



NOTICE OF PROPOSED AMENDMENT (NPA) No 2008-10

**DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN AVIATION
SAFETY AGENCY**

AMENDING

**DECISION NO. 2003/2/RM OF THE EXECUTIVE DIRECTOR OF THE EUROPEAN
AVIATION SAFETY AGENCY**

of 17 October 2003

on

**certification specifications, including airworthiness codes and acceptable means of
compliance, for large aeroplanes (« CS-25 »)**

“Class B/F Cargo Compartments”

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A. Explanatory Note

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending Certification Specifications for Large Aeroplanes (CS-25) as originally issued by Executive Director's Decision 2003/2/RM of 17 October 2003¹ and as last amended by Executive Director's Decision 2007/020/R of 20 December 2007² (CS-25 Amendment 4). The scope of this rulemaking activity is outlined in Terms of Reference (ToR) 25.041 and is described in more detail below.
2. The European Aviation Safety Agency (hereinafter referred to as the Agency) is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation³ which are adopted as "Opinions" (Article 19(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 19(2)).
3. When developing rules, the Agency is bound to following a structured process as required by Article 52(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as the "Rulemaking Procedure"⁴.
4. This rulemaking activity is included in the Agency's Advance Planning for 2008. It implements the rulemaking task 25.041 Class B/F Cargo Compartments.
5. The text of this NPA has been prepared by the Agency based on the draft text developed by the Rulemaking Group set up by the Agency for the rulemaking task 25.041. It is submitted for consultation of all interested parties in accordance with Article 52 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.

II. Consultation

6. To achieve optimal consultation, the Agency is publishing the draft decision of the Executive Director on its internet site. Comments should be provided within 3 months in accordance with Article 6(4) of the Rulemaking Procedure. Comments on this proposal should be submitted by one of the following methods:

CRT: Send your comments using the Comment-Response Tool (CRT) available at <http://hub.easa.europa.eu/crt/>

¹ Decision No 2003/2/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for large aeroplanes (« CS-25 »).

² Decision No. 2007/020/R of the Executive Director of the European Aviation Safety Agency of 20 December 2007 on Certification Specifications, Including Airworthiness Code and Acceptable Means of Compliance, for Large Aeroplanes (« CS-25 Amendment 4 »).

³ 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

⁴ 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, 13.6.2007.

E-mail: Only in case the use of CRT is prevented by technical problems these should be reported to the [CRT webmaster](#) and comments sent by email to NPA@easa.europa.eu.

Correspondence: If you do not have access to internet or e-mail you can send your comment by mail to:
Process Support
Rulemaking Directorate
EASA
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be received by the Agency **before 07 August 2008**. If received after this deadline they might not be taken into account.

III. Comment response document

7. All comments received in time will be responded to and incorporated in a comment response document (CRD). The CRD will be available on the Agency's website and in the Comment-Response Tool (CRT).

IV. Content of the draft decision

Background

8. Following an accident investigation of a South African Airways Boeing 747 Combi aeroplane lost in the Indian Ocean in 1987 with 159 fatalities the US National Transportation Safety Board (hereinafter NTSB) issued recommendations to revise the Class B cargo compartments standards. This was based on the report from the South African Board of Inquiry mentioning that a fire broke out in the Class B cargo compartment on the main deck, which could not be extinguished. An Airworthiness Directive (FAA AD 93-07-15⁵) was issued by the US Federal Aviation Administration (hereinafter FAA) requiring changes to Class B cargo compartments on the main deck of large transport aeroplanes. Similar requirements were addressed in Europe (e.g. in France and some other JAA countries) for large Combi aeroplanes.

Tests were performed by the FAA to investigate the efficacy of the Class B concept for smaller sized compartments, such as those installed in commuter aeroplanes. It was found that the maximum compartment size for which successful fire fighting could be imagined was much less than previously thought.

Further, the FAA tasked the Aviation Rulemaking Advisory Committee (hereinafter ARAC) to develop a proposal for future Class B cargo compartments. A Cargo Standards Harmonisation Working Group was formed including members from the FAA, Joint Aviation Authorities (hereinafter JAA), aircraft manufacturers and operators, which developed a draft status requirements and guidance (a draft Notice of Proposed Rulemaking (NPRM)) and a draft Advisory Circular (AC)) for a new Class B cargo compartment definition as well as design criteria for a new Class F cargo compartment type. This latter class of compartment was introduced because whilst it was concluded that manual fire fighting was not feasible for larger compartments, alternatives other than just the existing Class C were identified.

⁵ Available on the FAA AD website:
http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAD.nsf/MainFrame?OpenFrameSet

9. In March 2006 the Agency set up a Rulemaking Group (hereinafter referred to as the "Group") to accomplish the rulemaking task 25.041. The Group was composed of cabin safety experts, members of the JAA Cabin Safety Steering Group (CSSG), nominated by National Aviation Authorities, aircraft manufacturers and, operators as well as of observers from the FAA and Transport Canada. The Group started to work on this subject in accordance with the Terms of Reference (TOR) 25.041. The task was to review the work done and the documents prepared by the ARAC Cargo Standards HWG for the FAA, conduct a Regulatory Impact Assessment (RIA) and when justified by RIA to develop a revised Class B cargo compartment standard as well as a new Class F cargo compartment standard to be proposed for inclusion in CS-25.

Envisaged changes to CS-25

10. The proposed text revises CS 25.855(b) & (c), CS 25.857(b) & (f) and sub-paragraphs (a)(1)(ii) and (a)(2)(iii) of Part I of Appendix F of CS-25. By this revision, the size of the Class B compartment is now limited to allow fire-fighting activity from the door entrance without the need to step into the compartment. Further, a new Class F cargo compartment definition is added, which is not limited in size and which provides the means to control or extinguish a fire without requiring a crewmember to enter the compartment. This proposed Class F compartment standard accommodates the carriage of large amounts of baggage and cargo loads on Combi aeroplanes as well as in compartments of smaller sizes exceeding the new Class B definition. New aeroplane designs can take advantage from the variable solutions under the Class F definitions to ensure an acceptable level of fire protection.
11. The proposed Acceptable Means of Compliance (AMC) provides guidance for compliance with paragraphs CS 25.855 and CS 25.857 in respect to the definition of Class B and F cargo compartments. The AMC further provides guidance for usage of other fire protection means in the new Class F compartment such as Fire Containment Covers (FCC) or Containers rather than having a liner installed to contain a fire and to protect the critical systems and structure of the aeroplane.
12. On previous and current large Combi aeroplanes, transport of animals, such as horses accompanied by persons as horse handlers, is quite common. It is not the intention of this proposed rule to restrict those kinds of operations. The Agency believes that also in the future this kind of transportation will be possible under the new Class F cargo compartment standard by considering appropriate operational aspects to be determined for each intended usage, as in the past.

