European Aviation Safety Agency
Rulemaking Directorate

EXPLANATORY NOTE

CS-25 Amendment 8

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1. GENERAL

Executive Director Decision 2009/017/R amends Decision No 2003/02/RM of 17 October 2003 (CS-25 Initial Issue) as last amended by Executive Director Decision 2009/013/R of 14 October 2009 (CS-25 Amendment 7). It represents Amendment 8 of CS-25 Large Aeroplanes, and incorporates the output from the following EASA rulemaking tasks:

Rulemaking Task No.	TITLE	NPA No.
25.041	Class B/F Cargo Compartment	2008-10
25.015/25.016	Engine & Auxiliary Power Unit (APU) Failure Loads And Sustained Engine Windmilling	2007-15

Each Notice of Proposed Amendment (NPA) has been subject to consultation in accordance with Article 52 of the Basic Regulation[1] and Article 15 of the Rulemaking Procedure established by the Management Board[2]. For detailed information on the proposed changes and their justification please consult the above NPAs which are available on the Agency's website.

The Agency has addressed and responded to the comments received on each of the NPAs. The responses are contained in a comment-response document (CRD) which has been produced for each NPA (CRDs 2008-10, 2007-15) and which are also available on the Agency's web-site.

[1] Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC. OJ L 79, 19.03.2008, p. 1

[2] Management Board decision concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ("Rulemaking Procedure"), EASA MB 08-2007-03, 13.6.2007.

2. CRD REACTIONS

- In response to the CRD 2008-10, the Agency received the following substantive reactions, which are reproduced below together with the Agency's responses:

CRD Reaction No.	Commenter	Reaction	EASA Response
1	**JJ. Machon, JMJ Consulting**	**Response to** (SC9) **comment # 44, (c)** : "… *a minimum required testing with Class A & class B fires seems to be appropriate*." The following questions result and are requested to be clarified : (1) Would the Class B fire test method described in § 4.3.3 and Fig. 7 of DOT/FAA/AR/TN05-20 Technical Note, "*Minimum performance standard for aircraft cargo compartment Halon replacement fire suppression systems*", be considered appropriate ? (2) Would separate tests for Class A and Class B appear appropriate, or a simultaneous test with Class A and Class B fires in the same unit (the results of which would be more ambiguous to analyse) be required ?	Noted. On initial consideration the Agency agrees that the referenced Class B fire threat is a sensible start point for the development of a FCC standard. However, as stated in the CRD, the Agency is of the opinion that test data and experience is required before a more definitive position can be established. Again, until testing experience has been gained, the Agency does not feel that such questions can be answered with satisfactory confidence. An empirical testing approach, exploring aspects such as that mentioned (i.e simultaneous fires of different Classes) is expected for at least the initial design approval applications.
2	**JJ. Machon, JMJ Consulting**	**Response to** (Boeing) **comment # 13 :** "…their [the pallets'] fitment can be assured by the provision of a modified interface with the compartment floor." (1) TC20/SC9 has found no physical means (except possibly RFID tags) that could be incorporated into FCCs to discriminate as suggested by the comment. This statement implies that only a special variant of pallet might be allowed in a Class F compartment, defeating essential universal pallets interchangeability while the existing pallets were successfully tested, and the FCC - not the pallet - would ensure fire safety, so that identifying a pallet alone would not provide a guarantee. Clarification is requested. (2) It is thus suggested to delete, in the AMC's new § at the end of 5.b.(2), the words "physical "and "floor ", unless such means are fully identified, to retain only "… not be	Partially accepted It is expected that design features to allow only a special variant of pallet in a Class F compartment will only be required if it cannot be shown that all standard pallets designs provide sufficient protection from burnthrough and heat transfer. This sentence in the AMC was not intended to exclude other design means that achieve the same end result (e.g. a RFID based solution as mentioned may be found

