<br><br>**Comment summary**<br>Proposed CS-E 870 now gives two options, the existing 15 minutes at limiting EGT and shaft speeds, or 5 minutes at limiting EGT plus an alternate CS-E 740 endurance test. While it is self evident that that the 5 minutes + CS-E 740 test must be more severe than the 15 minutes, there is no requirement to prove this and hence there is no provision in the regulation to ensure equivalent severity.<br><br>**Suggested resolution**<br>Consider requiring equivalent severity for existing and proposed CS-E 870. |
| response | Noted.<br>EASA decided to withdraw the proposed amendment of CS-E 870 because further consideration concluded that the proposal is not workable. Hence, the current CS-E 870 is unchanged and applicants wishing to comply with this optional requirement may have to plan adequate testing, independently from whether they opt for the alternate endurance test or not. |

| **CS-E 890 Thrust Reverser Tests** | p. 45 |
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| comment | *84* comment by: *Steffen FRIEDRICH*<br><br>page 45<br>CS-E 890 Thrust Reverser Tests<br>(f)<br><br>Needs to be specified more in detail:<br>Active thrust reverser for endurance test or just thrust reverse rating level to run? |
| response | Noted.<br>The comment is not understood. The change made is an update of the existing reference to the CS-E 740 paragraph dealing with 'Inspection checks' after test completion. |

**Issue 2: Turbine-engine initial maintenance programme (IMP) test**

| **CS-E 930 Initial Maintenance Programme Test** | p. 45 |
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| comment | *14* comment by: *Francis Fagegaltier Services* |

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| | The proposed CS-E 930 uses the wording "*substantially conforms to the type design*". The comment made against CS-E 740 (c)(4)(ii) is also applicable here. May an agency measure (CS-E) add something to or modify a commission regulation (Part 21) ? |
| response | Please refer to response to comment 13. |

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| comment | *15* comment by: *Francis Fagegaltier Services*<br><br>The writing of the proposed CS-E 930 (b) reflects the fundamental difficulty created by the EASA's decision to place some certification specifications for engines in the AMC 20-6 instead of CS-E 1040, contrary to FAA with its FAR33.201. Note that FAR33.201 is now considered by FAA as being a "significant standards difference".<br><br>It is acknowledged that CS-E paragraphs and AMC texts are both agency's measures. Nevertheless, in principle, AMC are only "acceptable means of compliance". What is added by the proposed CS-E 930 (b) (that is only a reference to an AMC document) which is not already covered by CS-E 930 (a) ?<br><br>It is suggested to delete the proposed CS-E 930 (b) and, eventually, to add the reference to the ETOPS AMC to AMC E 930, on the basis that certification specifications are in CS-E 930 and acceptable means of compliance in AMC documents. |
| response | Accepted. |

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| comment | *105* comment by: *Rolls-Royce plc*<br><br>**Page 46 Section 4, Issue 2, CS-E 930**<br><br>**Comment summary**<br>Under option (b) the CS-E 930 provisions incorporate by reference the AMC 20-6, namely its certain section. This is for the first time in the entire CS-E, Section A, that an airworthiness standard incorporates by reference some advisory material. This is not and should not be a standard practice for performance driven regulatory material.<br><br>**Suggested resolution**<br>Revise text of the proposed CS-E 930 to state '(b) a simulated ETOPS mission cyclic endurance test for early ETOPS approval in accordance with CS-E 1040' or similar or better wording. |
| response | Partially accepted.<br>CS-E 930(b) has been deleted to rely on the generic content of CS-E 930(a).<br>AMC E 930 has been revised to reflect this change. The use of an early ETOPS test is a possibility that the applicant can use to show compliance with CS-E 930. |

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| comment | *16* comment by: *Francis Fagegaltier Services* |

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| | The JAA Engine Study Group, between 1984 and 2003, tried twice to introduce into JAR-E (basis of CS-E) a test equivalent to the FAR33 IMI test of 33.90. Each time, it was concluded that this was not appropriate and that JAR-E 25, introduced by JAR-E amendment 10, was sufficient. An important element of the rationale for such a decision can be found in … the proposed CS-E 930 itself ! The need for the very last sentence illustrates the possible over-interpretation of this "certification specification".<br>In any case, this sentence is not relevant to CS-E : 21.A.93, in particular 21.A.93 (b)(3)(iii), 21.A.101 and 21.B.100 govern the certification of changes to the type certificate, not CS-E. This sentence should be deleted. |
| response | Accepted.<br>A new paragraph has been created in AMC E 930 to discuss demonstration of compliance for changes to type certificate. |

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| comment | *17* comment by: *Francis Fagegaltier Services*<br>It is recognised that a cyclic endurance test, simulating flights in an accelerated manner, is very beneficial, especially when the full nacelle is part of it as in the ETOPS case. Indeed, early engine in-flight-shut-downs have occurred because of failure of or interference with one element of the nacelle itself. Nevertheless, most of the time, for compliance with CS-E 25 and in anticipation on the validation against FAR33.90, such cyclic tests are usually performed during the certification process of European engines.<br><br>However, as the need for a new CS-E 930 is not obvious, it is recognised that CS-E 25 and its associated AMC E 25 could have been made clearer and more specific on the subject. |
| response | Accepted.<br>AMC E 25 paragraph (1) has been amended to add a reference to the IMP test. |

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| comment | *24* comment by: *Francis Fagegaltier Services*<br>The wording "substantilly conforms" is not consitent with Part 21 (see 21.A.33). |
| response | Please refer to response to comment 13. |

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| comment | *42* comment by: *Rolls-Royce Deutschland*<br>"If the applicant applies for a change through amendment of an existing type certificate or through supplemental type certification, it is not required to complete the above test."<br><br>There are many types and degrees of "change". Taking the text at face value, it could be argued that all of them (with exceptions above) would now require to complete this text to show compliance, whereas the intent is to restrict its effectivity to new TCs. |
| response | Partially accepted. |

Taking into consideration comment 16 and this comment, the CS-E 930 last sentence has been deleted and a new paragraph (c) has been created in AMC E 930. This new paragraph describes the applicability of the test when considering changes to type certificate.

comment *103* comment by: *Rolls-Royce plc*

**Pages 45 - 51 Section 4, Issue 2, CS-E 930**

**Comment summary**
Terminology selected 'Initial Maintenance Programme' conflicts with definition of maintenance programme as provided by Part M.A.302, Part ML.A.302 respectively, and associated AMC&GMs. It also appears that the term IMP is not used consistently through the proposed AMC to E 930 (see (d) a structured inspection programme) and is not used in E 25 and associated AMC (scheduling information, or inspection programme).