V. Regulatory Impact Assessment

1. Purpose and Intended Effect

a. Issue which the NPA is intended to address

The purpose of this regulatory activity is to consider rule changes to CS 25.855 and CS 25.857, harmonised with changes to FAR §25.855 and FAR § 25.857, relating to Class B cargo compartments. In principle, the intended rule change would significantly limit the size of Class B compartments and introduce a new Class F cargo compartment. This proposed change is intended to ensure an acceptable level of safety for aeroplanes equipped with Class B cargo compartments.

Class B compartment standards were developed when cargo compartments were relatively small and aeroplanes were powered by reciprocating engines. With the advent of larger turbine-powered aeroplanes, cargo compartments have increased in size and those aeroplanes are operated at higher altitudes on longer routes. The level of protection provided by the current Class B compartment liners is less than that required for Class C compartments, since it was expected that fires would be

detected quickly and a crewmember would be able to extinguish the fire before it could damage the liner or aeroplane structure.

In November 1987, a South African Airways Boeing 747 Combi crashed into the Indian Ocean off the coast of Mauritius with the loss of 159 lives. The South African Board of Inquiry determined that a major fire had developed in the main deck (Class B) cargo compartment.

A study by the FAA (see Reference 1. in section 6 this RIA) indicated that it was unrealistic to expect crewmembers to enter the cargo compartment when fire was present in an attempt to extinguish the fire. Longer routes, combined with the seat of the fire being inaccessible may allow fires to develop to the level of severity that would damage the liner and subsequently the aeroplane structure or systems.

b. Scale of the issue

Based on the results of the South African Airways accident investigation, the NTSB recommended to the FAA to require all cargo carried in Class B cargo compartments of US-registered transport category airplanes to be carried in fire resistant containers, until fire detection and suppression methods for Class B cargo compartment fires are evaluated and revised as necessary (NTSB Recommendation No.A-88-061). The NTSB also recommended to the FAA to establish fire resistant requirements for the ceiling and sidewall liners in Class B cargo compartments of Transport Category Airplanes that equal or exceed the requirements for Class C and D compartments as set forth in Part III of Appendix F of FAR Part 25 (Title 14 Code of Federal Regulations (CFR) Part 25) (NTSB Recommendation No. A-88-063).

The accident resulted in reviewing by the FAA, JAA and Transport Canada of the regulations relating to Class B cargo compartments. The review and subsequent fire testing revealed that there were major deficiencies in the requirements for Class B cargo compartments. As a result of these studies the FAA issued Airworthiness Directive 93-07-15 and the French DGAC issued Airworthiness Directive 92-113(B)R1 introducing new requirements for Class B cargo compartments on in-service aeroplanes.

FAA AD, 93-07-15, issued on 14 April, 1993, requires operational and procedural changes, added emergency equipment, and enhanced fire detection and suppression on large main-deck Combi aeroplanes affected by the AD. In January 1994, JAA, FAA and Transport Canada developed standards for training of crewmembers assigned to monitor and fight cargo fires on board of aeroplanes with a main deck Class B compartment as required by the Airworthiness Directives.

The FAA tasked the Aviation Rulemaking Advisory Committee (ARAC) to develop a proposal for future class B cargo compartments. A Cargo Standards Harmonisation Working Group was formed including members from the FAA, JAA, aircraft manufacturers and operators, which developed a draft status requirements and guidance material (a draft NPRM and a draft AC) for a new class B cargo compartment definition as well as design criteria for a new class F cargo compartment type. This latter class of compartment was introduced because whilst it was concluded that manual fire-fighting was not feasible for larger compartments, alternatives other than just the existing Class C were identified.

The above draft status requirements and guidance material prepared by the Cargo Standards HWG have been reviewed by the Rulemaking Group set up in 2006 by the Agency. This Group (in which observers from the FAA and Transport Canada participated) has reached common position on the amendments to be proposed to CS-25, harmonised with the amendments envisaged to be proposed to FAR Part 25.

The proposed amendments to CS-25 contain:

- (i) Revised standards for Class B cargo compartments by revising CS 25.857(b) (1)

The intent of this change is to limit significantly the size of a Class B compartment.

- (ii) Standards for newly classified Class F cargo compartments by adding CS 25.857(f)(1), (2), and (3).

The Class F cargo compartment would not be limited in size but would require a means to control the fire without requiring a crewmember to enter the compartment.

Class B cargo compartments size limitation would be addressed by ensuring that there is sufficient access to enable a crewmember to reach any part of the compartment with the contents of a hand held extinguisher when standing at any one point external to the compartment - i.e. the access door. The size of the compartment would be a function of how the compartment is configured. The liner, floor and fire/smoke detection requirements for a Class B compartment would remain unchanged. However, it was considered that large cargo compartments on passenger carrying aeroplanes would still be acceptable provided the safety level could be maintained by some other means than manual fire fighting. Several ways to achieve this (other than the existing Class C definition) were envisioned and so a new Class F compartment category has been developed.

The introduction of Class F cargo compartments necessitates amending:

- CS 25.857 to introduce the compartment type and require a fire/smoke detection system, a means to extinguish or control a fire without requiring a crew member to enter a compartment and means to exclude hazardous quantities of smoke, flames or extinguishing agent from any occupied compartment.
- CS 25.855 (b) and (c) to add the new compartment type to the liner requirements
- Appendix F to add the new compartment type to the floor panel requirements to meet the same standard as Class B, C and E

The requirements for new Class F compartments would allow flexibility in new aeroplane designs while ensuring that adequate fire control can be obtained. The objective nature of the requirement is such that it is unlikely that further regulatory change would be required as a result of emerging technologies.

