Federal Aviation Administration
Aviation Rulemaking Advisory Committee

Transport Airplane and Engine Issue Area
Loads and Dynamics Harmonization Working Group

Task 15 – Structural Integrity of Fuel Tanks for Emergency Landing conditions and Landing Gear

Task Assignment

[Federal Register: August 27, 1998 (Volume 63, Number 166)]
[Notices]
[Page **45895**-45896]
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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Issues--New Tasks

AGENCY: Federal Aviation Administration (**FAA**), DOT.

ACTION: Notice of new task assignments for the Aviation Rulemaking Advisory Committee (ARAC).

SUMMARY: Notice is given of new tasks assigned to and accepted by the Aviation Rulemaking Advisory Committee (ARAC). This notice informs the public of the activities of ARAC.

FOR FURTHER INFORMATION CONTACT: Stewart R. Miller, Transport Standards Staff (ANM-110), Federal Aviation Administration, 1601 Lind Avenue, SW., Renton, WA 98055-4056; phone (425) 227-1255; fax (425) 227-1320.

SUPPLEMENTARY INFORMATION:

Background

The **FAA** has established an Aviation Rulemaking Advisory Committee to provide advice and recommendations to the **FAA** Administrator, through the Associate Administrator for Regulation and Certification, on the full range of the **FAA**'s rulemaking activities with response to aviation-related issues. This includes obtaining advice and recommendations on the **FAA**'s commitment to harmonize its Federal Aviation Regulations (FAR) and practices with its trading partners in Europe and Canada.

One area ARAC deals with is Transport Airplane and Engine Issues. These issues involve the airworthiness standards for transport category airplanes and engines in 14 CFR parts 25, 33, and 35 and parallel provisions in 14 CFR parts 121 and 135.

The Tasks

This notice is to inform the public that the **FAA** has asked ARAC to provide advice and recommendation on the following harmonization tasks:

Task 15: Structural Integrity of Fuel Tanks for Emergency Landing Conditions and Landing Gear

Review the current standards of Secs. 25.721, 25.963 and 25.994 as they pertain to the strength of fuel tanks and protection from rupture during emergency landing conditions including landing gear break-away. Review also any related **FAA** and JAA advisory material. In the light of this review, recommend changes to harmonize these sections and the corresponding JAR paragraphs, recommend new harmonized standards, and develop related advisory material as necessary.

The **FAA** expects ARAC to submit its recommendation(s) resulting from this task by July 31, 1999.

Task 16: Fire Protection of Structure

Review the current standards of Sec. 25.865 and those for corresponding JAR 25.865 as they pertain to the protection of Loads and Dynamics and structures from fires in designated fire zones. Review also **FAA** issue papers issued for engine support structures made of materials other than steel, and any related JAA advisory material. In the light of this review, recommend changes to harmonize this section and the corresponding JAR paragraph, recommend new harmonized standards, and develop related advisory material as necessary.

The **FAA** expects ARAC to submit its recommendation(s) resulting from this task by March 31, 2001.

The **FAA** requests that ARAC draft appropriate regulatory documents with supporting economic and other required analyses, and any other related guidance material or collateral documents to support its recommendations. If the resulting recommendation(s) are one or more notices of proposed rulemaking (NPRM) published by the **FAA**, the **FAA** may ask ARAC to recommend disposition of any substantive comments the **FAA** receives.

Working Group Activity

The Loads and Dynamics Harmonization Working Group is expected to comply with the procedures adopted by ARAC. As part of the procedures, the working group is expected to:

1. Recommend a work plan for completion of the tasks, including the rationale supporting such a plan, for consideration at the meeting of ARAC to consider transport airplane and engine issues held following publication of this notice.

2. Give a detailed conceptual presentation of the proposed

recommendations, prior to proceeding with the work stated in item 3 below.

3. Draft appropriate regulatory documents with supporting economic and other required analyses, and/or any other related guidance material or collateral documents the working group determines to be appropriate; or, if new or revised requirements or compliance methods are not recommended, a draft report stating the rationale for not making such recommendations. If the resulting recommendation is one or more notices of proposed rulemaking (NPRM) published by the **FAA**, the **FAA** may ask ARAC to recommend disposition of any substantive comments the **FAA** receives.