**Suggested resolution**
If same terminology as in the 14CFR Part 33.90 (IMI) can't be used, then it is suggested to apply terms different from Maintenance Programme as it constitutes more than just scheduling information but also necessary maintenance activities other than inspections.

response Partially accepted.
The term IMP is defined in AMC E 930(a)(2) in a way that refers to ICAs and hence there is no confusion with the maintenance programme to be established in compliance with Part-M or Part-ML. Furthermore, paragraph (d) (new (e)) of AMC E 930 has been revised to avoid using the term 'structured maintenance programme'; the new text states that a simplified IMP may consist of a fixed overhaul period, and this period should be determined based on the test results.

comment *104* comment by: *Rolls-Royce plc*

**Pages 45 - 46 Section 4, Issue 2, CS-E 930**

**Comment summary**
When text of the CS-E 930 read as proposed, it requires test also for repair design approvals under Part 21 Subpart M. The first para mandates to select and perform either test under (a) or (b), there is no other option for any design approval. The second para with exception clause only provides an alleviation for amended TC or STC.

**Suggested resolution**
Revise text of the E 930 and associated AMC E 930 to clarify that CS-E 930 only requires test run each engine model for which a new TC is required under Part 21.A.11 or 21.A.19. In addition, AMC E 25(1) requires an update as well to clarify that initial scheduled inspection interval is determined by E 930 test and may evolve after entering service, based on the service experience.

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| response | Partially accepted.<br>Please refer to response to comment 42.<br>AMC E 25 paragraph (1) has been amended to add a reference to the IMP test. |

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| comment | *136* comment by: *Rolls-Royce plc*<br><br>**Page 45 Section 4, Issue 2, CS-E 930**<br><br>**Comment summary**<br>I appreciate the use of phrasing from 33.90, making it quite clear that the regulations have been harmonised.<br><br>**Suggested resolution**<br>Observation |
| response | Noted. |

**AMC E 930 Initial Maintenance Programme Test** p. 46

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| comment | *23* comment by: *Francis Fagegaltier Services*<br><br>The very last sentence of the proposed AMC E 930 should be clarified to explain what the criteria are for judging if the test results support the desired fixed overhaul period. |
| response | Partially accepted.<br>The sentence has been re-worded to state that the applicant should substantiate the fixed overhaul period from the test results. EASA expects the applicant to make a proposal and justify any criteria used for the substantiation. |

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| comment | *71* comment by: *Safran Helicopter Engines*<br><br>page 46 §(a) Definitions (4) 'Overhaul'<br>Some engines can feature a modular concept for maintenance. In that case, overhaul can be performed at module level. It is proposed to include the modular concept in the overhaul definition.<br>Proposal :<br>'Overhaul': the process to disassemble, clean, inspect, repair or replace (as necessary), reassemble, and test for return-to-service approval within the manufacturer's overhaul data specifications. This process relates to the periodic disassembly of the entire Engine **or modules when applicable**, rather than maintenance of individual parts or assemblies. |
| response | Accepted. |

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| comment | *72* comment by: *Safran Helicopter Engines* |

page 49 - §(5) Pass/Fail Criteria (iii) Post-Teardown Inspection

The NPA proposes the following acceptance criteria for the test :
"*Post-Teardown Inspection*
*A post-test teardown inspection should demonstrate that each Engine part:*
*— conforms to the type design;*
*— is eligible for continued operation in service.*
*Hardware may be considered serviceable if the applicant includes, within the ICAs, appropriate inspections or limitations.*"

First item appears to be contradictory with the last sentence. Indeed, according to PART 21, type design is defined as :
"*(a) The type design shall consist of:*
*1. the drawings and specifications, and a listing of those drawings and specifications, necessary to define the configuration and the design features of the product shown to comply with the applicable type-certification basis and environmental protection requirements;*
*2. information on materials and processes and on methods of manufacture and assembly of the product necessary to ensure the conformity of the product;*
*3. an approved airworthiness limitations section of the instructions for continued airworthiness as defined by the applicable certification specifications; and*
*4. any other data allowing by comparison the determination of the airworthiness and, if relevant, the environmental characteristics of later products of the same type*"

Then, the acceptance criterion requires that each part after IMP test remain compliant with drawings and specifications which corresponds to a new part technical definition, meaning that no damage on the part is accepted. This appears to be inconsistent with the last sentence where damages can be accepted if appropriate ICAs are set. It is proposed to replace the first criterion "conforms to the type design" by conforms to the Type Certificate" which includes ICAs.
In addition, when the applicant substantiates a fixed Engine Overhaul Period ( TBO) through an IMP test, it appears not consistent to require the engine to be eligible for continued operation in service when, by definition of a TBO, an engine at the end of its TBO is not eligible for continued operation, as the removal for overhaul is required by the ICAs.
It appears that in any case, whether or not a TBO is substantiated, the criteria for eligibility for continued operation should be precised and linked to the ICAs.
It is proposed to refer to the serviceability criteria for engine without a a fixed Engine Overhaul Period (TBO), and to the absence of any immediate upcoming failure for engine having reached its TBO.

**Proposal :**

For engines without a a fixed overhaul period, post-test teardown inspection should demonstrate that each Engine part:
— conforms to the **type certificate**
— is eligible for continued operation in service (within the serviceability criteria of the ICAs).
Hardware may be considered serviceable if the applicant includes, within the ICAs, appropriate inspections or limitations.

