Comment Response Document (CRD)
to Notice of Proposed Amendment (NPA) 21-2005

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE AGENCY

AMENDING
DECISION NO. 2005/06/R OF THE EXECUTIVE DIRECTOR OF THE AGENCY
of 12 December 2005

on Certification Specifications, including airworthiness codes and acceptable means of compliance, for Large Aeroplanes (CS-25)

"FUEL TANK STRUCTURAL INTEGRITY / FUEL TANK ACCESS COVERS"

Explanatory Note

I. General

1. The purpose of the Notice of Proposed Amendment (NPA), dated 12 January 2006 was to envisage amending Decision 2005/06/R of the Executive Director of the Agency of 12 December 2005 on Certification Specifications, including airworthiness codes and acceptable means of compliance, for Large Aeroplanes (CS-25).

II. Consultation

2. The draft Executive Director Decision amending Decision N° 2005/06/R was published on the web site (www.easa.eu.int) on 12 January 2006.

   By the closing date of 23 February 2006, the Agency had received 7 comments from 5 national authorities, professional organisations and private companies.

III. Publication of the CRD

3. All comments received have been acknowledged and incorporated into a Comment Response Document (CRD). This CRD contains a list of all organisations that have provided comments and the answers of the Agency.

4. In responding to comments, a standard terminology has been applied to attest EASA's acceptance of the comment. This terminology is as follows:

   - **Accepted** – The comment is agreed by the Agency and any proposed amendment is wholly transferred to the revised text.
   - **Partially Accepted** – Either the comment is only agreed in part by the Agency, or the comment is agreed by the Agency but any proposed amendment is partially transferred to the revised text.
   - **Noted –** The comment is acknowledged by the Agency but no change to the existing text is considered necessary.
   - **Not Accepted -** The comment is not shared by the Agency

5. The Agency's Decision will be issued at least two months after the publication of this CRD to allow for any possible reactions of stakeholders regarding possible misunderstandings of the comments received and answers provided.

6. Such reactions should be received by EASA not later than **19th August 2006** and should be sent by the following link: CRD@easa.eu.int;

Com-ment #	Para	Commentor	Comment/Justification	Response	Resulting text
1.	General comments	Dassault Aviation	General: Why is it a necessity to modify a text that was discussed during harmonization process with FAA? The rule will another time derives in different texts. This will burden the substantiation work to answer to both regulations. Nevertheless, comments are made in the following paragraphs: CS 25.721 General (a): see 2.1 CS 25.721 General (b): see 2.2 CS 25.963 Fuel tanks: general (e) (2): see 2.3 CS 25.994 Fuel system components: see 2.4 AMC 25.963(d) Fuel Tank Strength in Emergency Landing Conditions: 4. <u>GENERAL</u> c. (i): see 2.5 2. <u>PROPOSED TEXT/ COMMENT</u>:	**Noted.** The EASA NPA text is not substantially changed from the JAA NPA text which reflects the harmonized text achieved with the FAA. It was the FAA who later changed their position towards Fuel Tank Structural Integrity requirements.	No text change.
			2.1 CS 25.721 General (a): Instead of "*The landing gear system must be designed …*", it is proposed to *write* "*The landing gear<u>, if directly attached to a fuel tank</u>, must be designed …*".	**Not accepted.** The proposed text, when adopted, would narrow the applicability of the new rule and certain configurations which should be subject to the new rule would be excluded. This is not the intent.	No text change.
			2.2 CS 25.721 General (b): Instead of "*The aeroplane must be designed to avoid any rupture leading to the spillage …*" , it is proposed to *write* "*The aeroplane must be designed to avoid <u>any fuel tank rupture</u> leading to the spillage …*".	**Not accepted** The proposed text ,when adopted, would narrow the applicability of the new rule and cases which should be subject to the new rule would be excluded. Paragraph 25.994 addresses the subject but may not cover all the cases.	No text change.
			2.3 CS 25.963 Fuel tanks: general (e) (2): Instead of *"All covers must have the capacity …, except that the access covers need not be more resistant than an access cover made from the base fuel tank structural material"* , it is proposed to *write "All covers must have the capacity …, except that the access covers need not be more resistant <u>than the</u>*	**Not accepted** It is the "structural material" which is tested and this was the intent of the new rule Also see the new AMC which is consistent with the new rule.	No text change.