The proposed amendment to CS-25 would affect only newly certificated aeroplanes.

c. Brief statement of the objectives of the NPA

The proposed changes to CS-25, harmonised with the changes to be proposed to FAR Part 25, is intended to amend the airworthiness standards for large aeroplanes/transport category airplanes to incorporate revised standards for Class B cargo compartments and establish standards for a new Class F cargo compartment. Compared to existing Class B cargo compartments standards (which does not limit their size) the new Class B cargo compartments would be significantly limited in size.

Class F cargo compartments would not be limited in size but would require a means to control the fire without requiring a crewmember to enter the compartment. This would entail the incorporation of a fire detection system, a means to exclude cargo compartment smoke and fumes from entering occupied spaces and dependent on the fire containment method chosen, a liner meeting requirements of Part III of Appendix F of CS-25 (or an equivalent standard).

The advisory material for Class F cargo compartments would propose several means of compliance for extinguishing or controlling a fire without the need for a crewmember entering the compartment. Possible options include for example:

Solutions not necessarily requiring a Cargo Compartment liner:

- Fire Containment Covers (FCC) over loaded pallets
- Fire containment containers, which might have additional separate fire detection and built-in suppression systems

Solutions requiring a Cargo Compartment liner:

- Installation of a built-in fire suppression system
- Use of portable fire extinguishers at the outside of the compartment via a port and to distribute the agent through a piping and nozzle system.

2. Options

a. The options identified

Option 1 - Do nothing

EASA would not proceed with the proposal to amend CS 25.855 and 25.857.

Option 2 - Voluntary Implementation

Designers would voluntarily implement the proposed standards for new aeroplanes.

Option 3 - Regulate to remove Class B Compartments

The standard of Class B compartments would disappear from the rule and hence the subject compartments would then need to be classified as Class C.

Option 4 - Regulate to restrict the dimensions⁶ of Class B Compartments

Class B would be allowed but with restricted dimensions. Hence larger compartments would then need to be classified as Class C.

Option 5 - Regulate to restrict the dimensions of Class B Compartments and introduce a new Class F Compartment

Class B would be allowed but with restricted dimensions and a new Class F Compartment introduced.

b. The preferred option selected

The preferred option is option 5. See paragraph 5.c.

3. Sectors concerned

- Airframe Manufacturers/Designers of Large Aeroplanes
- Operators of Large Aeroplanes
- Authorities/Regulators

4. Impacts

a. All identified impacts

i. Safety

⁶ The regulation would restrict compartments to dimensions that allow a crew member to extinguish a fire using a hand fire extinguisher standing at any one access point [related guidance would restrict the compartment depth to 132 cm (52 inches)].

A review of the Cabin Safety Research Technical Group Accident Database (1966-2005) and NTSB accident database (1962-2006) indicated that no accidents involving in-flight fires in Class B cargo compartments other than the South African Airways Boeing 747 have occurred.

However, with the number of combi-flights approximately less than 1% of all scheduled flights (Roelen, Pikaar, and Ovaa: An Analysis of the Safety Performance of Air Cargo Operators, National Aerospace Laboratory NLR, March 2000), it is estimated that western-built turbojet Combi aeroplanes have accumulated approximately 4.5 million flights worldwide over the period 1960 to 2003. Even at the 95% confidence level, one accident would result in a rate of occurrence of approximately 8×10^{-8} per flight, which is considered an unacceptably high level of risk.

Furthermore, the FAA fire tests (see Reference 1.) demonstrated the inability for personnel to effectively fight fires in all but the most modestly sized Class B compartments, underlining the need for improved regulation.

Limitations on the allowable size or configuration of the Class B compartment and the introduction of Class F compartment standards in the proposed amendments would offer a higher level of safety in controlling or suppressing fires in cargo compartments.

Option 1 - Do nothing

Cargo compartments that require entrance into the compartment to fight the fire do not have a safety standard acceptable for future certificated aeroplanes. To do nothing would mean that:

1. The regulations do not reflect this practice
2. The demonstrated safety risk, based on the in-service accident record and the FAA testing (see Reference 1), would not be addressed.

Option 2 - Voluntary Implementation

Operators/manufacturers might voluntarily adopt a higher safety standard for Class B compartments based on the available safety concerns but this is by no means certain. Since in flight fires are rare the perception of risk may be insufficient to prompt action by the manufacturers/operators to ensure that the intended fire safety standards are achieved. In practice this option is likely to result in the same in-service safety standard as Option 1.

Option 3 - Regulate to remove Class B Compartments

FAA test data has shown that if compartment dimensions are kept within certain limits, effective fire fighting is possible with a handheld extinguisher, i.e. the original safety intent of the Class B compartment can be achieved. However, larger compartments can result in a fire threat that cannot be controlled by crewmembers.

Based on the in-service accident record and the FAA testing deleting Class B cargo compartments from the regulations would have a marked improvement in safety. However, their removal would force manufacturers to install Class C compartments (with additional cost and weight penalties)

Option 4 - Regulate to restrict the dimensions of Class B Compartments

As a refinement to Option 3, this Option would limit the dimensions of a Class B compartment to those shown by the FAA testing to be compatible with crewmembers controlling a fire without the need to enter the compartment. This option increases safety whilst allowing manufacturers to design smaller compartments according to existing Class B standards. However, for larger

compartments manufacturers would need to meet the standards required for Class C compartments.

Option 5 - Regulate to restrict the dimensions of Class B Compartments and introduce a new Class F Compartment

In combination with the restriction of Class B compartments as in Option 4, the introduction of a new Class F compartment provides a further option for manufacturers whilst maintaining fire safety in larger cargo compartments. A new Class F compartment definition will provide an objective requirement that maintains the required level of safety.

ii. Economic

Option 1 - Do nothing

This option would not have any direct economic impact. However, there will be costs to manufacturers and operators as well as to society if an accident occurred resulting from a Class B cargo compartment fire.

Option 2 - Voluntary Implementation

Voluntary implementation would result in additional costs being incurred by those manufacturers that choose to design compartments that are compliant with the proposed standard. The cost impact is dependent on the design solution adopted as well as the extent of such "compliance".