For AMC E 930 (d) replace

"(d) Fixed Engine Overhaul Period.
The applicant may recommend a fixed overhaul period as the equivalent of an IMP, if the applicant does not intend to cover the Engine with a structured inspection programme. If this approach is selected, the applicant should:
— perform the Engine test of CS-E 930 in a similar manner to that described in paragraph (c) of this AMC;
— determine whether the test results support the desired fixed overhaul period."

by

"(d) Fixed Engine Overhaul Period.
The applicant may recommend a fixed overhaul period as the equivalent of an IMP, if the applicant does not intend to cover the Engine with a structured inspection programme. If this approach is selected, the applicant should perform the Engine test of CS-E 930 in a similar manner to that described in paragraph (c) of this AMC **except for paragraph 5 (iii) where a post-test teardown inspection should support the proposed fixed overhaul period and demonstrate that each Engine part:**
**— do not exhibit unacceptable mechanical damage (absence of any immediate upcoming failure)**
**If necessary the Instructions for Continued Airworthiness will be modified, in order to ensure that the engine remains airworthy between maintenance and overhaul intervals ;**
**For Engines having 30-Second OEI and 2-Minute OEI power ratings, IMP test results can be used as part of evidence of compliance to CS-E 25(b)(2) for OEI power availability demonstration at the end of the Fixed Engine Overhaul Period (TBO).**

response

Accepted.
The content of this comment is agreed with by EASA. AMC E 930 has been revised, although using a slightly different changes but meeting the intent of the comment.

comment

*73* comment by: *Safran Helicopter Engines*

Pages 47-49
*c(1)(iii) :*
*The accelerated severity cycle test is generally not considered ideal for Engine parts for which durability is primarily affected by hours of operation rather than by cycles. For those cases, the IMP substantiation may require other test or in-service experience data (including, if available, comparison of relevant past IMP demonstrations to subsequent successful entry-into-service (EIS) Engine experience).*
*c(6)(ii)*
*For a successful accelerated severity cycle test, the applicant may take credit from the full number of cycles for those Engine parts for which the test cycle was shown to be equal to or more severe than the assumed Engine flight cycle.*
*c(6)(iii)*
*... the applicant may need to draw supporting evidence...*

This paragraph should include the possibility to provide a demonstration showing that the accelerated test provides the same level of damages and then provides an equivalent level of severity.

proposal to modify c(1)(iii) :
The accelerated severity cycle test is generally not considered ideal for Engine parts for which durability is primarily affected by hours of operation rather than by cycles. For those cases, the IMP substantiation may require other test, in-service experience data (including, if available, comparison of relevant past IMP demonstrations to subsequent successful entry-into-service (EIS) Engine experience) or demonstration showing that the accelerated test provides an equivalent level of severity.

response

Not accepted.
The commented paragraph is considered clear enough regarding the required IMP substantiation. The proposed change may create confusion.

comment

*74* comment by: *Safran Helicopter Engines*

Pages 45-46-48
*AMC E 930*
*(a)*
*an Engine test that simulates the conditions in which the Engine is expected to operate in service, including typical start–stop cycles*
*c(1)(i)*
*the applicant should show that the proposed test cycle represents the expected in-service Engine flight cycles*

Engines intended for helicopter applications usually provides 30s /2min or 2min 30s OEI power ratings structures for emergency situations. Minimum availability of these emergency ratings is today understood to be 3x30s and 3x2min for 30s /2min OEI power ratings structure as per AMC E 40(b)(3) and (b)(4) § (4), and 1x2min30s for 2min 30s OEI. When further usage beyond those 3 usages, or cumulative usage of 2min30s OEI is provided by the applicant before engine removal for maintenance, this total cumulative usage should be validated during the IMP test in order to be fully representative of in-service usage and associated cyclic consumption.
It should also be specified that IMP test results can be used as part of evidence of compliance to CS-E 25(b)(2) for Engines having 30-Second OEI and 2-Minute OEI power ratings: the required in-service Engine evaluation programme usually integrating a dedicated accelerated mission test, including periodic(cumulative) and final OEI power demonstrations.

**Proposal :**

(c) IMP test
(1) IMP test cycle assessment
(i) General
The applicant should provide an assessment of expected service operating conditions as part of the test plan. In this assessment, the applicant should show that the proposed test cycle represents the expected in-service Engine flight cycles, including the following:
— established power/thrust ratings. **If the engine includes OEI power ratings, substantiation of cumulative usage of those OEI power ratings before maintenance should be performed as part of the IMP test.**
— reverse thrust use,

— component stress and temperature,
— exhaust gas temperature (EGT),
— vibration,
— cycle/operating time cumulative damage,

(5) Pass/Fail Criteria
(i) General
The Engine type design will comply with CS-E 930 when the post-test hardware condition demonstrates that the Engine will remain airworthy when applying the proposed IMP. The Engine should comply with paragraphs (c)(5)(ii), (iii) and (iv) of this AMC.
**In addition, IMP test results can be used as part of evidence of compliance to CS-E 25(b)(2) for Engines having 30-Second OEI and 2-Minute OEI power ratings for OEI power availability demonstrations.**

response

Partially accepted.
Paragraph (c)(1)(i) has been amended to add the proposed statement but at the bottom of the list, and the term 'representation' is used instead of 'substantiation'.
Paragraph (c)(5)(iii) (Post-test tear-down inspection) has been amended instead of (c)(5)(i) with the proposed statement, as (c)(5)(iii) is deemed a more appropriate place.

comment *75* comment by: *Safran Helicopter Engines*

Page 46:
c(1)(i)
The applicant should provide an assessment of expected service operating conditions as part of the test plan. In this assessment, the applicant should show that the proposed test cycle represents the expected in-service Engine flight cycles, including the following: ...
— vibration, ...

It should be precised that the IMP test must be representative of vibration environment arising from the engine. It is inddeed unpracticable to simultate all vibration sources from aircraft origin during the IMP test (which are addressed with CS-E 650 compliance).

