 European Aviation Safety Agency	<p style="text-align: center;">Turbine Engines Equivalent Safety Finding <i>Subject: Alternate Endurance Test</i> <i>(CS-E 740)</i></p>	<p style="text-align: right;">Issue: Proposed Page 1 of 2 Date: 08 June 2018</p>
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Subject: ESF – Alternate Endurance Test (CS-E 740)

Requirement Reference: Following CS-E¹ requirements: CS-E 740

¹ CS-E – *Certification Specifications for Engines, Amendment 4, dated 12 March 2015*

Introductory Note:

The following Equivalent Safety Finding (ESF) has been classified as an important ESF and as such shall be subject to public Consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

“2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.”

Statement of Issue

CS-E 740 prescribes endurance test schedules and specifications for Turbine Engines, in order to demonstrate safe continued operation within and up to its declared operating limits.

The Applicant considers that the engine design incorporates new features, materials and technologies such that it impacts the feasibility of conducting the endurance test schedules as prescribed by CS-E 740. The Applicant also considers that significant modifications of the test vehicle would be necessary to achieve the required conditions, such that it would not be representative enough of the type design, and that the test outcome could not be reconciled.

Applicant Proposal:


The Applicant proposes endurance test cycle and conditions, hereby called “alternate endurance test”, that allow the engine to be run in type design configuration, with limited test enabling modifications.

The Applicant also proposes to demonstrate engine durability by addressing the limiting damage mechanism while the engine is operating in service.

EASA Position:

EASA recognises the technological advancements introduced in modern turbine engines, such as higher bypass ratio, higher airflow and pressure ratio, increased secondary air system and cooling complexities. Consequently, applicants have faced increased difficulties to run the endurance test schedules at the conditions prescribed by CS-E 740 (in particular the combined target speed and



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temperature redline conditions), resulting in the need to modify the tested vehicle in order to demonstrate the expected engine operating limitations.

However EASA considers that the architecture and design of the subject engine are still in line with the technologies embedded in recent certified engines. As the endurance test cycle and conditions proposed by the Applicant significantly differ from the prescriptions of CS-E 740, an equivalent level of safety to that provided by CS-E 740 shall be demonstrated.

In order to demonstrate safe continued operation within and up to the declared engine operating limits, it is expected that the Applicant addresses the following aspects:

- All damage mechanisms for component and engine systems shall be exercised, to a level at least equivalent to the “intent of the current CS-E 740 tests”.
 - For all pertinent components, durability/severity criteria associated with these damage mechanisms shall be proposed and justified.
 - The damage levels, and the key contributing parameters, e.g. stresses and temperatures, shall be analysed and provided for the following conditions: The proposed alternate endurance test, the “intent of the current CS-E 740 test” and, when applicable, the actual most severe predicted in-service conditions.
 - The conditions associated with the “intent of the current CS-E 740 test” should achieve maximum metal temperatures and representative thermal response of the pertinent components, associated with a fully deteriorated type design engine reaching Exhaust Gas Temperature (EGT) redline in service. Those should be combined with redline speeds, as prescribed by the current rule.
- The test times and conditions necessary to derive the proposed engine operating limitations (e.g. redlines) shall be proposed and justified. Upon acceptance by the Agency, those will be declared in the EASA Type Certificate Data Sheet (TCDS).
- If test enabling modifications are used, their impact on the test results shall be detailed and found acceptable by the Agency, and reconciled with the type design.

The Applicant may propose additional compensating factors to contribute to the demonstration of the equivalent level of safety.

Any provisions of CS-E 740 that are not covered by the proposed alternate endurance test shall be demonstrated through additional testing or other evidence found acceptable by the Agency.