Option 3 - Regulate to remove Class B Compartments

Removal of Class B compartments from the rule would mean that large aeroplane manufacturers and operators would have no other option but to meet the Class C compartment standards for their baggage and cargo compartments on passenger-carrying aeroplanes, with the attendant economic burden. Class E compartments are reserved for cargo only transportation. Thus, there will be no solution between the very small Class A compartment and a cost burdensome Class C compartment.

Option 4 - Regulate to restrict the dimensions of Class B Compartments

Under this option, Class B compartments would be limited to a maximum 'reach' dimension (132 cm (52 inches) measured from the centre line of the entrance), and larger compartments would have to be designed to Class C standards with associated cost penalties.

Small compartments are typically used to stow passenger baggage, so there is a relationship between the number of passenger seats and the necessary baggage stowage volume. Most of these aeroplanes are equipped with cabin overhead bins, in addition to an assigned baggage compartment. Some of these compartments exceed the 132 cm (52 inches) criterion. To develop and introduce Class C compartments for such new aeroplane types would clearly carry a significant cost impact.

Option 5 - Regulate to restrict the dimensions of Class B Compartments and introduce a new Class F Compartment

Option 5 is the same as Option 4 but with the introduction of a new Class F cargo compartment (in addition to Class C) for those compartments exceeding the 132 cm (52 inches) criterion.

The Class F cargo compartment is intended to provide a safe and more economically viable alternative (than the Class C) design concept, allowing flexibility in terms of design solutions. The variation of options allowed by the

class F design leaves room for future solutions using new materials for fire barriers that might be incorporated in the design. In addition, the development of fire suppression systems, either for a limited volume such as a container or pallet size, as well as for complete mid-size or large cargo compartments on Combi aeroplanes will be fostered by keeping the objectivity of the rule.

There will likely be a cost impact for large aeroplane manufacturers that design baggage compartments exceeding the 132 cm (52 inches) criterion. Assuming current baggage amounts continue to be carried in the future, some of those aeroplane types may require cargo compartment designs that meet Class C or the new Class F standards. Alternatively, an option that might be considered is to install two or more smaller Class B compartments. This, of course, will have attendant cost implications and may be, in certain instances, impracticable due to the restrictions it would impose on cabin layout.

This new Class F is intended to allow various means of extinguishing or controlling the fire, such as:

1. Use of an approved container or cover,
2. Installation of a suppression system based on a built-in piping and nozzle system, leading agent from portable fire extinguishers to every area of the class F compartment in combination with an appropriate liner.

Of course, an alternative to the Class F compartment would be a Class C. However, it is expected that the development and installation of a liner plus a fire suppression system, equivalent to a Class C standard of compartment, is the most costly solution.

For those aeroplanes with baggage compartments smaller than that dictated by the 132 cm (52 inches) criterion there would be no economic impact. However, for large Combi aeroplanes and smaller aeroplanes with larger baggage compartments there will be an economic impact. The cost increment of implementing the new standards depends on the means of compliance selected for converting from Class B to Class F cargo compartments but is likely to be quite significant. The incremental costs would be dependent on the solution chosen and might include a Halon fire suppression system, liners, containers, fire containment covers etc., and would comprise of:

- o Development and Certification costs
- o Parts and Installation costs
- o Extra Fuel costs
- o Maintenance costs

It is difficult to make precise estimates of these costs. However, estimates made by the FAA in relation to aeroplanes currently in-service suggest that incorporation of Class F cargo compartment requirements (by installing a Halon fire suppression system and a liner meeting the standards of Part III of Appendix F of FAR Part 25) on 15 aeroplanes in the United States at the 1999 level is \$15.6 million discounted, or \$17.7 million undiscounted dollars. In discounting and summing all of the system costs over the 25-year period of analysis, for 15 and 30 Combi aeroplanes, the result is a range of \$15.6 to \$29.7 million respectively in discounted costs. Most of these costs are for purchasing and installing the fire-suppression system.

iii. Environmental

Any environmental impact will be minimal. However, there may be some environmental impact resulting from any of the proposed regulatory changes, depending on the means of compliance used for the fire suppression system in

the cargo compartment. If the Means of Compliance included a Halon system then this could have an adverse effect on the environment, depending on the reliability of the associated future fire/smoke detection systems. Halon replacement fire suppression systems are being developed, but are not yet available and approved.

iv. Social

There is no social impact resulting from any of the proposed regulatory changes.

v. Other aviation requirements outside EASA scope

This regulatory activity is being co-ordinated with JAA in their considerations relating to any changes to JAR-26. The JAA has included a rulemaking task into their 2008 Rulemaking Programme (NPA 26-XX) which is going to address the issue of extending the applicability of the new Class B/F compartment standards proposed to CS-25 to become retroactively applicable to existing aeroplanes.

vi. Foreign comparable regulatory requirements

ICAO requirements for cargo compartment protection in large aeroplanes are found in paragraphs g)1) and 2) of section D.2 "System Design Features" in Sub-part D of PART IIIB of Annex 8 (Tenth Edition, April 2005) to Chicago Convention⁷ – Airworthiness of Aircraft :

- "1) each cargo compartment accessible to a crew member in a passenger-carrying aeroplane shall be equipped with a fire suppression system;*
2) each cargo compartment not accessible to a crew member shall be equipped with a built-in fire detection system and a built-in fire starvation or suppression system; and [...]"

The proposed standards would be in line with paragraphs 1) and 2) above of the ICAO requirements.

The ARAC established the Cargo Standards Harmonization Working Group, assigning it the task of developing a draft NPRM with associated documents, such as advisory circulars, concerning new or revised requirements for Class B cargo compartments of transport category airplanes. The draft NPRM and Advisory Circular are under development within the FAA which are expected to be based on the advisory committee recommendations, taking also into account the proposed amendment to CS-25 as presented in this NPA resulting from the work of the Agency's rulemaking group with the involvement of the FAA and Transport Canada to achieve harmonisation within respective future CS-25/FAR Part 25/CAR Subpart 25 regulations.

b. Equity and fairness in terms of distribution of positive and negative impacts among concerned sectors

This Regulatory Impact Assessment has taken into consideration the impact of the proposed regulatory activity on small entities. CS-25 Airframe Manufacturers are not small entities. However, some relatively small Operators and Manufacturers of Regional aeroplanes may perceive that the new standards for cargo compartments should not be applied to these aeroplanes since they do not have the same element of risk that could be present on larger Combi aeroplanes. Certain Combi aeroplane manufacturers and regional airlines operating Combi aeroplanes in the US have objected to the proposed amendments because:

⁷ The Convention on International Civil Aviation, signed in Chicago on 7 December 1944.