**Proposal:**

c(1)(i)
The applicant should provide an assessment of expected service operating conditions as part of the test plan. In this assessment, the applicant should show that the proposed test cycle represents the expected in-service Engine flight cycles, including the following: ...
— **engine** vibration, ...

response

Accepted.

comment *76* comment by: *Safran Helicopter Engines*

page 47:

The paragraph "(2) IMP Test Engine Configuration" does not cover hardware items that are part of the engine type design but not mounted on the engine (within the aircraft).
It is proposed to address this specific case.

**Proposal:**

(2) IMP Test Engine Configuration
(i) General
CS-E 930 requires the test to be performed with an Engine that substantially conforms to its final type design. Therefore, no significant Engine modification should be required to complete the IMP test. **Engine pieces of equipment or accessories, which are part of the engine type design and not directly installed on the engine, may be substantiated taking credit of validated analyses and/or other tests. Equipment qualification performed under CS-E 80 (b) may be considered as an appropriate means of compliance in this case.**

response Accepted.

comment *77* comment by: *Safran Helicopter Engines*

page 51:
§(d) Fixed Engine Overhaul Period

Clarifications should be brought about the acceptance criteria of the test in case the engine has fixed overhaul period (paragraph (d)). It is stated "determine whether the test results support the desired fixed overhaul period". It is not clear if specific acceptance criteria are to be defined and aggreed with the agency in this case or if post tear down criteria of paragraph AMC E 930 (c)(5)(iii) remain applicable. Specific criteria for engines with TBO should be defined.

**Proposal:**

Proposal to replace AMC E 930 (d) by

"(d) Fixed Engine Overhaul Period.
The applicant may recommend a fixed overhaul period as the equivalent of an IMP, if the applicant does not intend to cover the Engine with a structured inspection programme. If this approach is selected, the applicant should perform the Engine test of CS-E 930 in a similar manner to that described in paragraph (c) of this AMC except for paragraph 5 (iii) where a post-test teardown inspection should support the proposed fixed overhaul period and demonstrate that each Engine part:
— do not exhibit unacceptable mechanical damage (absence of any immediate upcoming failure)
If necessary the Instructions for Continued Airworthiness will be modified, in order to ensure that the engine remains airworthy between maintenance and overhaul intervals ;
For Engines having 30-Second OEI and 2-Minute OEI power ratings, IMP test results can be used as part of evidence of compliance to CS-E 25(b)(2) for OEI power availability demonstration at the end of the Fixed Engine Overhaul Period (TBO)."

response

Partially accepted.
AMC E 930 paragraph (d) (now (e)) has been amended in a way to simplify it and referring to paragraph (c)(5)(iii) (now (d)(5)(iii)).
Paragraph (d)(5)(iii) now better distinguishes the types of damages that may be found at the end of the test. It also stipulates that for those parts damaged beyond criteria ensuring safe continued operation, the applicant should substantiate the finding that there is no imminent failure and should provide in the ICAs an appropriate fixed Engine overhaul period. Finally, it also includes a sub-paragraph addressing OEI power ratings as proposed.

comment

*85* comment by: *Steffen FRIEDRICH*

page 46
AMC E 930 Initial Maintenance Programme Test
(c) IMP test (1)(i)

>for „reverse thrust use“ same as CS-E890 (8f):

Needs to be specified more in detail:
Active thrust reverser for alternate endurance test or just thrust reverse rating level to run?

>for „vibration“

Needs to specified more in detail:
Unbalance Condition - Max or as is/random (within limits) / factored pass-off limits?

response

Not accepted.
Reverse thrust use: EASA expects the applicant to take into account how the thrust reverser should be used in service operation when defining the engine test cycles.
Vibration: this refers to engine vibrations, hence the word ‘engine’ has been added. The applicant will either use the EDTO/ETOPS vibration specifications, or propose to EASA some levels of unbalance. Note that AMC E 930 paragraph (d)(3) requires to check the unbalance vibrations experienced during the test so that they effectively represent the conditions expected during an Engine flight cycle.

comment

*106* comment by: *Rolls-Royce plc*

**Page 46 Section 4, Issue 2, AMC E 930**

**Comment summary**
Given text differences of (a)(2), (a)(3) and (b) to AC 33.90-1A safety objective of EASA IMP test significantly differs from the IMI test under 14 CFR Part 33.90 (demonstrate sufficient engine reliability and establish maintenance tasks for EIS (proposed by EASA) vs validate interval of inspections considered necessary to determine airworthiness of the engine (exercised by FAA))

**Suggested resolution**

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| | Considering engine reliability is not primary intent of the airworthiness code contained in CS-E, and potential for another significant standard difference to be raised by the FAA, revise the text of the AMC to harmonise the safety objective of the proposed test. |
| response | Not accepted.<br>EASA does not envisage that the proposed amendment will generate an SSD with the FAA.<br>The wording used in the new CS-E 930 includes the objective of this specification that is to ensure an adequate engine reliability that is commensurate with the IMP. It is as well an underlying intent from FAA FAR 33.90.<br>AMC E 930 is similar to the FAA AC 33.90-1A, except that it reflects common practices that many applicants do not use fixed maintenance inspection intervals. Hence it provides more flexibility to applicants (who may still elect to use IMI intervals i.e. a 'hard time' policy). |

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| comment | *107* comment by: *Rolls-Royce plc*<br><br>**Pages 46, 56 Section 4, Issue 2, AMC E 930 Appendix 1, section 2, Option 1, Turbine-engine IMP test**<br><br>**Comment summary**<br>Texts in proposed AMC E 930 (a)(3) and the Appendix 1 to the NPA indicate that EASA understanding or interpretation of difference between On Condition and Hard Time Maintenance may not be aligned with the rest of the aviation industry and regulators<br><br>**Suggested resolution**<br>'The initial maintenance inspection (IMI) approach would be one method that the applicant may use. Other methods would be allowed, in particular on-condition based maintenance programming.' Please clarify what is the difference between the two methods. On condition maintenance may also require inspections in either mandatory or recommended intervals. |
| response | Noted.<br>It is agreed that an IMP may include hard time tasks (such as replacement, inspection) in addition to 'on-condition' maintenance instructions (e.g. a task is to be performed when some conditions are met).<br>The new AMC E 930 does not specify how an IMP is built and offers flexibility to the applicant in the way the IMP is defined and applied during the test. |