Com-ment #	Para	Commentor	Comment/Justification	Response	Resulting text
			<u>base fuel tank structure</u>" . 2.4 CS 25.994 Fuel system components: Instead of *"Fuel system components in an engine nacelle or in the fuselage …in CS 25.721 (b)"* , it is proposed to write *"Fuel system components in an engine nacelle <u>(for wing mounted engine or configurations where it is likely to come into contact with the ground)</u> or in the fuselage …in CS 25.721 (b<u>) and (c</u>)"*	**Not accepted.** The proposed text when adopted would narrow the applicability of the new rule The proposed text would effectively remove the requirement for conducting a safety assessment for all possible configurations. The related AMC addresses the wing mounted engine configurations specifically.	No text change.
			2.5 AMC 25.963(d) Fuel Tank Strength in Emergency Landing Conditions: 4. <u>GENERAL</u> c. (i): **" VL1 equals to … above standard"** Why not to refer to CS 25.479 (a) where they are defined. Justification: Precision to avoid supplementary work burden.	**Not accepted.** Future rulemaking (see the EASA task 25.028 "Fuel Tank Protection From Debris and Fire") may remove the definition from the CS 25.479 (a) (see the JAA CRD, response to comment No.010, last sentence.	No text change.
2.	Draft Decision Proposal 5 - AMC25.963(d) Chapter 4, paragraph (a) titled *Fuel tank pressure loads*	DGAC France	A) Split paragraph a) into two paragraphs by adding a "(b)" at the beginning of the sentence starting "any internal barriers to free flow…" within the paragraph (a). Consequently renumber current paragraphs (b) to (f) into (c) to (g). B) At the end of paragraph (a) *(and before the new paragraph b) proposed in A) above)*, clarify the rule by adding : • the QUOTE/ENDQUOTE text proposed in **Option A** at the end of the following justification or • the QUOTE/ENDQUOTE text proposed in **Option B** at the end of the following justification,	**Noted.** The specific design case offered for discussion is considered to be sufficiently addressed by the text of 25.963(d) and the associated guidance material, i.e. the text indicates that the first approach (option A) as described in the comment should be taken. Therefore there is no need to amend the text as proposed. If a different means of compliance is being applied to a specific certification program this may become subject of a Certification Review Item (CRI)	No text change.

Comment #	Para	Commentor	Comment/Justification	Response	Resulting text
			once EASA has decided which one of the two options suits its understanding of the rule. Justification: A) paragraph (a) deals with clarification of CS25.963(d)(1), but from the sentence starting with “any internal barriers to free flow…” to the end of the paragraph, there is a clarification to CS25.963(d)(3). It is therefore recommended to create a dedicated paragraph numbered (b). B) It is necessary to clarify the intent of the rule CS25.963(d)(1) for choice of values K. In subparagraph 25.963 (d) (1), various values for K are defined depending on whether the fuel tank is considered to be within the fuselage contour or outside of the fuselage contour. During a ongoing certification program, it has been encountered a design as presented in figure (a) below where the barrier between 2 fuel tanks (one internal to the fuselage and another outside the fuselage) cannot be considered as a solid pressure barrier. Therefore the pressure is considered to be transmitted from the wing fuel tank to the fuselage centre fuel tank. This design leads to difficulties to choose the applicable K: 1. The first approach could then be to consider the 2 fuel tanks as a unique only one for the definition of L and to apply the K for the fuel tank inside the fuselage. For example, for the forward load case and a design similar to figure (a), $L=L_m$ and K=9. This appears to be the most conservative approach in this case. It seems not realistic to apply 9 g to the whole tank. Indeed, the wing part of the tank will		

Com-ment #	Para	Commentor	Comment/Justification	Response	Resulting text
			not be designed to withstand 9g but a lower factor. 2. A second approach is to consider the inside and outside tanks as independent from a hydrostatic point of view and to sum the pressures in each fuel tank by a. considering a conservative interface point for the transmission of the pressure (choice of the point “n” on the figure (a)), b. defining for each fuel tank the length L, and, c. applying to each fuel tank the relevant K. As a conclusion of the above choice and in order to clarify the intent of the rule, one of the following options shall be chosen and be added in AMC 25.963(d), at the end of paragraph 4 a: **Option A**: *QUOTE:* If the barrier between a fuel tank inside the fuselage and a fuel tank outside the fuselage cannot be considered as a solid barrier, then the pressure is transmitted from the outside fuel tank to the inside one. Therefore, the two fuel tanks should be considered as a unique one in the definition of the ultimate hydrostatic design conditions for the inside fuselage. *ENDQUOTE.* **Option B**: *QUOTE:* If the barrier between a fuel tank inside the fuselage and a fuel tank outside the fuselage cannot be considered as a solid barrier, then the pressure is transmitted from the outside fuel tank to the inside one. Therefore, the ultimate hydrostatic design conditions for the inside fuselage will be found by defining a conservative frontier between the two tanks and from this frontier, compute the pressure in the inside fuel tank by adding the impact of the pressure		

