Proposed Equivalent Safety Finding on CS-E 740 – Endurance Test

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 defines the engine Endurance Tests which consist of 25 six-hour stages. Each stage comprises 5 parts. CS-E 740(b)(1) requires: *"The test must be made in the order defined in the appropriate schedule and in suitable non-stop stages. An alternative schedule may be used if it is agreed as being at least as severe. In the event of a stop occurring during any stage, the stage must be repeated unless it is considered to be unnecessary. The complete test may need to be repeated if an excessive number of stops occur."*

Applicant's Proposal

In order to achieve simultaneously the required conditions of rotor speeds and Turbine Entry Temperature (TET) for Take-off (T/O) and Maximum Continuous (MC) in a three shaft engine design, various specific engine configuration changes are necessary for each of these ratings. To carry out the configuration changes between each T/O and MC part of the prescribed schedule would require many mid stage stoppages and be very time consuming.

In order to avoid an excessive number of engine stops during the Endurance Tests, the applicant proposes to revise the test order but to maintain an even distribution of elements by organizing the endurance tests in 3 "blocks". The applicant request the agreement of the Agency.

Applicants Safety Equivalency Demonstration

In order to minimise the number of hardware changes for engine matching purposes, the applicant proposes to separate the T/O and MC Parts but to maintain an even distribution of elements by dividing the endurance tests into three blocks. Each block will contain approximately one third of the Parts of the prescribed CS-E 740 tests schedule. In the applicant's proposal each stage of

the Endurance Tests is not run in accordance with a predefined schedule. The Parts of any stages may be completed in any order or combination within their respective block and a limited overlap zone between adjacent blocks is allowed. Part 2s may be completed in any block. This is detailed in the table in annex of this CRI.

The definitions of the Parts are the ones in CS-E 740.

The following rules will be applied:

1. The tests intent is to run at maximum rotational speed of each spool simultaneously at sea level test bed conditions and at the turbine entry temperatures for which approval is sought;

2. The minimum number of Parts in one block as defined by Table 1 must be completed before running Parts in another block;

3. Each Part is run without interruption;

4. A minimum of seven Part 2 shall be completed before the next block can begin;

5. A maximum of nine Part 2 shall be completed during any block;

6. Each Part 2 is preceded by a 5 minutes period at Ground Idling;

7. Each Part 3 is followed by a 10 minutes period at Ground Idling;

8. Each Part 4 is run as incrementals starting with 10 minutes at Ground Idling;

9. Each Part 5s starts with 4.5 minutes at Ground Idling;

10. Stage 22 low oil pressure parts shall be performed between 120 and 138 hours endurance;

11. Stage 22 Part 2 shall be completed as an incremental Part 2(E);

12. The maximum normal oil pressure stage shall be completed within the 2nd Block with a T/O Part 2(D);

13. To demonstrate the ability of the engine to complete one stage without an oil change (ie non-stop) one complete stage will be run during the first 25 hours of the Endurance Test and one during the last 25 hours;

The following variations may also be applied:

14. Instead of carrying out separate performance calibration tests before and after the Endurance Tests, the Preliminary and Final Calibration may be run as the first and final Part 4 extended to include a T/O thrust point.

EASA proposes that the “blocking” does not reduce the severity of the Endurance Tests and provides an Equivalent Safety Finding with CS-E 740.

Annexe – Table 1 - Endurance Tests Block Definition

Stage	Part 1	Part 2 (*)	Part 3	Part 4	Part 5	Remark
1	X	X / Y / Z	X	X	X	
2	X	X / Y / Z	X	X	X	
3	X	X / Y / Z	X	X	X	Bleeds in operation
4	X	X / Y / Z	X	X	X	
5	X	X / Y / Z	X	X	X	
6	X	X / Y / Z	X	X	X	
7	X / Y	X / Y / Z	X / Y	X / Y	X / Y	Bleeds in operation
8	X / Y	X / Y / Z	X / Y	X / Y	X / Y	
9	X / Y	X / Y / Z	X / Y	X / Y	X / Y	
10	Y	X / Y / Z	Y	Y	Y	
11	Y	X / Y / Z	Y	Y	Y	
12	Y	X / Y / Z	Y	Y	Y	
13	Y	X / Y / Z	Y	Y	Y	Bleeds in operation
14	Y	X / Y / Z	Y	Y	Y	
15	Y	Y	Y	Y	Y	Maximum oil pressure
16	Y / Z	X / Y / Z	Y / Z	Y / Z	Y / Z	
17	Y / Z	X / Y / Z	Y / Z	Y / Z	Y / Z	Bleeds in operation
18	Y / Z	X / Y / Z	Y / Z	Y / Z	Y / Z	
19	Z	X / Y / Z	Z	Z	Z	
20	Z	X / Y / Z	Z	Z	Z	
21	Z	X / Y / Z	Z	Z	Z	
22	Z	Z	Z	Z	Z	Minimum oil pressure
23	Z	X / Y / Z	Z	Z	Z	Bleeds in operation
24	Z	X / Y / Z	Z	Z	Z	
25	Z	X / Y / Z	Z	Z	Z	

(*) Part 2 can be run as either a Part 2(C) (10 each), 2(D) (5 each), or 2(E) (10 each) subject to items 4, 5, 6, 10,11 and 12 in the EASA position.

X identifies Parts belonging to the first block of the Endurance Tests.

Y identifies Parts belonging to the second block of the Endurance Tests.

Z identifies Parts belonging to the third block of the Endurance Tests.