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| comment | *109* comment by: *Rolls-Royce plc*<br><br>**Page 47 Section 4, Issue 2, AMC E 930**<br><br>**Comment summary**<br>Why text of (c)(2) does not refer to other CS-E requirements related to engine testing such as E 140, E 150 or E 600?<br><br>**Suggested resolution** |

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| | Please consider adding reference to other engine test related requirements as appropriate. |
| response | Noted.<br>EASA did not consider it necessary to add references to other generally applicable CS-E paragraphs. |

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| comment | *110* comment by: *Rolls-Royce plc*<br><br>**Page 48 Section 4, issue 2, AMC E 930**<br><br>**Comment summary**<br>Test duration under (c)(4) is intended to demonstrate that the engine remain airworthy and serviceable (on-wing) for declared interval between inspections or overhauls. Demonstration of effectiveness of maintenance activities, unless safety related, is not a safety objective of airworthiness standards<br><br>**Suggested resolution**<br>Revise proposed text of AMC E 930(c)(4), that number of cycles or running duration should be suitable to demonstrate engine type design remains airworthy and in a serviceable condition between scheduled inspections that will be part of ICA. |
| response | Not accepted.<br>The purpose of the test is stated in CS E 930 and in paragraph (b) of AMC E 930. The commented paragraph (c)(4) (now (d)(4)) of AMC E 930 stipulates that the total number of test cycles and the test duration should be sufficient to demonstrate the effectiveness of the IMP. This should obviously be considered in the scope of the purpose of the test, there is no need to repeat it in this paragraph. |

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| comment | *111* comment by: *Rolls-Royce plc*<br><br>**Page 48 Section 4, issue 2, AMC E 930**<br><br>**Comment summary**<br>Words ‘when applying the proposed Initial Maintenance Programme’ in (c)(5)(i) imply also maintenance activities such as refurbishment, overhaul or other forms of maintenance to restore airworthy condition, which is not intent of the proposed regulatory material.<br><br>**Suggested resolution**<br>Revise proposed text of AMC E 930(c)(5), that the engine remains airworthy and serviceable when exposed to proposed interval of scheduled inspections. |
| response | Not accepted.<br>AMC E 930(d)(5)(i) does not imply that the overhaul is part of the IMP.<br>Furthermore, the IMP may use either hard time based maintenance programming, on-condition based maintenance programming, or a combination of both. This has been clarified in the definition of IMP provided in AMC E 930(a)(2).<br>Hence, the IMP may not only be made of scheduled inspections, but may contain other maintenance tasks required to ensure the engine remains airworthy until an overhaul or removal is performed. |

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| comment | *112* comment by: *Rolls-Royce plc*<br><br>**Page 50 Section 4, issue 2, AMC E 930**<br><br>**Comment summary**<br>(c)(7)(i) contains words 'an approved test', this means EASA will issue an approval certificate to perform this test, which will affect EASA LOI and already stretched resources by requiring EASA heavy involvement.<br><br>**Suggested resolution**<br>Revise proposed (c)(7)(i) by deleting word approved. |
| response | Accepted. |

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| comment | *113* comment by: *Rolls-Royce plc*<br><br>**Page 50 Section 4, issue 2, AMC E 930**<br><br>**Comment summary**<br>Wording in subclause (C)(7)(i)(A) using 'test should be interrupted' does not sufficiently ensure applicability compared to other subclauses ((B) and (C))<br><br>**Suggested resolution**<br>Revise proposed (c)(7)(i) by deleting word approved. |
| response | Partially accepted.<br>The comment is not fully understood. However, EASA re-considered the validity of points (A), (B), and (C). It has been concluded that point (C) is in contradiction with point (B) that requires completion of the early ETOPS test before EIS. Hence point (C) has been deleted. |

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| comment | *114* comment by: *Rolls-Royce plc*<br><br>**Page 50 Section 4, issue 2, AMC E 930**<br><br>**Comment summary**<br>Requirements of (c)(7) namely (C)(7)(i)(A), (B) and (C) must be projected to the AMC 20-6 as well and this NPA does not propose any updates to it<br><br>**Suggested resolution**<br>Update AMC 20-6 as part of this NPA accordingly, as the early ETOPS test (or portion of it) is now acceptable method of compliance to E 930 if applicant seeks demonstration in accordance with the option (b). |
| response | Not accepted.<br>There is no need to amend AMC 20-6B in the frame of this NPA.<br>Please note that EASA will soon repatriate the content of AMC 20-6B in the different corresponding regulations, including CS-E (refer to the EPAS, RMT.0673). |

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| comment | *115* comment by: *Rolls-Royce plc*<br><br>**Page 50 Section 4, issue 2, AMC E 930**<br><br>**Comment summary**<br>It is not clear how requirements of (C)(7)(i)(B) and (C) related to a completion of the rest of the entire early ETOPS test post type-certificate approval and prior EIS will be enforced in EU environment. Certificate of approval is based on demonstration of compliance with requirements of Certification Basis not on commitments and promises.<br><br>**Suggested resolution**<br>If this commitment is expected to be provided in a certification documents (e.g. the compliance plan) or to be addressed in a more general manner (in a DOA procedure for EU holders/applicants in accordance with points 21.A.239 and 21.A.263), then this NPA requires an expansion to clarify and also cover AMC&GMs to Part 21 (Subpart B and Subpart J). in addition, If the respective DOA holder has not previously exercised the practice of delaying the test beyond the design approval in order for the DOA to demonstrate this capability in its design assurance system (DAS), the required procedural changes need to be addressed via a significant change to the DAS in accordance with point 21.A.247. |
| response | Accepted.<br>The term 'prior to EIS' has been deleted from paragraph (B) and paragraph (C) has been deleted. |