4. Provide a status report at each meeting of ARAC held to consider transport airplane and engine issues.

The Secretary of Transportation has determined that the formation and use of ARAC are necessary and in the public interest in connection with the performance of duties imposed on the **FAA** by law.

Meetings of ARAC will be open to the public. Meetings of the Loads and Dynamics Harmonization Working Group will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of working group meetings will be made.

Issued in Washington, DC, on August 20, 1998.

Joseph A. Hawkins,
Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 98-22999 Filed 8-26-98; 8:45 am]
BILLING CODE 4910-13-M

Recommendation Letter

400 Main Street
East Hartford, Connecticut 06108

Pratt & Whitney
A United Technologies Company

July 6, 2000

Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Attention: Mr. Anthony Fazio, ARM-1

Subject: Fast Track Report (25.721, 25.963, 25.994)

Reference: FAA Tasking to TAEIG, dated November 19, 1999.

Dear Tony,

Attached is a "Fast Track" report for 25.721, 25.963 and 25.994, which was prepared by the Loads and Dynamics Harmonization Working Group. This report contains unresolved minority opinions and after extensive discussion at the June 28, 2000, TAEIG meeting, it was concluded that there was little value in asking the Working Group to continue working the subject.

TAEIG voted (3 yes, 1 no, 4 abstain) to forward the report to the FAA for continued processing in the Fast Track system. It is requested that the report and associated regulatory/advisory material be returned to TAEIG at Phase 4.

Sincerely yours,

C. R. Bolt

C. R. Bolt
Assistant Chair, TAEIG

copies: *Larry Hanson - Gulfstream
Kristin Carpenter - FAA
*Effie Upshaw - FAA

*letter only

CRB_07_06_00_6

ANM- 98-429-A

Acknowledgement Letter

ARM-209

#15

JUL 31 2000

Mr. Craig Bolt
Assistant Chair, Transport Airplanes
and Engines Issues Group
400 Main Street
East Hartford, CT 06108

Dear Mr. Bolt:

This letter acknowledges receipt of your July 6 letter transmitting a report developed by the Loads and Dynamics Harmonization Working Group. Along with the report addressing §§ 25.721, 25.963, and 25.994, structural integrity of fuel tanks for emergency landing conditions and landing gear, we also received the minority opinions expressed by working group members.

The report will be forwarded to the Transport Airplane Directorate for review. The Federal Aviation Administration's progress will be reported at the Transport Airplane and Engine Issues (TAE) meetings.

I would like to thank the Aviation Rulemaking Advisory Committee, particularly those members associated with TAE and the Loads and Dynamics Harmonization Working Group for their cooperation in using the fast track process and completing the working group reports in a timely manner.

TAS 215
ANM-98-429-A
63 FR 45895

Sincerely,
ORGINIAL SIGNED BY
ANTHONY F. FAZIO

Tony F. Fazio
Director, Office of Rulemaking

ARM-209:EUpshaw:fs:7/20/00:PCDOCS #12776 v1
cc: ARM-1/20/200/209; APO-300/320, ANM-114 (K. Carpenter)
File #1340.12

File #ANM-98-429-A (Structural integrity of fuel tanks)

Recommendation

ARAC WG Report
Protection of fuel tanks in a minor crash landing
FAR/JAR 25.963(d), 25.721, and 25.994
June 12, 2000

Category 3

1 - What is underlying safety issue to be addressed by the FAR/JAR?

To protect fuel tanks from rupture during a minor crash landing.

2 - What are the current FAR and JAR standards relative to this subject?

Current FAR text:

§ 25.963(d) Fuel tanks within the fuselage contour must be able to resist rupture, and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in Sec. 25.561. In addition, these tanks must be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely.