Com-ment #	Para	Commentor	Comment/Justification	Response	Resulting text
			in the outside fuel tank, taking into account the respective L and K for each fuel tank. The figure (a) illustrates this approach and the formula below: pressure(m) = ρ.g * $n_{OUTSIDE}$ *L_n + ρ.g * n_{INSIDE} * (L_m - L_n) [Figure (a) moved to Appendix 1] *ENDQUOTE*		
3.	General comments	CAA-UK	The original JAA NPA went through a comment/response process, and the results of that are listed in the Appendix to this EASA NPA. It is noted that whilst some comments were taken on board, many were not on the basis that further work would be undertaken by EASA under the 2007-2010 Workplan. Most comments were from CAA and FAA. One aspect that CAA felt strongly about was the lack of a requirement in this NPA to properly establish the fire resistant requirements of the fuel tank structure around the tank access covers. The requirement establishes a Fire Resistant standard for the covers but then accepts that these need not be Fire Resistant if the surrounding structure is not. This is considered to be OK for ‘conventional’ aluminium structures but of some doubt for likely plastic aircraft of the future. This concern is outlined in some detail in FAA comment 015 and will be the subject of further work per the Workplan. It is also interesting to note that in a recent B787 Issue Paper, FAA have required that more massive debris beyond that defined in this NPA for engine and tyre (and corresponding current AC) must be considered – and then assess the effects of fuel leakage. Therefore, the CAA wishes to stress to the Agency the need and urgency to complete a harmonized set of rules.	**Noted.** The Agency plans to further address the issue and to reach a better harmonized text during completion of the EASA task 25.028 “Fuel Tank Protection From Debris and Fire”.	No text change.

Com-ment #	Para	Commentor	Comment/Justification	Response	Resulting text
			Justification: Harmonization		
4.	Draft Decision AMC 25/963(d) Paragraph 4 'General'	CAA-UK	Neither the text nor the examples given address the situation where the centre fuel tank inside the fuselage (subject to 9g) and outboard fuel tanks (subject to 4.5g) are effectively one tank because the fuel flow between the tanks fills the air gap in the downstream cell in less than the 0.5 second criteria of paragraph 4(a)(2). This makes the calculation of the hydrostatic head and the pressure design factor K unclear when analysing the centre section fuel cell. Is it correct to use the full combined head of both cells multiplied by a factor K=9, or some combination of hydrostatic head and pressure factor? Justification: Clarification	**Noted.** The specific design case offered for discussion is considered to be sufficiently addressed by the text of 25.963(d) and the associated guidance material, i.e. the text indicates that the first approach (option A) as described in the comment should be taken. Therefore there is no need to amend the text as proposed. If a different means of compliance is being applied to a specific certification program this may become subject of a Certification Review Item (CRI).	No text change.
5.	Draft Decision AMC 25.963 (e) Paragraph 3 'Impact Resistance'	CAA-UK	The first sentence of paragraph (a) identifies three sources of damage (tyre fragments, engine debris, other likely debris). The description of the damage trajectory models in paragraphs (b)(i) and (b)(ii) address the tyre debris and the engine debris but not the 'other likely debris'. We have assumed this to be describing FOD, (e.g. stones etc. on the runway that may be thrown up by the tyres). For wing mounted engines, the engine debris model may cover the FOD threat, but this would not be the case for rear fuselage mounted engines. What model should be used then, for the 'other likely debris'? Justification: Clarification	**Noted.** See comment No. 011 in the JAA CRD. The Agency plans to address the issue further, see response to comment No. 3 in this CRD.	No text change.