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| comment | *137* comment by: *Rolls-Royce plc*<br><br>**Page 50 Section 4, Issue 2, CS-E 930**<br><br>**Comment summary**<br>Text in section 7 Using the early ETOPS test of AMC 20-6 Revision 2 saying "(B) Prior to EIS, the AMC 20-6 Revision 2 test must be completed in its entirety." This seems inconsistent with the idea of AMCs not being mandatory. Additionally, AMC 20-6 rev 2 only addresses two-engine aeroplanes.<br><br>**Suggested resolution**<br>Reword to "Prior to EIS, the AMC 20-6 Revision 2 test **should** be completed in its entirety…" |
| response | Accepted. |

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| comment | *142* comment by: *Rolls-Royce plc*<br><br>**Page 49 cs-e930 5 (iii)**<br><br>**Comment summary**<br>States on teardown parts must conform to type design, but if they are worn, but within ICA limits they may no longer conform the type design? |

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| | **Suggested resolution**<br>- |
| response | Accepted.<br>This has been reflected in a revision of AMC E 930 paragraph (c)(5)(iii) (now (d)(5)(iii)). |

**Issue 3: Substantiation of piston-engine TBO/TBR**

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| comment | *18* comment by: *Francis Fagegaltier Services*<br>There is no specific possibility for proposing comments on AMC E 25.<br><br>Here is then a comment on the TBO subject.<br><br>With regard to TBO, it is noted that in this NPA 2023-06 there is no cross-reference to EASA NPA 2011-15 “non-binding guidance on TBO limits”. |
| response | Noted.<br>NPA 2011-15 dealt with TBO extension in the frame of the aircraft maintenance programme, as compared to the TBO recommended by the engine TCH.<br>The NPA 2023-06 proposal deals with how the engine TC applicant can demonstrate a TBO during the certification of the engine. So, there was no need to mention NPA 2011-15 as these are two separate topics.<br>Note: The AMC2 M.A.302 (d) created in 2013 from NPA 2011-15 has been withdrawn in the same year by ED Decision 2013/034/R |

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| comment | *19* comment by: *Francis Fagegaltier Services*<br>another comment on TBO.<br><br>As a reminder, here is copied the position of the European engine authorities at time of JAA (PPSCC means propulsion sub-certification committee) in relation to approval of a TBO. Some changes were introduced into Part 21 : ICA are now part of the type certiifcate (21.A.41). BUt this does not fundamentalle change the principles.<br><br>*PPSCC position on approval of TBO (Time Between Overhaul)*<br><br>*1 - Relevant requirements*<br><br>*The requirements for « instructions for continued airworthiness », necessary to comply with JAR 21.61, were introduced into JAR-E by Orange Paper E/97/1 (see JAR-E 25). These stipulate that the corresponding manual (s) should contain data that are acceptable to the authority and that only the airworthiness limitation section must be approved by the authority.*<br><br>*JAR-OPS 1.910 (b) stipulates that the operator’s maintenance programme must be approved by the authority.* |

*JAR 21.181 (a) stipulates that the maintenance must be performed in accordance with the applicable JARs (with no definition of these JARs).*

*It is noted that, except for the airworthiness limitation section, the instructions for continued airworthiness are neither part of the type design (JAR 21.31) nor part of the type certificate (JAR 21.41). Therefore changes to these instructions are not required to be approved under JAR 21 sub-part D.*

*2 - Purpose*

*A TBO maintenance programme should be part of the « instructions for continued airworthiness ». However, TBO is only one of several types of maintenance philosophies which may be included in such instructions. Other examples include « On condition » maintenance, condition monitored maintenance, reliability centred maintenance, or a hard time life limit for the entire engine which would be scrapped at end of its life. The TC holder may also recommend alternative methods ( e.g. TBO or on-condition ) leaving the operator to choose that which best suits their operation. Furthermore, a single engine type may include a mix of methods; the compressor being on-condition whilst the turbine is operated to a fixed TBO for example.*

*The need for a JAA policy was identified during the approval of CRIs on TBO for some engine projects.*

*This PPSCC position paper is intended to provide a wider guidance for all JAA engine teams.*

*3 - Engine airworthiness*

*In an engine,*

*either*
*a part is life limited in order to prevent a hazardous failure or failures resulting in an unacceptably high engine shut down rate, and the life limits are published in the airworthiness limitation section of the « instructions for continued airworthiness »,*

*or*
*a part is not life limited and .... there is no life limit.*

*If an unsafe condition arises in service from a part which is not-life-limited, the authority may decide to introduce a mandatory life limit for this part and/or impose inspections to detect imminent failure. The safety is usually ensured by such life limits or inspections but not by imposing an overhaul.*

*4 - Fleet safety level*

*The authorities do not consider that imposing a TBO is always necessary for ensuring the adequate safety level of aircraft fleets. The principle of « on condition » maintenance has been satisfactorily used for years on many engine types. Recognising that the holder of the engine type certificate has the best knowledge of the engine design and associated airworthiness and reliability, the authorities base*

*their judgement on the ground of the effects on airworthiness only, whilst the constructors would also take into account economics and serviceability. The operator, who has responsibility for his aircraft, must make his own decision on all these aspects.*

*It is also recognised that private operators should retain the prime responsibility for their operations.*

*Furthermore, people using aircraft offered for commercial public transportation are entitled to expect that this aspect of engine reliability/integrity has been considered by the authority.*

*5 - Airworthiness directives*

*Airworthiness directives (ADs) might impose actions to be performed at « next overhaul » or make reference in some way to overhaul. It is noted that such ADs are normally prepared by the authority of the type certificate holder with information and risk analysis provided by the TC holder. Therefore, it is assumed that such ADs will only refer to the overhaul periods which are « recommended » by the TC holder.*

