# Fuel tank safety

## Flammability Reduction





## Flammability Reduction

- Purpose of the meeting
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- Background
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- Rulemaking task for FRS
- Ignition prevention
- Novelty for civil aviation – reducing flammability
- The FAA NPRM
- Issues
- Comments to FAA
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- Summary-conclusions





## Purpose of the meeting

- Purpose is to exchange views on flammability reduction systems.
- Three presentations are scheduled:
  - EASA
  - Mr des Clers (independant expert)
  - Airbus
- Any other?
- Presentations will be followed by a discusion and summary-conclusions





## Review of conclusions from June 2004 workshop

- The RIA dated June 2004 will be published on the web-site in July.
  - Status: Done
- The revision of this RIA to take into account new elements brought by the FAA NPRM consultation will done by an EASA Rulemaking Group
  - Status: Rulemaking group yet to be set-up
- The EASA will review the results of the study done, at the request of FAA, by the Sandia Laboratory relative to the efficiency of SFAR-88
  - Status: Study is not yet available. EASA does not have the resource to commission an independent one and is not convinced such study be able to provide definitive conclusions. EASA agrees that the influence of the efficiency of SFAR-88 actions is a key issue of cost-benefit analysis.

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## Review of conclusions from June 2004 workshop

- **Keep the communication channels open:**
  - This is likely to take the form of another information meeting with a wider audience including national Authorities after summer.
  - Status: Today's meeting. Meeting information was put on EASA web-site at events
- **AEA offered a Fuel tank Safety focal points for discussions with EASA**
  - Status: offer is acknowledged with thanks. Such focal point would find its natural place in the rulemaking group mentioned above.



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## Background

**Following the Boeing 747 in flight explosion which occurred in July 1996 ('TWA 800'), failures within the fuel system that could result in explosion have attracted a lot of attention.**

**Since 1990, there has been 3 events (a PAL 737-400 in Manila, 1990, TWA 747 in 1996, and a Thai 737-300 in 2001).**

**Subsequently, actions were launched into two directions: ignition prevention and flammability reduction system.**



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## Rulemaking framework for FTS

- The rulemaking framework for such issues is somewhat complex because they need to address generally speaking the following items:
  - Amendment to certification specifications to improve the standards for fuel tank systems. This will address the case of future TC and future amendments to TC/ future STC in accordance to the changed product rule.
  - Requirement to Design Approval Holders (e.g. TC, STC holders) to review their existing design to identify compliance with the amended certification specification
  - Requirements for operators to introduce resulting modifications in individual aircraft and maintenance programme
  - Requirement to install certain systems in aircraft in production and possibly in aircraft in service Attachment 1



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## Rulemaking task for FRS

- **Task 25.056 Inerting/Fuel Tank Safety: updated proposal**
  - **Specific tasks:**
    - Evaluate need to revise the impact assessment in order to take into account new elements brought by the results of the FAA consultation (e.g. economics)
    - Prepare modifications to CS-25 to include requirements for FRS for future airplanes
    - Prepare technical elements for production cut-in around 2008
  - **Schedules**
    - TOR drafting under progress.
    - NPA and draft technical elements for production cut-in 3Q 2006
    - CS Final and technical elements for production cut-in available by 3Q 2007

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## Rulemaking task for FRS

- **Task 25.056 Inerting/Fuel Tank Safety:**
  - **Reactions are welcome on these updated proposals**



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## Ignition prevention

- An ignition prevention effort was launched, re-enforcing the traditional certification approach: keep hazardous sparks and energy sources out of the fuel system.
- FAA published a revised requirement – 25.981 – in FAR 25 Amdt 102, EASA in CS 25 Amdt 1; those requirements have similar intent but differ in some respects.
- Using those revised requirements, FAA and EASA conducted design reviews of in-service aircraft. Those reviews are now nearly finished; the last certification and maintenance issues (including the 'CDCCL' – Critical Design Control Configuration Limitation) are currently being closed.
- EASA has promoted an aggressive AD publication schedule, and is generally ahead of FAA by 18-24 months.