Com-ment #	Para	Commentor	Comment/Justification	Response	Resulting text
6.	General comments	Austro Control	Austro Control is fully supporting this NPA.	**Noted.**	No text change.
7.	General comments Paragraphs 25.561, 25.721, 25.963,	FAA	The FAA notes that it had commented to this same proposal (NPA 25E-304) at an earlier date. These comments are included Appendix II of the current proposal along with the EASA disposition. EASA did not accept any changes we recommended. Additionally, FAA does not agree with the EASA disposition of our comments. Therefore, these comments are also valid for NPA-21-2005. We look forward to working with EASA in the future to settle these technical disagreements. See earlier FAA comments to this proposal [Appendix 2] Justification: See earlier FAA comments to this proposal [Appendix 2]	**Noted.** See the reply to comments No. 14 and 15 in the JAA CRD.	No text change.

Appendix 1

Figure attached to comment from DGAC France

$pressure(m) = \rho.g * n_{OUTSIDE} * L_n + \rho.g * n_{INSIDE} * (L_m - L_n)$

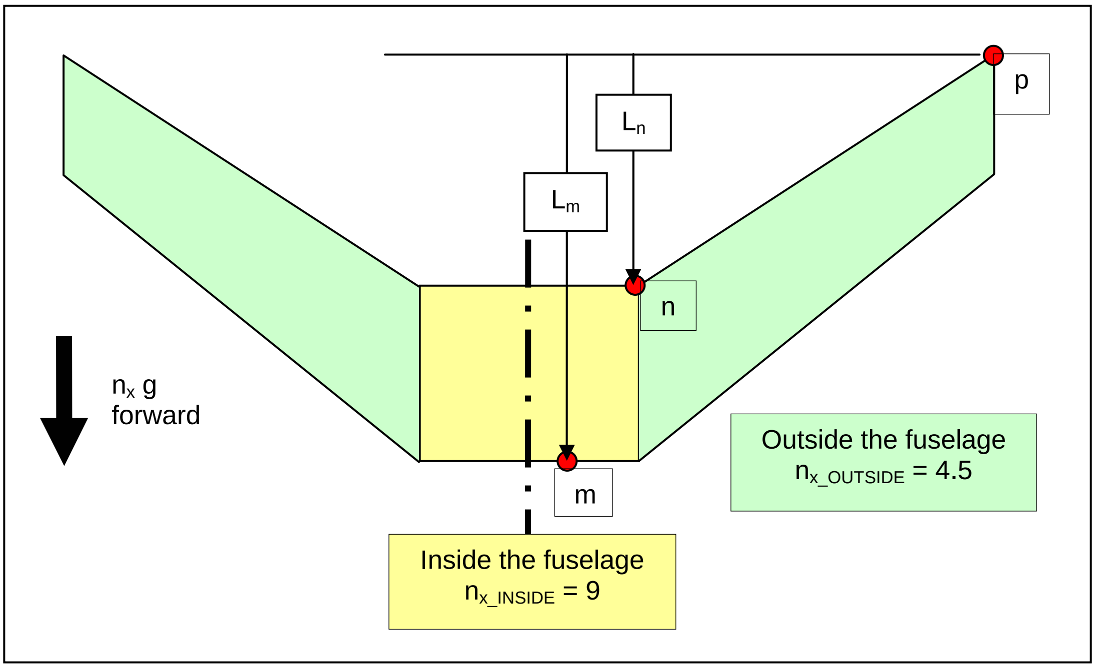

Figure a: Transmission of pressure from a fuel tank outside the fuselage and a fuel tank inside the fuselage (example with a forward load case)

Appendix 2

FAA Comments to JAA NPA 25E-304

FAA comments on NPA 25E-304, Fuel Tank Structural Integrity/Fuel Tank Access Covers

Fuel Tank Structural Integrity
The FAA participated in the ARAC development of the fuel tank structural integrity proposal, and plans to propose similar requirements and advisory material as found in NPA 25E-304. Like the JAA, the FAA believes the ARAC proposal represents a significant improvement over the existing regulations and advisory material. However, recent certification projects have indicated certain deficiencies in the ARAC proposal, as indicated in the FAA comments below.

JAR 25.561: The FAA concurs with the proposed amendment to JAR 25.561.