- Most of their cargo consists of passenger baggage
- They generally operate on short route structures
- There have been no accidents or incidents involving Class B compartments on Regional aeroplanes.

However, the FAA fire tests (see Reference 1.) showed the difficulty in extinguishing a fire, in cargo compartments having a dimension, as measured from the centre line of the entrance, of greater than 132 cm (52 inches), primarily due to the reluctance of the flight attendants to enter the compartment. Therefore, for cargo compartments of this size the risk remains, and hence the intent of the rule to control the fire cannot be met.

5. Summary and Final Assessment

a. Comparison of the positive and negative impacts for each option evaluated

Option 1 - Do nothing

There is no economic impact resulting from the "Do Nothing" option since no costs will be incurred by any Sector. However, this option would mean neglecting an obvious safety risk associated with the current regulations for Class B compartments. Keeping the safety level for current Class B standards is considered unacceptable based on the in-service experience resulting from the accident to the South African Airways Boeing 747 Combi aeroplane and the fire tests carried out by the FAA (see Reference 1.).

Option 2 - Voluntary Implementation

Airframe Manufacturers who perceive that they are exposed to a higher safety risk (i.e. larger Combi aeroplane manufacturers) may voluntarily implement improved standards that would achieve a higher level of safety. However the safety standards achieved are unlikely to be consistent and hence would introduce a level of inequality.

Manufacturers of commuter and business aeroplanes are perhaps less likely to voluntarily implement changes to their design standards due to a perception that operational parameters justify maintaining the existing standard. On this basis the economic and safety impacts may be considered as being the same as Option 1.

Option 3 - Regulate to remove Class B Compartments

To delete Class B compartments would improve the safety standard. However, it would limit the flexibility in terms of potential design solutions for cargo compartments. Passenger large aeroplane manufacturers would need to qualify cargo compartments to the Class C standard which is likely to have an unnecessarily high cost impact.

Option 4 - Regulate to restrict the size of Class B Compartments only

This option would increase definitely the safety level on Class B compartments. This option would also reduce the cost impact over Option 3 since fewer aeroplanes would be affected.

Although this option includes Class B baggage/stowage compartments in a limited size, it is still considered to be too restrictive and conservative for larger volumes.

Option 5 - Regulate to restrict the size of Class B Compartments and introduce a new Class F Compartment

As for Option 4 the level of safety for Class B compartments would be definitely increased based on the enhanced fire extinguishing capability.

For larger cargo compartments this change introduces an additional Class F standard with an enhanced safety standard beyond that currently achieved by large Class B cargo compartments. It is based on standards for existing Class C compartments plus further alternatives that may result in more cost beneficial design solutions. For Class F cargo compartments either no crew action is needed or only in a limited form without the need to enter the compartment.

There will be an economic impact on new aeroplanes programmes with main deck cargo compartments, which will probably result in increased costs in terms of aeroplane design, certification and manufacture as well as operating costs. It is estimated that the enhanced safety standard of Class F compartments does justify the increased costs for design and aeroplane operation.

The introduction of main deck cargo compartment fire extinguishing systems may have the potential for a minor environmental impact until suitable Halon replacement systems are developed.

This regulatory activity has been harmonised with FAA and Transport Canada and it is anticipated that it will result in a common standard.

b. A summary describing who would be affected by these impacts and analysing issues of equity and fairness

The proposed change to CS-25 is likely to directly affect large aeroplanes manufacturers including their design organisations, and Operators.

Currently the affected aeroplane categories consist of business aeroplanes, regional aeroplanes and Combi aeroplanes. Aeroplanes with small baggage compartments (of dimensions lower than the max 132 cm (52 inches) criterion) would be unaffected by the proposed regulatory change.

Manufacturers and Operators of aeroplanes, which may have Class B cargo compartments greater than the maximum dimension of 132 cm (52 inches), and shorter route structures may perceive that these aeroplanes do not have the same element of risk as the larger Combi aeroplanes.

As outlined in paragraph 4.b. of this chapter, the Agency believes that the current standard of class B, for the compartment sizes on smaller aeroplanes, is not sufficient to meet the intent of the rule and therefore a regulatory correction is justified for new type certified aeroplanes of this size.

c. Final assessment and recommendation of a preferred option

After due consideration the Agency believes that **Option 5 - Rulemaking Action** is to be preferred since this option improves the fire protection standards for Class B compartments as deemed necessary to achieve an adequate safety standard, and at the same time provides aeroplane manufacturers the flexibility to design at minimized economic impact.

6. References

1. FAA Report (Technical Note) *"Effectiveness of Flight Attendants Attempting to Extinguish Fires in an Accessible Cargo Compartment"* , DOT/FAA/AR-TN99/29⁸, April 1999

⁸[Available on the FAA Fire Safety Branch website](#)

B DRAFT DECISION

The text of the amendment is arranged to show deleted text, new text or new paragraph as shown below:

- deleted text is shown with a strike through: ~~deleted~~
- new text is highlighted with grey shading: **new**
-

indicates that remaining text is unchanged in front of or following the reflected amendment.

Book 1

SUBPART D - DESIGN AND CONSTRUCTION

Proposal 1: To amend CS 25.855 to read as follows:

CS 25.855 Cargo or baggage compartments (See AMC to CS 25.855 and 25.857)

....

~~(b) Class B through Class E cargo or baggage compartments, as defined in CS 25.857, must have a liner, and the liner must be separate from (but may be attached to) the aeroplane structure.~~ The following cargo or baggage compartments, as defined in CS 25.857, must have a liner that is separate from, but may be attached to, the aeroplane structure:

(1) Class B through Class E cargo or baggage compartments; and

(2) Class F cargo or baggage compartments, unless other means of containing the fire and protecting critical systems and structure are provided.