§ 25.721 General
(a) The main landing gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause--
(1) For airplanes that have a passenger seating configuration, excluding pilots seats, of nine seats or less, the spillage of enough fuel from any fuel system in the fuselage to constitute a fire hazard; and
(2) For airplanes that have a passenger seating configuration, excluding pilots seats, of 10 seats or more, the spillage of enough fuel from any part of the fuel system to constitute a fire hazard.
(b) Each airplane that has a passenger seating configuration excluding pilot seats, of 10 or more must be designed so that with the airplane under control it can be landed on a paved runway with any one or more landing gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard.
(c) Compliance with the provisions of this section may be shown by analysis or tests, or both.

§ 25.994 Fuel system components.
Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway.

Current JAR text:

JAR paragraph 25.963(e) is identical to FAR paragraph 25.963(d). JAR 25.963(d) reads as follows:

(d) Fuel tanks must, so far as it is practicable, be designed, located and installed so that no fuel is released in or near the fuselage or near the engines in quantities sufficient to start a serious fire in otherwise survivable crash conditions. (see also ACJ 25.963(d).

JAR paragraph 25.721 is identical to FAR § 25.721 and JAR 25.994 is identical to FAR 25.994.

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed?

The JAA has an ACJ 25.963(d) to require additional items under a broad interpretation of JAR 25.963(d) and JAR 25.721. In addition Certification Review Items have been use to provide additional criteria.

The FAA has imposed fuel inertia loading condition on tailplane tanks outside the fuselage contour by use of a Special Condition:

> Tailplane Tank Emergency Landing Loads. In addition to the requirements of § 25.963(d), the following applies;
> (a) The tailplane tank in the horizontal stabilizer must be able to resist rupture and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in § 25.561.
> (b) For the side load condition the quantity of fuel need not exceed 85 percent when determining pressure loads outside the fuselage contour for the 3g lateral direction.

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in?:

The main difference derives from JAR Paragraph 25.963(d) and the interpretations for 25.963(d) in ACJ 25.963(d).

ACJ 25.963(d) provides that the tanks outside the fuselage but inboard of the landing gear, or adjacent to the most outboard engine support the emergency landing loads of 25.561. All tanks outside the fuselage contour are assumed to be 85 percent full.

ACJ 25.963(d) also provides that fuel tank installations should be such that the tanks will not be ruptured by the airplane sliding with its landing gear retracted, nor an engine mounting tearing away.

4 - What, if any, are the differences in the current means of compliance?

ACJ 25.963(d) and a JAA Certification review items provide the means of compliance with 25.963(d) and also impacts 25.721 and 25.994. This includes fuel inertia loading for tanks outside the fuselage contour, considerations of sliding on the runway with combinations of landing gear not extended, additional landing gear breakaway criteria, and conditions of nacelles breaking away.

In compliance with the ACJ interpretation of JAR 25.963(d) the US manufacturers have used a chordwise head to determine fuel pressure under emergency landing load factors. The European manufacturers have used 85 percent of the maximum permissible volume

5 – What is the proposed action?

For each proposed change from the existing standard, answer the following questions:

6 – What should the harmonized standard be?

1. Amend Section 25.561 by revising paragraph 25.561 (c) to read as follows:

(c) For equipment, cargo in the passenger <u>and cargo</u> compartments, and any other large masses, the following apply:

(1) * * * * *

(2) When such positioning is not practical (e.g. fuselage mounted engines or auxiliary power units) each such item of mass shall be restrained under all loads up to those specified in paragraph (b)(3) of this section. The local attachments for these items should be designed to withstand 1.33 times the specified loads if these items are subject to severe wear and tear through frequent removal (e.g. quick change interior items). <u>Cargo in cargo compartments located below or forward of all occupants in the airplane need comply only with c(1)(ii).</u>

* * * * *

* * * * *

2. Amend Section 25.721 to read as follows:

(a) The landing gear system must be designed so that when it fails due to overloads during take-off and landing the failure mode is not likely to cause spillage of enough fuel to constitute a fire hazard. The overloads must be assumed to act in the upward and aft directions - in combination with side loads acting inboard and outboard up to 20% of the vertical load or 20% of the drag load, whichever is greater.