*6 - Recommendations*

*6.1 For engine certification*

*(a) At time of engine certification, except the airworthiness limitation section which is formally approved by the authority, the manual(s) provided in compliance with JAR-E 25 should be acceptable to the authority, i.e. the content would be approved by the applicant and the instructions for continued airworthiness should be, to the satisfaction of the authority, such that no unsafe condition is expected to develop if compliance with the proposed instructions is maintained (this is considered as being information needed for compliance with JAR 21.21 (c)(3)).*

*(b) Extensions of the recommended TBO, if a TBO is proposed by the applicant, will be made by the TC holder under its DOA in accordance with an agreed procedure. An extension to the TBO may be requested by the operator but this would normally be expected to be submitted as part of a life development programme previously agreed with the authority.*

*6.2 Post TC activity*

*6.2.1 For issue or renewal of piston engined aircraft certificate of airworthiness or operator's approval*

*(a) Maintenance based on the TC holder's recommendation is acceptable.*

*(b) Extension not exceeding 20% of the « recommended » overhaul periods may be acceptable if additional inspections are proposed at completion of « recommended » period and then at 100 hours or yearly intervals, whichever occurs first.*

*(c) Extensions in excess of 20% are not acceptable for Public Transport operations. They may be acceptable for Private operations subject to additional inspections at*

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| | *120% of « recommended » overhaul period and thence at 100 hours or yearly intervals, whichever occurs first.*<br><br>*(d) An extension of the « recommended » TBO under (b) or (c) above should not be understood as an extension of the applicability of ADs. Any airworthiness directive making reference to overhaul should be understood, and accordingly applied, as referring to the overhaul period recommended by the TC holder.*<br><br>*6.2.2 For issue or renewal of turbine engined aircraft certificate of airworthiness or operator's approval*<br><br>*(a) Maintenance based on the TC holder's recommendation is acceptable.*<br><br>*(b) Any variations from the TC holder's recommendations may only be made in accordance with procedures agreed by the authority.* |
| response | Noted.<br>Request for TBO extension from operators is not in the scope of NPA 2023-06. |

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| comment | *20* comment by: *Francis Fagegaltier Services*<br><br>AMC E 25, §(6)(a) : it is believed that the sentence "The TBO/TBR value should be agreed by EASA" is not acceptable in the legal system in Europe. Although ICA are now part of the type certificate, there is apparently no legal basis for a formal approval by the Agency.<br><br>What would be the responsibility of EASA if an accident occurs due to an engine failure before the 600 flight hours specified in this AMC ?<br><br>On which legal basis EASA could impose a specific value to the TBO : is it not a commercially competitive figure ?<br><br>CS-E and associtéed AMC should not interfere with business decisions but should specify safety objectives. |
| response | Noted.<br>ICA other than ALS items are not approved by EASA, however they are reviewed to ensure that the applicant complies with CS-E 25(c)(5). The word 'agree' is used in the AMC, not 'approved'. |

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| comment | *21* comment by: *Francis Fagegaltier Services*<br><br>In AMC E 25, §(6)(b) : how is defined what is allowed by the CS-E 440 test ? This reference must be clarified. |
| response | Accepted.<br>This refers to the values mentioned in paragraph (6)(a), the reference has been added. |

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| comment | *22* comment by: *Francis Fagegaltier Services*<br>In AMC E 25, §(6)(b)(iii), how is defined the "level of engine deterioration" ? How is kown the condition of the engine at the end of the intended TBO ? This obscure "requirement" should be clarified. |
| response | Noted.<br>The commented sentence has been used in JAA CRIs with the same wording and EASA therefore used it also in the proposed AMC.<br>EASA expects that the applicant defines the acceptable engine deterioration level that is reached at TBO time. |

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| comment | *34* comment by: *Transport Canada Civil Aviation Standards Branch*<br>On Page 51 - Transport Canada suggests the following comment:<br><br>Suggest to revise CS-E 25 to add TBO/TBR requirement, and AMC E 25 to say that applicants “must” substantiate a TBO/TBR not “may”.<br><br>Rationale: The Safety recommendation by the Austrian Federal Safety Investigation Authority states ‘Amend the certification requirements for piston engines, CS-E:…failures”. The proposed language in AMC E 25 alone may not address the Austrian Authority recommendation. |
| response | Please refer to response to comment 32. |

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| comment | *48* comment by: *Transport Canada Civil Aviation Standards Branch*<br>NPA 2023-06 page 51 segment 4 **Issue 3: Substantiation of piston-engine TBO/TBR** Proposed point (6)(b) to AMC E 25 states “if the applicant wishes to propose a TBO/TBR higher than what the CS-E 440 test allows to substantiate, then the following method may be used: ….”, and CS-E 440 is an endurance test of 150 hours duration. Even with the options of applicants “wishes” and “may”, any 600 hours interval is higher than what the CS-E 440 test directly substantiates. Unless the cyclic test is performed on all the hardware that was exposed to the full 150 hours endurance test, then such IMI (cyclic endurance) test would not be “additional”. Too much interpretation of factoring the endurance test duration toward substantiation of the engine TBO/TBR interval. Consideration to call such test by its purpose instead of re-using the “cyclic endurance test” name for a different purpose than CS-E 440 endurance test. (note the nomenclature difference in EASA SC E-19 between EHPS.420 Endurance Demonstration and EHPS.430 Durability Demonstration.) |
| response | Accepted.<br>The term ‘engine cyclic durability test’ is used in the resulting text. |

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| comment | *49* comment by: *Transport Canada Civil Aviation Standards Branch*<br>NPA 2023-06 page 51 segment 4 **Issue 3: Substantiation of piston-engine TBO/TBR** proposed point (6)(b)(iv) & (v) refers to Engine cyclic test when CS-E 150 (b) states “(b) During all tests, only servicing and minor repairs must be permitted |

except that major repairs or replacement of parts may be resorted to, provided that the parts in question are subjected to an agreed level of penalty testing."