(c) Ceiling and sidewall liner panels of Class C cargo or baggage compartments, and ceiling and sidewall liner panels in Class F cargo or baggage compartments, if installed to meet the requirements of sub-paragraph (b)(2) of this paragraph, must meet the test requirements of Part III of Appendix F or other approved equivalent methods.

....

Proposal 2: To amend CS 25.857 to read as follows:

CS 25.857 Cargo Compartment Classification (See AMC to CS 25.855 and 25.857)

....

(b) ~~Class B.~~ (See AMC 25.857(b).) A Class B cargo or baggage compartment is one in which -

(1) There is sufficient access in flight to enable a crewmember to effectively reach any part of the compartment with the content of a hand fire extinguisher, standing at any one access point and without stepping into the compartment, to extinguish a fire occurring in any part of the compartment using a hand fire extinguisher;

....

....

(f) **Class F.** A Class F cargo or baggage compartment is one in which -

- (1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station;
- (2) There are means to extinguish or control a fire without requiring a crewmember to enter the compartment; and
- (3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent from any compartment occupied by the crew or passengers.

Proposal 3: To amend subparagraph (a)(1)(ii) and (a)(2)(iii) of Part I of Appendix F of CS-25 to read as follows:

Appendix F

Part I – Test Criteria and Procedures for Showing Compliance with CS 25.853, 25.855 or 25.869

(a) Material test criteria–

(1)....

....

(ii) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, trays and galley furnishings, electrical conduit, air ducting, joint and edge covering, liners of Class B and E cargo or baggage compartments, floor panels of Class B, C, ~~or E~~ or F cargo or baggage compartments, cargo covers and transparencies, moulded and thermoformed parts, air ducting joints, and trim strips (decorative and chafing), that are constructed of materials not covered in sub-paragraph (iv) below, must be self-extinguishing when tested vertically in accordance with the applicable portions of Part I of this Appendix or other approved equivalent means. The average burn length may not exceed 20 cm (8 inches), and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.

....

(2)...

....

(iii) A cargo or baggage compartment defined in CS 25.857 as Class B, C, ~~or E~~ or F must have floor panels constructed of materials which meet the requirements of sub-paragraph (a)(1)(ii) of Part I of this Appendix and which are separated from the aeroplane structure (except for attachments). Such panels must be subjected to the 45-degree angle test. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source may not exceed 15 seconds, and the average glow time may not exceed 10 seconds.

BOOK 2
AMC – SUBPART D

Proposal 4: To amend AMC 25.857 as follows:

AMC to CS 25.855 and 25.857
~~Cargo Compartment Classification~~ Cargo or baggage compartments

1. PURPOSE

This Acceptable Means of Compliance (AMC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of the airworthiness standards for Class B and Class F cargo compartments for large aeroplanes. This AMC provides a rational method for demonstrating that the requirements of the related paragraphs of CS-25 are met and that fires occurring in the compartments can be controlled to ensure that they do not present a hazard to the aeroplane or its occupants. Like all AMC material, this AMC is not, in itself, mandatory and does not constitute a requirement. Terms used in this AMC, such as "shall" and "must," are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described herein is used.

2. RELATED DOCUMENTS

a. Certification Specifications.

- CS 25.851 Fire extinguishers
- CS 25.855 Cargo or baggage compartments
- CS 25.857 Cargo compartment classification
- CS 25.858 Cargo compartment fire detection systems

b. FAA Advisory Circulars (AC).

~~Relevant part of the FAA Advisory Circular~~ The following FAA Advisory Circulars are accepted by the Agency as providing acceptable means of compliance with CS 25.857:

- AC 25-17, Transport Airplane Cabin Interiors Crashworthiness Handbook, ~~dated 4/5/77/94~~ (relevant parts addressing the applicable FAR Part 25/CS-25 paragraphs)
- AC 25-9A, Smoke Detection, Penetration, and Evacuation Tests and related Flight Manual Emergency Procedures, ~~dated 6/1/94~~
- AC 25-18, Transport Category Airplanes Modified for Cargo Service, ~~dated 6/1/94~~ are accepted by the Agency as providing acceptable means of compliance with CS 25.857.
- AC 20-42C, Hand Fire Extinguishers for use in Aircraft
- AC 25-22, Certification of Transport Airplane Mechanical Systems

3. BACKGROUND

CS 25.857(b) and 25.857(f) provide standards for certification of two classes of cargo compartments, Class B and Class F.

A Class B cargo compartment is configured in a manner that allows a crewmember to extinguish or control any fire likely to occur in the compartment using a hand fire extinguisher. While the person combating the fire must have access to the compartment, it must not be necessary for that person to physically enter the compartment to extinguish the fire (see CS 25.857 (b)(1)). The contents of the compartment may be reached by hand or with the contents of a hand extinguisher while standing in the entry door.

A Class F cargo compartment is similar to a Class C compartment in that there are means to extinguish or control the fire without any requirement for access.

Both Class B and Class F cargo compartments have fire or smoke detection systems to alert the crew to the presence of the fire.

4. COMPARTMENT CLASSIFICATION

All cargo compartments must be properly classified in accordance with CS 25.857 and meet the requirements of CS 25.857 pertaining to the particular class involved (see CS 25.855 (a)).

In order to establish appropriate requirements for fire protection, a system for classification of cargo or baggage compartments was developed and adopted for large aeroplanes.