(b) The airplane must be designed to avoid any rupture leading to the spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway, under the following minor crash landing conditions:

(1) Impact at 5 fps vertical velocity, with the airplane under control, at maximum design landing weight, all gears retracted and in any other combination of gear legs not extended.

(2) Sliding on the ground, all gears retracted up to a 20° yaw angle and as a separate condition, sliding with any other combination of gear legs not extended with 0° yaw

(c) For configurations where the engine nacelle is likely to come in contact with the ground, the engine pylon or an engine mounting must be designed so that when it fails due to overloads (assuming the overloads to act predominantly in the upward direction and separately predominantly in the aft direction), the failure mode is not likely to cause the spillage of enough fuel to constitute a fire hazard.

3. Amend Section 25.963 by revising paragraph 25.963(d) to read as follows:

(d) Fuel tanks must, so far as is practical, be designed, located, and installed so that no fuel is released, in quantities sufficient to start a serious fire, in otherwise survivable emergency landing conditions; and:

(1) Fuel tanks must be able to resist rupture and to retain fuel under ultimate hydrostatic design conditions in which the pressure P within the tank varies in accordance with the formula:

$P=0.34*K*L$

Where__

P = fuel pressure in psi at each point within the tank

L = a reference distance in feet between the point of pressure and the tank farthest boundary in the direction of loading..

K = 4.5 for the forward loading condition for fuel tanks outside the fuselage contour.

K = 9 for the forward loading condition for fuel tanks within the fuselage contour

K = 1.5 for the aft loading condition

K = 3.0 for the inboard and outboard loading conditions for fuel tanks within the fuselage contour

K = 1.5 for the inboard and outboard loading conditions for fuel tanks outside of the fuselage contour

K = 6 for the downward loading condition

K = 3 for the upward loading condition

(2) Fuel tank internal barriers and baffles may be considered as solid boundaries if shown to be effective in limiting fuel flow.

(3) For each fuel tank and surrounding airframe structure, the effects of crushing and scraping actions with the ground should not cause the spillage of enough fuel , or generate temperatures that would constitute a fire hazard under the conditions specified in §25.721(b).

(4) Fuel tank installations must be such that the tanks will not be ruptured by an engine pylon or engine mounting or landing gear, tearing away as specified in 25.721(a) and (c).

4. Amend Section 25.994 to read as follows:

Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in § 25.721(b)

7 – How does this proposed standard address the underlying safety issue (identified under #1)?

- The proposed change to 25.561 would ensure fuel tanks would be protected from cargo shifting in the cargo compartment under emergency landing condition.
- The changes to 25.721(a) ensure that the conditions of landing gear tearing away are considered with reasonable level of side load condition, in addition to the upward and aft loads.
- The changes to 25.721(b) cover gear up combinations..
- The emergency landing load factors were established for solid mass items in the fuselage and bear little relevance to fluid in tanks especially external to the fuselage. Fuel pressure loads would be determined by an alternative set of factors rather than the emergency landing load factors which would achieve the same design level as already achieved in the operational fleet
- Certain pressure design factors (e.g. forward condition) for tanks outside the fuselage would be ½ of those on the inside of the fuselage. The calculated pressures would consider a full head rather than the chordwise head and all tanks would be considered full.

- A decent rate of 5 fps for the "minor crash landing" condition is established for the purpose of protecting fuel tanks.
- The conditions of landing with any gear combination not extended are clarified in 25.721 to require all gears retracted and any other combination of gear legs not extended.
- The conditions for landing gear breakaway in 25.721 are also clarified.
- Nacelle breakaway conditions are added to 25.721
- The minor crash landing condition is clarified for section 25.994 by referencing 25.721.
- Consideration of thermal effects is added to 25.963(d)

8 – Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain.

An increase in the level of safety because it adds fuel tank pressure load criteria to fuel tanks outside the fuselage contour, provides additional break-away criteria for nacelles, and a requirement to consider fuel tank heating.

9 – Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain.

Same or slight increase since much of the proposed criteria have been achieved by certification review items, equivalent safety findings, and for tail tanks, by Special Condition.

