Proposed Equivalent Safety Finding on CS-E 740 and CS-E 750 – Endurance Test and Engine Starting Tests

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 02/04 dated 30 March 2004, 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 assumes compliance by a single engine test followed by a full engine strip. CS-E 750 Starting test assumes testing will be carried out during the Endurance Test.

The Applicant is proposing to show compliance to the Endurance Test and Starting Test requirements by compiling evidence taken from three separate Endurance Tests of engines for which similarity is claimed each of which deviate however in some aspects from the full intent of the Endurance Test requirement.

FAA determined the method of compliance for Part 33.87 and 33.93 to be an ELoS , EASA propose to reflect this with this Equivalent Safety Finding against CS-E 740 (Endurance Test) and CS-E750 (Starting Tests).

Applicant's Proposal

The Applicant in this case has applied for Validation by EASA of their FAA Certificate of Compliance to Part 33 for the subject engine type.

The Applicant initially intended to show compliance to the Endurance Test requirement by a single engine test. This test (Test 1, see below) was stopped prematurely however due to the loss of all HPT (High Pressure Turbine) airfoils. 95% of running schedule had been completed.

Prior to a second attempt the Applicant developed modifications to address the causes of the initial failure and, with these embodied, completed a successful second Endurance Test (Test 2).

The Applicant proposes however to take some credit from the original test for those parts which have been confirmed to be in a serviceable condition during the piece part inspection, so as to reduce the degree of engine strip necessary to the second Endurance Test.

The Applicant also proposes to take advantage of a previous test (Test 3), prior to the two described above, which, even though run to a lower thrust rating, featured a representative starting demonstration so as to reduce the number of starts necessary for the second Endurance Test.

These proposals, based on similarity of hardware and conditions, were carefully assessed by the FAA, including the incomplete test demonstration for some parts which were piece part inspected but backed up by in-situ inspections from a fully completed second test, and agreed to be acceptable as a finding of Equivalent Level of Safety.

The following table summarises the split of Endurance Test compliance aspects an the applicable source of data:

Requirement	**Data source**
Confirmation that the engine is safe for continued operation following Endurance testing: Full strip inspection of the following: fan, LPC (low pressure compressor) (booster), HPC (high pressure compressor) including the OGV (outlet guide vanes), diffuser, forward outer seal and HPT rotor structure, TCF (turbine centre frame) structure, LPT (low pressure turbine) rotor structure, accessory gearbox, the controls and accessories, and external configuration hardware.	**Test 1***
Confirmation that the engine is safe for continued operation following Endurance testing: Full strip inspection of the following Combustor, nozzle support, and HPT/TCF/LPT flowpath hardware. Visual inspection (assembled condition) and flowpath borescope of: fan, LPC (booster), HPC, including OGV, diffuser, forward outer seal and HPT rotor structure, turbine centre frame structure, LPT rotor structure, accessory gearbox, the controls and accessories, and external configuration hardware.	**Test 2****
Demonstration of engine deterioration to justify the claimed thrust Rating.	**Test 2**
Demonstration of durability of engine bleed systems and percentage bleed flows to be approved.	**Test 2**
Demonstrate satisfactory engine operation and component condition with maximum lubrication oil scavenge temperature conditions and with maximum and minimum lubrication oil supply pressure conditions.	**Test 1**
Demonstrate satisfactory engine starting capability.	**Test 1,Test 2 & Test 3*****
Accessory loading.	**Test 2**

* Test 1 - Completed only 95% of the Endurance Test schedule, but only 57 out of 100 Starts.

** Test 2 - Completed a full Endurance Test schedule but only 73 out of 100 Starts.

***Test 3 - Completed a full Endurance Test schedule but to a lower rating, with the full required 100 Starts.

EASA Position

EASA would support the FAA conclusion in their ELoS and conclude that an Equivalent Level of Safety is achieved when combining the findings, as proposed by the Applicant and described above, of three separate Endurance Tests.