Classes A, B, and C were initially established; Classes D, E, and F were added later. Class D has been eliminated from the CS-25 specifications (by Amdt 3). The classification is based on the means by which a fire can be detected and the means available to control the fire.

a. A Class A compartment (see CS 25.857(a)) is one that is located so close to the station of a crewmember that the crewmember would discover the presence of a fire immediately. In addition, each part of the compartment is easily accessible so that the crewmember could quickly extinguish a fire with a portable fire extinguisher. A Class A compartment is not required to have a liner.

b. A Class B compartment (see CS 25.857(b)) is one that is more remote than a Class A compartment and must, therefore, incorporate a fire or smoke detection system to give warning at the pilot or flight engineer station. Because a fire would not be detected and extinguished as quickly as in a Class A compartment, a Class B compartment must have a liner in accordance with CS 25.855 (b). In flight, a crewmember must have sufficient access to a Class B compartment to reach any part of the compartment by hand or with the contents of a hand extinguisher when standing at any one access point, without stepping into the compartment. There are means to ensure that, while the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent will enter areas occupied by the crew or passengers.

c. A Class C compartment (see CS 25.857(c)) differs from a Class B compartment in that it is not required to be accessible in flight and must, therefore, have a built-in fire extinguishing system to suppress or control any fire. A Class C compartment must have a liner and a fire or smoke detection system in accordance with CS 25.855 (b) and CS 25.857(c)(1). There must also be means to exclude hazardous quantities of extinguishant and products of combustion from occupied areas (see CS 25.857(c)(3)).

d. A Class E compartment (see CS 25.857(e)) is found on an all-cargo aeroplane. Typically, a Class E compartment is the entire cabin of an all-cargo aeroplane; however, other compartments of such aeroplanes may be also classified as Class E compartments. Shutting off the ventilating airflow to or within the compartment controls a fire in a Class E compartment. A Class E compartment must have a liner (see CS 25.855 (b)) and a fire or smoke detection system installed in accordance with CS 25.857(e)(2). It is not required to have a built-in fire suppression system.

e. A Class F compartment (see CS 25.857 (f)) is one in which there are means to control or extinguish a fire without requiring a crewmember to enter the compartment. Allowing access by a crewmember in the presence of a fire warning is not envisioned. Class F compartments that include a built-in fire extinguisher/suppression system or require the use of acceptable fire containment covers (FCCs) would meet these requirements. The Class F compartment must have a fire or smoke detection system installed in accordance with CS 25.857(f)(1). Unless there are other means of containing the fire and protecting critical systems and structure, a Class F compartment must have a liner meeting the requirements of part III of Appendix F , or other approved equivalent methods (see CS 25.855 (b)).

5. FIRE PROTECTION FEATURES

Based on the class of the compartment, fire protection features must be provided. The fire protection features must be shown to meet the standards established by the original type certification basis for the aeroplane or later CS-25 standards. These features may include liners, fire or smoke detection systems, hand fire extinguishers, and built-in fire suppression systems.

a. Liners

The primary purpose of a liner is to prevent a fire originating in a cargo compartment from spreading to other parts of the aeroplane before it can be brought under control. For Class B compartments, it is assumed that the fire will be quickly extinguished. Therefore, the liner does not need to be qualified to the requirements of Part III of Appendix F. For Class F cargo compartments, the fire might have grown larger prior to being suppressed, and therefore, better protection is needed to prevent damage to surrounding systems and structure. However, the liner does not need to serve as the compartment seal. It should be noted, however, that the liner is frequently used to perform the secondary functions of containing discharged extinguishing agent and controlling the flow of oxygen into the compartment. If other means, such as compartment walls, are not capable of performing those functions, the liner must be sufficiently airtight to perform them.

The liner must have sufficient fire integrity to prevent flames from burning through the liner before the fire can be brought under control and the heat from the fire is sufficiently dissipated. As stated in Part III of Appendix F, in addition to the basic liner material, the term "liner" includes any design feature, such as a joint or fastener that would affect the capability of the liner to safely contain a fire.

b. Access

Class B. Class B compartments must provide sufficient accessibility to enable a crewmember to reach any part of the compartment by hand or with the contents of a hand extinguisher without physically entering the compartment. This requirement, by its nature, tends to limit the size and shape of the compartment. Additionally, the access provisions should be sufficiently large to enable the crewmember to determine visually that a fire has been extinguished.

(1) "To reach any part of the compartment" means that the crewmember should be able to open the door or hatch and, standing in the opening, reach by hand anywhere in the compartment where cargo or baggage can be located. The extension of the crewmember's reach through the use of fire extinguisher wands, etc., should not be considered in determining reach.

(2) Based on the estimated reach of a 95 percentile male, the outline of any compartment, viewed from above, should fit within a vertical cylinder of radius 132 cm (52 inches) measured from the centerline of the access door or hatch (see Figure 1). This dimension assumes the above male can reach a one foot square box located anywhere within the compartment. Access by a smaller crewmember to reach the same area within the compartment could require that the crewmember move laterally within the access door or hatch opening, while not physically entering the compartment.

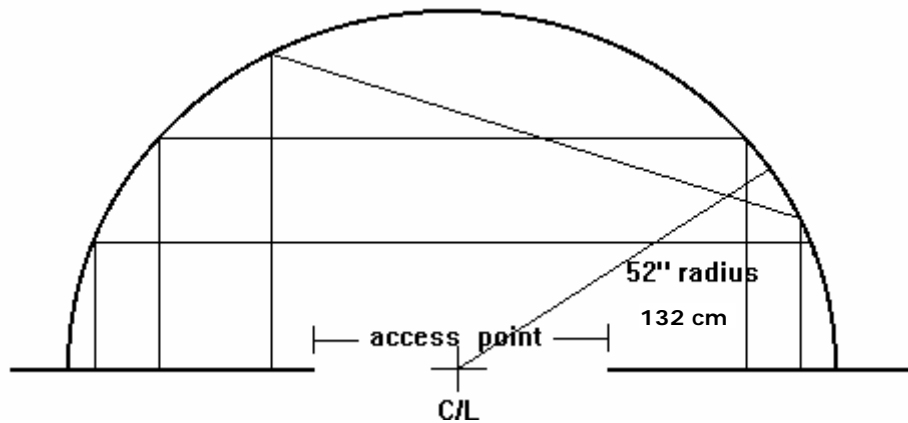


Figure 1

Example of possible cargo compartment shapes within 132 cm (52 inches) reach from access point centreline.

Class F. In the case of a Class F compartment, a means should be provided to control or extinguish a fire without a crewmember entering the compartment.