		limited to, features at the container/pallet to cargo compartment interface…", in order to fit, e.g., a RFID solution (neither physical, nor floor).	acceptable). The text "Means may include … but not be limited to …" was chosen with this intent in mind. However, the Agency agrees that perhaps better clarity can be achieved through a revision. However, the proposed revision perhaps does not provide clarity (e.g. is a RFID solution located at the "interface"?). The reference AMC text will be revised to read in full (AMC to 25.857 5. b. (2)): "…. Class F cargo compartment designs which rely on fire containment, e.g. fire hardened containers/pallets and/or FCCs (placed over palletised loads or non-fire hardened containers) should be considered in regards to the possibility of incorrect usage. All practicable means to prevent the carriage of cargo in standard containers or pallets (if special pallets are required) and/or the omission of FCCs, should be incorporated. Means may include, but not be limited to, physical features at the container/pallet to cargo compartment floor interface, operational procedures such as requiring aircraft crew verification of cargo loading before every flight or a suitable detection system that would warn the aircraft crew in the event a non authorised cargo configuration has been loaded." As already replied in the CRD and above, the Agency is receptive to the concept of a warning system, as opposed to a physical barrier to loading unauthorised cargo configurations. It is understood that practicalities such as the carriage of obviously non-flammable items, which will require no special fire protection means, may make such solutions attractive. The Agency sees operational procedures as falling into this category, as well as proposals such as the RFID based solution mentioned. The point made about the possibility of a warning being ignored is a
		(3) Regardless of the means, non-fireproof containers or pallets without an FCC will remain allowed (see AMC § 5.b.(2) Class F) for "obviously non-flammable items". Thus the absence of any "physical" feature required on containers or FCCs can only be used as a warning : it must not prevent a unit without this feature from being loaded. This warning might be ignored : back, anyway, to required operational	

			concern already identified by the Agency. In order that overall safety is maintained at a level comparable to that achieved with other classes of cargo compartment the Agency at this time envisages that a warning based solution will only be acceptable if it assures a clear warning to a member of the aircraft's crew.
3	**JJ. Machon, JMJ Consulting**	**Response to** (IATA) **comment # 21** : "… *the effects of a rapid loss of aircraft pressurization must be assessed* …" This response refers to rapid decompression (a very rare event), but does not address normal pressure balancing during climb and descent (which occurs on all flights). This requires that any container must have minimum air venting openings (see ISO 11242 standard), and a pallet's venting capability is limited only by imperfect closure of an FCC bottom around its periphery. The key question seems to be : if a fire is contained by a container or an FCC, is there a risk of fire flare up during descent, as evidenced by recorded Class E accidents (in a considerably larger air volume)? TC20/SC9 believes this is limited - specially within FCCs - by the free inner volume, resulting in slow entry of at most 25% of that free inner volume in outside air, so that the risk of flare up should not exist except if an FCC was largely open. It further estimates, at this stage, that testing in a ground pressure environment with a defined air venting area (same as DOT/FAA/AR/TN05-20 methods) is a worst case which would at least partly reflect descent, otherwise difficult to simulate in a ground test. EASA concurrence or comments would be appreciated.	Noted. The question of additional air being drawn into a FCC was considered by the rulemaking group. This can be by the normal pressure balancing during descent but will probably also occur due to the effects of a fire itself. In the latter case, the initial heat output of the fire heats the internal air and thus some will leak out of the same imperfect sealing of the FCC that is needed for the normal climb/descent air transfer. With the fire starved of oxygen, cooling occurs and air is thus drawn in to equalise the pressure. Some increase in the fire activity may then occur and the cycle be repeated. This cycling has been observed in FCC tests at ground ambient pressure witnessed by the Agency. The degree by which the detected fire activity increased during a cycle was small and because such an increase will be less than the initial combustion, the FCC will easily continue to protect the aircraft and occupants for as long as the cycling may continue. The effect of air ingestion during aircraft descent after a fire can be considered as making the overall oxygen available for combustion no worse than if the fire started and continued at ground level, which of course must be shown to be safe anyway. The Agency feels at this time that any additional effects of ventilation around the FCC in the Class F cargo compartment that may help FCC air ingestion are likely to be insignificant.