(iv) The maintenance programme associated with the intended TBO/TBR should be performed and validated during the Engine cyclic test.
(v) Complementary analysis and/or testing should be provided to support any aspects not adequately demonstrated throughout the Engine cyclic test.

As a maintenance program may include top overhaul or complete engine block/crank shaft refurbishment, scope of allowable on-wing (engine not removed from aircraft) activities should be discussed.

response

Noted.
EASA expects the applicant to include necessary maintenance tasks in the instructions for continued airworthiness. This can for instance include the replacement of some parts. Note that we replaced the term 'maintenance programme' by 'instructions for continued airworthiness' to avoid confusion with the 'aircraft maintenance programme' required under Part M.

comment *78* comment by: *Safran Helicopter Engines*

Page 51:
AMC E 25 Instructions for continued airworthiness

What is the basis allowing to delclare a 600h to 1000h TBO for piston engines with only 150h endurance test performed ?
Equivalent approach should be proposed for turbine engines

response

Noted.
The piston engine endurance test is defined such that it corresponds to an accumulation of thermal and fatigue cycles at an accelerated rate to simulate 600 to 1000 hours of in-service operation. EASA does not consider it applicable to turbine engines.

comment *116* comment by: *Rolls-Royce plc*

**Page 51 Section 4, issue 3, AMC E 25**

**Comment summary**
What is a definition of the Time Between Replacements? Is it replacement of life-limited parts?

**Suggested resolution**
Replace TBO/TBR by more suitable term time in service interval (as defined by AC 120-113) and clarify that Time in service interval do not authorize safe life for life-limited parts or for items specified in an EASA-approved Airworthiness Limitation Section (ALS).

response

Partially accepted.

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| | The TBR is a recommended number of running hours or calendar time before the engine requires replacement (instead of overhaul). This explanation has been added to AMC E 25.<br>TBR does not replace or cancel any existing ALS requirement. |

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| comment | *117* comment by: *Rolls-Royce plc*<br><br>**Page 51 Section 4, issue 3, AMC E 25**<br><br>**Comment summary**<br>TBO is often specified also by calendar or running time in addition to cycles. Cyclic test under (6)(a) does not appropriately addresses components affected by running or calendar time rather than number of cycles<br><br>**Suggested resolution**<br>Clarify how calendar time when declared would be substantiated. |
| response | Accepted.<br>An explanation of what means TBO and TBR has been added. This includes the possibility to provide calendar time limitation. We have also clarified that the described TBO/TBR substantiation addresses engine running hours only. Therefore, we have also added as a new sub-paragraph (c) that the applicant may include calendar time in the TBO/TBR to take into account engine degradation factors depending on time such as corrosion, material degradation, etc. |

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| comment | *118* comment by: *Rolls-Royce plc*<br><br>**Page 51 Section 4, issue 3, AMC E 25**<br><br>**Comment summary**<br>Term maintenance programme as used in (6)(b)(iv) is defined by Part M.A.302, ML.A.302 respectively, is based on ICA and requires Competent Authority approval. This is very confusing, as it appears that here it is used for servicing, scheduled inspections interval and associated information.<br><br>**Suggested resolution**<br>Revise proposed text of AMC E 25, by replacing ambiguous terminology that causes confusion. |
| response | Accepted.<br>The term ‘maintenance programme’ has been replaced by ‘instructions for continued airworthiness’. |

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| **Appendix 1 - Impact assessment** | p. 56 |

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| comment | *108* comment by: *Rolls-Royce plc*<br><br>**Pages 46, 56 Section 4, Issue 2, AMC E 930 Appendix 1, section 2, Option 1, Turbine-engine IMP test** |

**Comment summary**
Texts in proposed AMC E 930 (a)(3) and the Appendix 1 to the NPA indicate that EASA understanding or interpretation of difference between On Condition and Hard Time Maintenance may not be aligned with the rest of the aviation industry and regulators

**Suggested resolution**
'The initial maintenance inspection (IMI) approach would be one method that the applicant may use. Other methods would be allowed, in particular on-condition based maintenance programming.' Please clarify what is the difference between the two methods. On condition maintenance may also require inspections in either mandatory or recommended intervals.

response | Please refer to response to comment 107.

**d. Economic impact** p. 58

comment | *27* comment by: *Francis Fagegaltier Services*

On page 59 of the NPA, under the sub-title "ICAO and third country references ....", in issue 1, the words "CS-E 740 on endurance testing is currently broadly harmonised with the equivalent FAR §33.87 rule" seem to be inaccurate ! Otherwise, why would the FAA declare 33.87 as an **FAA Significant Standards Difference ?**

response | Not accepted.
There is an SSD specifically on CS-E 740(f)(ii) vs. 14 CFR 33.87(a)(7) (adjustment of maximum exhaust gas temperature).
https://www.easa.europa.eu/sites/default/files/dfu/EASA%20CS-E_SSD%20List%20%28TIP%20Rev6%29_Turb%20Eng_CS-E%20Am5%20vs%20Part33%20Am34_FINAL.PDF

**e. General Aviation and proportionality issues** p. 60

comment | *53* comment by: *FAA*

Page 60

Referenced Text: "The proposal of this NPA (creation of CS-E 930) will bring about harmonisation with the FAA rule, although it will be more performance based."

Comment: It is not clear how the new CS-E 930 will be more performance based than the FAA rule.

Proposed Resolution: Delete "although it will be more performance based." or clarify

Comment Type: Conceptual

response | Partially accepted.
CS and AMC E 930 allow the applicant to use an IMI method, like considered under FAR 33.90, or other methods in particular on-condition based maintenance

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| programming. The commented sentence of the NPA intended to underline this slight difference between the EASA proposal and the FAA rule. It may be that the term ‘performance based’ is not the most appropriate. In the end CS-E 930 allows to demonstrate a ‘maintenance programme’ and not only a ‘maintenance inspection’. Hence, the CS is less prescriptive on this aspect.<br>Please note that the NPA will not be re-published though. |