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## The novelty : flammability reduction (1/3)

- The risk of an ignition source appearing in the tanks prompted FAA to investigate reducing the flammability exposure of the air / fuel vapours mixture present within the fuel system, in line with NTSB recommendations.
- In 1998 FAA tasked an ARAC Working Group with studying various alternatives. The ARAC group concluded that at this stage the only viable alternative could be based upon ground inerting, and further research was necessary if FAA wanted to mandate another option.
- In 2000 FAA tasked another group to investigate the detail of ground inerting – it was then judged impractical.
- FAA undertook some research with the intention was to develop a simple system from the existing technology, tailored for civil aviation needs. By assuming that a 12% oxygen concentration prevents ignition and flame propagation into explosion with a pressure rise sufficient to damage aircraft structure, and minimizing (not eliminating) the exposure time to concentrations greater than 12%, in 2002 the FAA was able to propose a more realistic system concept.
- This system concept was disclosed to the industry in the spring of 2002. The system concept was evaluated in flight by both Airbus and Boeing, respectively on an Airbus A320 and a Boeing 747-400.



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## The novelty : flammability reduction (2/3)

- In the course of 2003, Boeing decided to propose this system on new production airplanes, and to make a similar system available for retrofit to in-service aircraft.
- On 17th February 2004, the FAA Administrator announced that the FAA intended to develop rulemaking that would propose requiring the introduction of flammability reduction measures on all affected large transport airplane. The press release also stated that the FAA proposal would also prompt a retrofit of 3 800 Airbus and Boeing airplanes (the US fleet) over 7 years.
- FAA finally published the corresponding NPRM on 18th of November 2005.
- EASA had taken a much simpler view, considering that most of the problem is due to heat transfer to the fuel tank. The necessary energy for ignition to cause an explosion decreases when temperature increases and all recent events occurred on heated tanks. The requirement to minimize flammability by eliminating unnecessary heat transfer into the tanks was induced into CS-25 by Amdt 1.

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## The novelty : flammability reduction (3/3)

- In 2004, EASA/JAA drafted a Regulatory Impact Assessment (RIA) on the subject, extract of the conclusion:-

  *"On the basis of this RIA, it is considered that a production cut-in is justified, with regard to the safety benefit. It is, therefore, recommended that the necessary rulemaking be initiated, as quickly as possible, to require the introduction of FRS into all new production aircraft with high flammability fuel tanks by 2008. At this time, a full retrofit is not considered justified. The additional costs to industry (in addition to the production cut-in costs of FRS) are high when compared to the additional safety benefit in terms of hull losses prevented. However, in the absence of a case for mandating a full retrofit programme, further consideration could be given to a solution based on each affected manufacturer's position for their individual models."*

Note : the RIA did not take into account the FAA NPRM and some of its consequences on costs and benefits.



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## The FAA NPRM (1/2)

- **The NPRM introduces into Part 25 the certification requirements for the Flammability Reductions Means (FRM) in a new Appendix K and rules permitting the determination of the flammability exposure (Appendix L). Those requirements are generally similar to the Special Condition used to certify similar systems on the Boeing 747 and 737, which is harmonised with EASA.**
- **Those requirements would be applicable to future designs, basically requiring a FRM on anything except for aluminium wing tanks. Fuel tanks installed within the fuselage contour or made of non conductive material (composite) would be required to have a FRM.**
- **For in-service aircraft, the NPRM is introducing requirement for operators through changes in Part 91, 121, 125 and 129 (for N-registered airplanes), basically preventing them from operating aircraft with high flammability exposure tanks beyond a certain date. An alternative to the FRM is offered, as fuel tanks can be made 'explosion proof' (able to withstand the effect of an explosion) by embodiment of an Ignition Mitigating Means (IMM) – an unlikely solution.**



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## The FAA NPRM (2/2)

- **As for SFAR 88, this retrofit is applicable to aircraft carrying more than 30 pax or a payload of 7 500 lbs; however, this rule apparently excludes 'airplane designed solely for all-cargo operations'. This affects the centre tanks of Boeing 707, 727, 737, 747, 757, 767, 777 and Airbus A300, A310, A320 and A330/340.**
- **The NPRM defines the date for having the modification, ranging from December 2012 to December 2014. To avoid the classical asymptotic curve toward the final date characterizing retrofits, it is also required that each operator will have retrofitted 50% of its fleet at mid-term.**
- **TC holders are required to develop design solutions, through a new Subpart I introduced into Part 25, dealing with continued airworthiness and safety improvement (not suitable for CS 25).**
- **All TC holders are required to submit a flammability exposure analysis.**
- **Other intermediate conditions apply for current certification projects.**