JAR 25.721: The FAA supports the proposed amendment to JAR 25.721, but believes that additional criteria are needed to address landing gear failures. The proposed JAR 25.721(a) would be considered a local design criterion to protect fuel tanks from rupture and puncture due to the failure of any landing gear unit and its supports. Compliance to this requirement may be considered assuming that all other landing gear units are extended and do not fail. The FAA believes, however, that this does not adequately address multiple landing gear failures, which have occurred in service. Therefore, the FAA believes that an additional requirement is necessary to ensure that fuel tanks are designed and located to withstand failures of any one or more landing gears.

JAR 25.963(d): The FAA believes the clause "so far as is practical" should be deleted from the first sentence of the proposed JAR 25.963(d).

Also in reference to the first sentence of the proposed JAR 25.963(d), the FAA believes that "emergency landing conditions" should be changed to "ground impact conditions." Specifying "ground impact conditions" would not only require consideration of a wheels up landing on a paved runway, as described in the proposed JAR 25.721(b), but would also require consideration of off-runway events, such as RTO overruns.

While the FAA recognizes that off-runway events cannot be quantified in terms of specific structural loading criteria, we believe that certain design principles and precautions can be incorporated in the fuel tank design that would greatly improve the capability to withstand these events. For example, the use of internal bladders and structural crush zones, and the consideration of fuselage break points are all ways to reduce the likelihood of a fuel tank rupture during an off-runway event.

FAA Advisory Circular 25-8, "Auxiliary Fuel System Installation", dated May 2, 1986, provides design considerations for auxiliary fuel tanks, and includes criteria for structural integrity and crashworthiness. The FAA believes that the guidance material in this AC is largely applicable to any fuel tank, and that the structural integrity and crashworthiness provisions should be included, as appropriate, in the proposed ACJ 25.963.

JAR 25.994: The FAA concurs with the proposed amendment to JAR 25.994.

Fuel Tank Access Covers
The ARAC recommendation is to incorporate wording directly into the rule (FAR/JAR 25.963(d)) that would allow the fuel tank access panels to be "equivalent to the adjacent / surrounding skin," rather than meet the fire resistant standard stated in the current FAR. This proposal is a step backward in fuel tank safety, particularly in the post crash fire environment.

The current transport fleet post crash safety record is based upon use of aluminum structures. These structures conduct heat well and are "fire resistant" as defined in FAR 1.1. The fire resistance requirement in FAR 25.963 was introduced because of the use of nylon fuel tank access panels by one manufacturer. These panels suffered severe damage when exposed to underwing fires.. The doors were

replaced with cast aluminum doors to provide appropriate fire resistance. The impact resistance of fuel tank panels made of cast aluminum, however, was found to cause a safety concern. Therefore the cast aluminum doors were replaced by doors with improved impact resistance in areas of the wing exposed to tire and uncontained engine debris. Section 25.963 was amended to require both fire resistance and impact resistance for fuel tank access panels. While this rulemaking addressed the adverse service experience of conventional transport airplanes with fuel tank structures that made of impact and fire resistant aluminum, the FAA did not foresee the future use of composite structures nor possible development of non conventional delta wing designs that may significantly reduce the inherent safety of conventional fuel tank designs. Looking back, §25.963 should establish an objective standard for fuel tanks integrity for impact and fire resistance.
The Concorde and other accidents have highlighted the safety implications of damage to fuel tanks from debris or fire. The delta wing design of the Concorde allows the use of lower wing skins made of 1.2 mm titanium. While this material offers excellent fire resistance, the impact resistance was found to be inadequate. The British Midlands 737 event also underscores the need to provide impact resistance for fuel tanks.

In addition, the evolution of airplane structures has resulted in the use of new materials for fuel tank structures. One aspect of these new materials is a possible lessening of their resistance to fire. (e.g. composite horizontal stabilizer fuel tanks.)

Based upon the use of new materials and the need to assure fuel tank integrity from both fire and impact damage, the FAA position is that the current FAR 25.963 requirement for the fuel tank access panels to be impact and fire resistant should be applied to the entire external surfaces of the fuel tank. The harmonized rule should not reduce the current level of safety and allow use of doors made of materials that do not meet fire resistance standards, as defined in FAR/JAR Part 1. The FAA intends to apply special conditions to future airplane designs requiring that both impact resistance and fire resistance are addressed on fuel tanks located in the wing and stabilizer, etc. so that the level of safety achieved by the current transport fleet is not inadvertently reduced by introduction of newer technology materials, or the evolution of airplane designs such as the “Sonic Cruiser”.