(1) One means is to design the compartment to Class C requirements but not include a built-in fire suppression system. One suppression method might be to utilize a plumbing and nozzle distribution system within the compartment that would provide acceptable suppression capability throughout the volume of the compartment. The source for such a system could be hand fire extinguishers, which interface with the distribution system through a suitable interface nozzle. This reduces the complexity and costs associated with a built-in suppression system and could be suitable for smaller compartments. For certification purposes, the extinguishing agent concentration should be measured in flight, following aeroplane flight manual (AFM) procedures, and the length of protection time afforded by the system should be recorded. This time of protection should be used to establish AFM limitations for cargo or baggage compartment fire protection times. The operator, for route planning, could then use these times. For Halon 1301 fire extinguishing agent, a minimum five percent concentration by volume at all points in the compartment is considered adequate for initial knock-down of a fire, and a three percent concentration by volume at all points in the compartment is considered the minimum for controlling a fire after it is knocked down. This option requires the use of a liner as stated in CS 25.855 (b).

(2) Another means of providing fire protection in a Class F compartment might be the use of cargo containers or fire containment covers (FCCs) shown to be capable of containing a fire. Some FCCs have already been developed and are typically constructed of woven fiberglass-based materials that will pass the oil burner test requirements of Part III of Appendix F.

This is in line with the revised CS 25.855 which for a Class F cargo or baggage compartment not using FCCs requires a ceiling and sidewall liner constructed of materials that meet the requirements of Part III of Appendix F and be separated from the aeroplane structure (except for attachments), while the floor panels must comply with Part I of Appendix F.

Similarly, if FCCs are proposed as a means of compliance for the new Class F compartment, it is likely that in order to meet the intent they must also meet these standards (i.e. Part III of Appendix F for the sides and top and Part I of Appendix F for the bottom). However, based on full scale qualification testing there is evidence that alternative materials, not fully in compliance with Part III of Appendix F, might also be acceptable for FCC side and top portions, as long as they are successfully tested and meet the intent of the rule.

It is recommended that the Agency be contacted for concurrence when FCC or Container qualification is envisaged in order to address the relevant test method.

If FCCs are used as means of compliance, they must completely surround all cargo, including underneath the cargo, except for obviously non-flammable items, such as metal stock, machinery, and non-flammable fluids without flammable packaging. Because the fire is controlled or extinguished within the isolated compartment, but is separated from the actual cargo compartment boundaries, the cargo compartment liner requirements of CS 25.855(c) would not apply. However, the effects of the heat generated by the contained/covered fire should be evaluated to ensure that adjacent systems and structure are not adversely affected. For certification purposes, test data with the actual design configuration and possible fire sources would have to be provided. The temperature and heat load time history measurements at various locations above, around and below the FCC are needed to ensure the continued safe function of adjacent systems and structure. The time history data should be used to establish the length of protection time afforded by the system and subsequent AFM limitations for cargo or baggage compartment fire protection times. The operator would then use these times for route planning purposes.

c. Extinguishing Agent.

In order to effectively extinguish or control a fire in a Class B or F cargo or baggage compartment, sufficient fire extinguishing agent must be allocated. Guidance on this topic has been contained in FAA AC 20-42C. This guidance material is accepted by the Agency as addressing how to implement the provisions of CS 25.851(a) that require that at least one hand fire extinguisher be located in the pilot compartment, at least one readily accessible hand fire extinguisher be available for use in each Class B or Class F cargo/baggage compartment, and one or more hand fire extinguishers be located in the passenger compartment for aeroplanes with 7 or more passengers.

d. Fire Control.

"To control a fire" (CS 25.857(f)(2)) implies that the fire does not grow to a state where damage to the aeroplane or harm to the passengers or crew occurs during the time for which the fire protection system is demonstrated to be effective. This in turn implies that critical aeroplane systems and structure are not adversely affected and the temperature and air contaminants in areas occupied by passengers and crew do not reach hazardous levels.

(1) Adequate protection should be provided for cockpit voice and flight data recorder and wiring, windows, primary flight controls (unless it can be shown that a fire cannot cause jamming or loss of control), and other systems and equipment within the compartment that are required for safe flight and landing.

(2) Regardless of a compartment's classification, it must be demonstrated that hazardous quantities of smoke, flames, extinguishing agent, or noxious gases do not enter any compartment occupied by passengers or crewmembers. FAA Advisory Circular 25-9A, Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures, provides guidance concerning smoke penetration testing.

(3) If an aeroplane has one or more Class B cargo compartments, portable protective breathing equipment must be provided for the appropriate crewmembers in accordance with CS 25.1439.

(4) Additional protective breathing equipment or breathing gas supply, and additional fire extinguishers, may be required for Class B cargo compartment operation to ensure that the fire can be controlled for the time the aeroplane is expected to be in the air after onset of a fire.

6. PROCEDURES AND LIMITATIONS

a. To ensure that the contents of Class B and F compartments are either accessible or located such as to allow fire fighting, any cargo or baggage loading limitations and any operational limitations or procedures provided must be identified with placards in the compartment. The loading and operational limitations must also be addressed in the appropriate weight and balance or loading document.

b. Any operational limitations or procedures necessary to ensure the effectiveness of the fire protection system for Class B and Class F cargo and baggage compartments should be clearly defined in the AFM. This should include such items as any changes to the ventilation system to prevent the entrance of smoke or gases into occupied areas, use of hand fire extinguishers, use of protective breathing equipment, use of protective clothing, and use of the FCCs. The certification engineers should work closely with the Agency to ensure that additional training necessary for crewmembers assigned to combat fires is adequately addressed.

c. Any time limit for a cargo or baggage compartment fire protection system, or other conditions or procedures related to combating a fire in a compartment, should be clearly defined in the AFM.

7. AFM CONSIDERATIONS.

a. Crewmember(s) designated to combat a fire in a Class B compartment will need special training. Fires occurring in luggage are difficult to extinguish completely and rekindling may occur. Crewmembers designated to combat fires in Class B compartments should be trained to check periodically to ensure that a fire has not grown back to hazardous proportions.

b. Aeroplane flight manuals should contain instructions to land at the nearest suitable airport following smoke/fire detection, unless it can be positively determined that the fire is extinguished.

c. Any limitations regarding occupancy of Class B and Class F compartments during flight, or during takeoff and landing, should be defined in the AFM.

d. Any loading restrictions associated with access to cargo or baggage or special containers should be clearly identified in the AFM. This would include, but not be limited to, placement of luggage in a Class B compartment or identification of special containers or covers associated with fire protection in a Class F compartment. If covers are used in conjunction with a Class F cargo compartment, they should be easy to install and sufficiently durable to withstand in-service conditions.