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## Issues raised

- **The main question is probably: should EASA take a different course from FAA?**
  - **Are the implementation costs justified by the expected safety enhancement?**
  - **Are there any alternatives (e.g. limiting heat input, by reducing pack running on ground)?**
  - **Is the efficiency of the FAA proposed measure sufficient to deal with the risk?**
  - **Could a different course by EASA lead to additional liability / responsibility questions?**
  - **Are the applicability criteria sufficiently justified?:**
    - **passenger versus cargo aeroplanes**
    - **30 pax or 7500 lbs payload**

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## Comments to FAA

- EASA will write to FAA to present its position taking into account the outcome of this meeting



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## Summary-conclusions

- Industry regrets that EASA does not launch a study on the effectiveness of SFAR 88, but maybe industry can commission study itself
- Effectiveness of many aspects of FAA NPRM proposed measures is questioned
- Self-ignition is an issue to be considered in validating the effectiveness
- FAA NPRM generates considerable comments
  - Cost estimates
  - Ground effect
  - Accident rates
  - Effectiveness of SFAR 88
  - Exclusion of freighters
  - Etc.
- RIA should also consider safety of mechanics
- EASA RIA should be updated before closing date of NPRM
- Industry regrets that EASA does not formally comment the FAA NPRM
- EASA will establish its final position towards the extend of retrofit based on the updated RIA
- Harmonisation is essential
- EASA will discuss industry concerns with FAA colleagues
- Industry will formally request EASA to comment on NPRM



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## Attachment 1

- Outline of EASA rulemaking framework for Fuel tank Safety



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## The regulatory framework for fuel tank safety issues

- Design Approval Holder rules:
  - Long term: included in the proposed revision of 1592/2002 to extend EASA scope
    - Proposed revision to article 5 would include in the TC: Syllabus for Maintenance certifying staff type rating, syllabus of pilot type rating, MMEL, additional airworthiness specifications for a given type of operations
    - Task 21.039 of rulemaking inventory: Incorporation of 'operational' issues in Type certificate.
      - NPA scheduled 3 quarter 2006
      - Opinion scheduled 3 quarter 2007.

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## The regulatory framework for fuel tank safety issues

- **Design Approval Holder rules:**
  - **In the meantime:**
    - Use of letters or Airworthiness Directives to request 'reviews' by Design Approval Holders.



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## The regulatory framework for fuel tank safety issues

- **Maintenance rules:**
  - **Maintenance programmes**
    - Part-M M.A.302 requires maintenance programmes to be based on data produced by TC holders, STC holders or organisations required to by Part-21.
    - Anything else requires the approval by the competent authority. In the case of ALIs this is EASA.
  - **Maintenance Data**
    - Part-145 145.A.45 requires AMOs to hold and use current maintenance data.
    - The maintenance instructions can only be modified with the approval of the competent authority.



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## The regulatory framework for fuel tank safety issues

- **Maintenance rules:**
  - **Maintenance Training**
    - Part-145 145.A.30(e) and Part-M M.A.706 require personnel to be competent and this competence to be evaluated in view of their tasks.
    - This is part of the organisation's expositions that is approved by the competent authority.
  - **Control of aircraft configuration**
    - Part-M M.A.301 requires operators to control the configuration of their aircraft and to have an embodiment policy for non mandatory modifications and for repairs
    - Furthermore, M.A.304 requires modifications and repairs to be accomplished in compliance with Part-21. The resulting maintenance data will then become maintenance data that needs approval to be changed.



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## The regulatory framework for fuel tank safety issues

- **Maintenance rules:**
- **Shared responsibility**
  - **In the EU system, the responsibility is shared between the operators, the maintenance organisations and the design organisations.**
  - **The safeguards are already built into the European structure and it is not planned to redistribute the responsibilities.**