CS-E AMENDMENT 2 - CHANGE INFORMATION

The Agency publishes amendments to Certification Specifications as consolidated documents. These documents are used for establishing the certification basis for applications made after the date of entry into force of the amendment.

Consequently, except for a note “Amdt. E/2” under the amended paragraph, the consolidated text of CS-E does not allow readers to see the detailed changes introduced by the new amendment. To allow readers to also see these detailed changes this document has been created. The same format as for publication of Notices of Proposed Amendments has been used to show the changes:

1. text not affected by the new amendment remains the same: unchanged
2. deleted text is shown with a strike through: ~~deleted~~
3. new text is highlighted with grey shading: new
4. ....
   Indicates that remaining text is unchanged in front of or following the reflected amendment.
   ....

1. **<u>Improvement of formatting</u>**
Creation of separate page numbering for each subpart to improve readability.

2. **<u>Add AMC E 520(c)(2) to the contents of CS-E as follows:</u>**

CONTENTS (General lay-out)

…

CS-E BOOK 2 - ACCEPTABLE MEANS OF COMPLIANCE

…

SUBPART D – TURBINE ENGINES; DESIGN AND CONSTRUCTION

…

Book 1 Airworthiness Code

SUBPART A - GENERAL

3. **<u>Editorial correction to CS-E 15(d) to re-introduce the following definitions:</u>**

CS-E 15 Terminology

…

(d) For piston Engines

…

Critical Altitude	means the maximum attitude at which, in standard atmosphere, it is possible to maintain, at a specified rotational speed without ram, a specified power or a specified manifold pressure. Unless otherwise stated, the critical altitude is the maximum altitude at which it is possible to maintain, without ram, at the maximum continuous rotational speed, one of the following: a. The maximum continuous power, in the case of engines for which this power rating is the same at sea level and at the rated altitude.

	b. The maximum continuous rated manifold pressure, in the case of engines the maximum continuous power of which is governed by a constant manifold pressure.

…

Maximum Best Economy Cruising Power Conditions	means the crankshaft rotational speed, Engine manifold pressure and any other parameters recommended in the Engine manuals as appropriate for use with economical-cruising mixture strength.
Maximum Recommended Cruising Power Conditions	means the crankshaft rotational speed, Engine manifold pressure and any other parameters recommended in the Engine manuals as appropriate for cruising operation.

SUBPART D - TURBINE ENGINES; DESIGN AND CONSTRUCTION

4. Revise CS-E 520 to read:

CS-E 520 Strength

(a) …

(b) …

(c) (1) …

(2) Validated data (from analysis or test or both) must be established and provided for the purpose of enabling each aircraft constructor to ascertain the forces that could be imposed on the aircraft structure and systems as a consequence of out-of-balance running and during any continued rotation with rotor unbalance after shutdown of the Engine following the occurrence of blade Failure as demonstrated in compliance with CS-E 810. If the Failure of a shaft, bearing or bearing support or bird strike event, as required under CS-E 800, result in higher forces being developed, such Failures must also be considered, except for bird strike in relation to continued out-of-balance running. ~~The data must include, but is not limited to, the relevant out-of-balance forces and Engine stiffnesses, together with the expected variations with time of the rotational speed(s) of the Engine's main rotating system(s) after blade Failure.~~ (See AMC E 520(c)(2))

(d) …

Book 2 Acceptable Means of Compliance

SUBPART A - GENERAL

5. Editorial correction to AMC E 140 to read:

AMC E 140
Test-Engine configuration

For turbine engines, if the power turbine accessory drives are not loaded, the equivalent power should be added as required by CS-E 140 (d)(1~~3~~) to the required power at the output drive so that the power turbine rotor assembly is operated at or above the same level as it would be if the power turbine accessory drives were loaded.

SUBPART D - TURBINE ENGINES; DESIGN AND CONSTRUCTION

6. Add a new AMC E 520(c)(2) to read:

AMC E 520(c)(2)
Engine Model Validation

(1) Validated data specifically for blade loss analysis typically include:

- Finite element model
- Out-of-balance,
- component failure,
- rubs (blade-to-casing, and intershaft),
- resulting stiffness changes,
- aerodynamic effects, such as thrust loss and engine surge, and
- variations with time of the rotational speed(s) of the Engine's main rotating system(s) after failure.

(2) Manufacturers whose engines fail the rotor support structure by design during the blade loss event should also evaluate the effect of the loss of support on engine structural response.

(3) The model should be validated based on vibration tests and results of the blade loss test required for compliance with CS-E 810, giving due allowance for the effects of the test mount structure. The model should be capable of accurately predicting the transient loads from blade release through run-down to steady state. In cases where compliance with CS-E 810 is granted by similarity instead of test, the model should be correlated to prior experience.

(4) Validation of the engine model static structure is achieved by a combination of engine and component tests, which include structural tests on major load path components, or by analysis, or both. The adequacy of the engine model to predict rotor critical speeds and forced response behaviour is verified by measuring engine vibratory response when imbalances are added to the fan and other rotors (See CS-E 650). Vibration data is routinely monitored on a number of engines during the engine development cycle, thereby providing a solid basis for model correlation.

(5) Correlation of the model against the CS-E 810 blade loss engine test is a demonstration that the model accurately represents:

- initial blade release event loads,
- any rundown resonant response behaviour,
- frequencies,
- failure sequences, and
- general engine movements and displacements.

(6) To enable this correlation to be performed, instrumentation of the blade loss engine test should be used (e.g., use of high-speed cinema and video cameras, accelerometers, strain gauges, continuity wires, and shaft speed tachometers). This instrumentation should be capable of measuring loads on the engine attachment structure.

(7) The airframe and engine manufacturers should mutually agree upon the definition of the model, based on test and experience.