			Therefore, and taking all of the above into account, the Agency is of the opinion that tests at ground ambient conditions, with a simple external ventilation requirement (outside or in a normally ventilated room of no more than X cubic metres would be a simple definition perhaps) will probably be acceptable for the FCC certification standard. A specialised test chamber, with a defined ventilation rate, as required in the referenced DOT/FAA MPS, is unlikely to be justified as a requirement for a FCC test standard. However, it must be repeated that acceptable confidence in the assumptions discussed above will require some development testing of various configurations. The Agency does not believe that an acceptable test standard can be developed from theoretical considerations and calculations alone.

- In response to the CRD 2007-15, the Agency received the following substantive reactions, which are reproduced below together with the Agency's responses:

CRD Reaction No.	**Commenter**	**Reaction**	**EASA Response**
5	Francis Fagegaltier Services	If we understand the response correctly, the EASA position is that the likelihood of suffering a 1 IDF condition and having to complete a diversion of greater than 180mins is considered Extremely Improbable. There is, therefore, no requirement under CS-25.1309 for the Aircraft Constructor to demonstrate acceptable aircraft characteristics for such events since the Aircraft Catastrophic effect will occur at an acceptably low rate. This was the conclusion of a substantial effort expended by both Industry and Authorities in developing FAA AC25-24. However, this seems contrary to the Engine regulation (CS-E525): *If any of the Engine's main rotating systems will continue to rotate after the Engine is shutdown* ***for any reason while in flight****, and means to prevent that continued rotation, are not provided, any continued rotation* ***during the maximum period of flight*** *and in the*	Partially Accepted The duration of the windmilling event to be considered should cover the expected diversion time of the aeroplane. In the event that the diversion time exceeds 180 minutes then, for a 1 IDF failure condition, it has been determined based on service data that this equates to a probability of less than 10^{-9} /flight hour. The failure condition is therefore extremely improbable and consideration of diversion times greater than 180 minutes is unnecessary as the failure condition is so unlikely to occur during the entire operational life of the fleet. This was the position taken by the WG who developed these proposals and is fully harmonised with FAA.

		flight conditions expected to occur with that Engine inoperative must not result in effects that would be unacceptable under CS-E 510. …and its associated advisory material (AMC E525): *Conditions that should be considered and addressed…should include… Rotor unbalance resulting from* ***blade loss and subsequent rotor damage****. Consideration should be given to* ***extended periods of continued rotation*** *under these conditions in conjunction with the assumed flight envelope with one Engine shut down, including, where applicable, supersonic and supersonic to subsonic transition flight conditions.* Unlike the proposed AMC25-24 §5 (c)(1), CS-E525 assumes that the failure (in this instance, a 1 IDF blade release [in accordance with CS-E810]) has already taken place. It is now incumbent on the Engine Applicant to demonstrate that no Engine Hazardous effect occurs (in this case, the most likely effect of concern would be separation of the engine from the airframe) for the full duration of any declared diversion capability, regardless of the likelihood of the event. There appears, therefore, to be a disparity between the obligations of the Engine and Aircraft constructors. This could lead to the unsupportable situation where the Aircraft side of an engine mount has to be designed only to survive <180min diversion at 1 IDF whilst the Engine side of the same mount has to be designed to survive 345min (from a recently Approved example) diversion at 1 IDF. It is not unusual that the engine requirements are set so as to provide some margin but this difference does not seem justifiable. We also note the draft decision amending CS-25 (as proposed in NPA 2008-01) which states… *CS 25.1535 ETOPS approval* *Each applicant seeking approval for ETOPS must:* *(a) Comply with the requirements of CS-25 considering the maximum mission time and the longest diversion time for which approval is being sought…* We would appreciate the Agency's views and advice on:	It is recognised that this approach creates an inconsistency with current engine design philosophy which assumes blade loss as a particular risk (probability=1) and requires the engine applicant to demonstrate that no hazardous engine effects are present throughout the full duration of the diversion. This has developed from an historical difference in approach and will create an additional margin on the engine structure. However, the impact on engine applicants of maintaining this additional margin for diversion times beyond 180 minutes is considered to be insignificant in terms of engine design or costs. For ETOPS approval under proposed CS 25.1535, the windmilling condition is not specifically referenced. However, this will be clarified through a new AMC 25.1535(a). Responding to the specific questions, the following can therefore be summarised: 1) The discrepancy has arisen from an historical difference in approach between engine and airframe regulation. 2) The text of proposed CS 25.1535 will be clarified through an addition to AMC 20-6. 3) The difference is considered to be insignificant in terms of its impact on engine design or costs. 4) See 2).

