

Equivalent Safety Finding on CS-E 40 – Ratings, CS-E 60 - Provision for Instruments and CS-E 740 – Endurance Tests

1 Introductory Note

The following Equivalent Safety Finding (ESF) has been classified as an important ESF and as such has been 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".

2 Statement of Issue

The applicant has identified the presence of a transient over-temperature "thermal bloom", of varying duration and magnitude, that can exceed the declared Max take-off (MTO) steady state Inter Turbine Temperature (ITT) limit for up to 2 minutes and 12°C, under the combination of the following conditions:

- One engine out automatic power reserve (APR), or emergency dual engine manual power reserve (MPR) operation.
- Deteriorated condition. Engine is near end of life.
- Above hot day breakpoint ambient conditions (> ISA+18.9°C).
- Certain combinations of other initial engine conditions prior to the snap acceleration that produce a maximum thermal transient in duration and magnitude.

Although no dedicated certification activity was agreed for the formal approval of this transient over-temperature, which is not published in the engine Type Certification Data Sheet (TCDS), an algorithm is built into the Engine Electronic Control Unit (ECU) software to trim the ITT values during this type of transient before they are displayed to the pilot. Therefore, the pilot will not be aware of the ITT over-temperature transient above the approved limits caused by this type of transient.

CS-E 40(e) requires that the Engine's rated Powers/Thrusts and any operating limitations established under CS-E 40 which must be respected by the crew of an aircraft must be listed in the Engine Type certificate data sheet specified in 21.A.41.

CS-E 60(a) states that “Provision must be made for the installation of instrumentation necessary to ensure operation in compliance with the Engine operating limitations....”

CS-E 740(f)(4)(iii) establishes the testing required to approve a transient over-temperature in excess of that for steady state running, with a time limitation of 2 minutes.

3 Applicant's Proposal

CS-E 40: It is not required for the crew to respect the steady state temperature limit exceedance caused by this type of transient, under the conditions and limitations established by the proposed compensating factors.

CS-E 60: The lack of ITT exceedance display to the pilot is acceptable, under the conditions and limitations established by the proposed compensating factors.

CS-E 740: For the specified transient, an approval of the over-temperature transient is not required, based on the combination of low probability of occurrence, maintenance actions after each occurrence, and appropriate testing, as described by the proposed compensating factors.

4 Applicants Safety Equivalency Demonstration

- a). The Engine manuals will be revised to incorporate evaluation criteria and appropriate maintenance action instructions after an APR/MPR use to ensure that the over-temperature transient will be limited to its use in one flight after which appropriate maintenance action will be taken. These maintenance instructions will be agreed with the EASA. Instructions to perform maintenance action after APR/MPR use will be provided to the Aircraft manufacturer via engine installation manual as required by CS-E 20(d). The engine installation documents will enable the Aircraft manufacturer to display appropriate indications to prevent dispatch and point to the required maintenance action to be accomplished.
- b) The over-temperature transient will be defined by its max. expected value and max. expected duration, based on validated data.
- c) The applicant will show that the amount of testing above the certified MTO ITT limit is sufficiently extensive to conservatively demonstrate the durability of the turbine assembly for a number of periods of 2 minutes. The applicant will show that this number of periods will not be exceeded in a single flight. At least this number of periods of continuous testing of at least 2 minutes each will be demonstrated by test at an ITT equal to or higher than the proposed transient ITT which is above the existing ITT redline noted in the Engine TCDS. The condition of the Engine will be shown to be satisfactory for safe continued operation after the test.
- d) The lack of ITT exceedance display to the pilot is acceptable provided that the exposure is limited to one flight after which appropriate maintenance action will be taken, as ensured by point a) above, and successful testing is demonstrated as specified on point c).

5 EASA Position

The EASA agrees with the proposal of the applicant which has been modified with inputs from the public consultation (see Comment Response Document for more information).