		1. Whether or not the apparent discrepancies between Engine and Aircraft requirements are genuine and, if so, are felt to be justified (and why). 2. Whether or not the proposed text for CS-25.1535 is consistent with the proposed text for AMC25-24 §5 (c)(1). If the above reveals an inconsistency which is not justified: 3. What action will be taken to reach a position which imposes common/consistent requirements on both Aircraft and Engine constructors? 4. Assuming the Decisions from NPAs 2008-01 and 2007-15 are accepted into the CSs as written, how are these requirements to be interpreted in the meantime?	
27	UK CAA	**Page No:** 14 **Paragraph No:** (5) Systems Integrity (a) **Comment:** The EASA response, to comment 27, does not relate to the proposal. The original comment related to those aircraft for which only the minimum number of systems had been shown to withstand the vibratory environment defined for the imbalance condition. For such aircraft it is essential that no MMEL dispensation is permissible for a system that has been shown to be essential for continued flight. **Justification:** The purpose of NPA 2007-15 is to ensure that CSF&L is not compromised by the vibratory environment associated with the loss of an engine fan blade. The loss of an engine fan blade is considered to be a specific event and not subject to assessment on the basis of probability. The MMEL addresses existing failures, and, if dispatch were permitted with an essential system inoperative, the aircraft would be only one failure, the loss of a fan blade, away from a catastrophic failure condition, thus negating the intent of the NPA. The EASA response considers probabilities, diversion times and additional system failures, none of which are applicable to the subject comment.	Not Accepted The approach adopted in the WG did not consider engine fan blade failure and subsequent sustained engine rotor imbalance as a particular risk, but used a probability approach. Under the MMEL, dispatch with an essential system inoperative is not permitted. Dispatch with part of a redundant essential system inoperative may be permitted, but the remaining elements would still be required to ensure failure is extremely remote and that no single failure could result in loss of function. Therefore the probability of having an imbalance event combined with the defined diversion times is already low (<10-9/flight hour) and consideration of additional system failures is unnecessary.

3. EDITORIAL CORRECTIONS IN CS-25 AMENDMENT 8

Apart from the changes that resulted from the above NPAs, this Amendment 8 of CS-25 also incorporates several changes aiming to remove certain editorial errors and inconsistencies identified. Their description/justification is as follows:

- In book 1 appendix F, the title of Part III, was unintentionally deleted at amendment 6. This amendment 8 reinstates it.
- In addition, an Appendix H typo was corrected.
- In book 2, some AMCs are corrected:

    - Some editorial errors are corrected in AMC 25.703 and AMC 25.1309 when referring to FAR 25, CS-25 or JAR 25.
    - A wrong reference is deleted in AMC 25.735
    - In AMC 25.783, a paragraph of CS 25.783 was reproduced with a missing part of it, which makes it confusing. This is corrected.
    - AMC 25.981 was replaced by AMC 25.981 (a) and (b) (1) and (b) (2) but was erroneously not deleted.