10 – What other options have been considered and why were they not selected?:

For the fuel tank pressure load criteria, the working group considered several options including a full pressure head criterion using the 25.561 load factors with a partially full tank (85 percent) and a chordwise head criterion with a full tank. Neither of these criteria was considered acceptable because they applied simplistic inertia load factors, derived for fixed mass objects in the fuselage, to a fluid outside the fuselage. In the end, it was decided to use fuel tank pressure factors for the tanks outside the fuselage that would achieve the current fleet strength levels for tanks outside the fuselage. The factors for tanks, inside the fuselage, were adjusted to ensure that they would not provide lower loads than the existing standards.

11 - Who would be affected by the proposed change?

The revised rule would be applicable to new airplanes for which the application for type certificate is received after the effective date.

12 - To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble?

Much of the proposed rule text is based on existing ACJ advisory material and certification review items. See the attached NPRM.

13 - Is existing FAA advisory material adequate? If not, what advisory material should be adopted?

There is no existing FAA advisory material, AC 25-963-2 and corresponding ACJ is proposed and is attached.

14 - How does the proposed standard compare to the current ICAO standard?

The current ICAO standard has no specific criteria for fuel tank protection.

15 - Does the proposed standard affect other HWG's?

No.

16 - What is the cost impact of complying with the proposed standard

Economic analysis still to be done but it is expected to be small in comparison to standard industry practice.

17. - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

Advisory Circular AC 25.783-1A is submitted with full consensus of the working group

18.- -Does the HWG wish to answer any supplementary questions specific to this project?

Not at this time.

19. – Does the HWG want to review the draft NPRM at "Phase 4" prior to publication in the Federal Register?

Yes

20. – In light of the information provided in this report, does the HWG consider that the "Fast Track" process is appropriate for this rulemaking project, or is the project too complex or controversial for the Fast Track Process? Explain.

Yes

Revised per Munch meeting 24 May 2000. Also revised 31 May 00. LCH removed change tracking. JH provided revised words for 25.561(c) and (c)(2) cargo in cargo compartments and re-orderd 25.721.

DRAFT- NOT FOR PUBLIC RELEASE. Dated 31 May 2000

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

[14 CFR part 25]

[Docket No. ; Notice No.]

RIN:

Revised Requirements for the Structural Integrity of Fuel Tanks

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes to revise the fuel tank design requirements of the Federal Aviation Regulations (FAR) for transport category airplanes to require that fuel tanks are designed for fuel pressures arising from emergency landing conditions. The proposals also include consideration of fuel tank ruptures due to the aircraft impacting on and subsequently sliding along the ground with all combinations of landing gears not extended and due to an engine pylon or engine mounting or landing gear tearing away. These actions would ensure that fuel tanks would be able to resist rupture and retain fuel under emergency landing conditions, thus increasing safety by reducing the risk of a post crash fire. This proposal has been developed in co-operation with the Joint Aviation Authorities (JAA) of Europe and the U.S., Canadian and European aviation industries through the Aviation Rulemaking Advisory Committee (ARAC).

DATES: Comments must be received on or before [insert a date 120 days after the date of publication in the Federal Register]

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. , 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. . Comments may also be submitted electronically to nprmcmts@mail.hq.faa.gov. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), FAA, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: James Haynes, Airframe and Propulsion Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, FAA, 1601 Lind Avenue, SW., Renton, WA 98055-4056; telephone (206) 227-2131.

SUPPLEMENTARY INFORMATION

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. ____ ." The postcard will be date stamped and returned to the commenter.

Availability of NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5984).

Internet users may reach the FAA's web page at http://www.faa.gov or the Federal Register's web page at http://www.access.gpo/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration, Office Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267-9680. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, that describes the application procedures.

Background

The manufacturing, marketing and certification of transport airplanes is increasingly an international endeavor. In order for U. S. manufacturers to export transport airplanes to other countries the airplane must be designed to comply, not only with the U.S. airworthiness requirements for transport airplanes (14 CFR part 25), but also with the airworthiness requirements of the countries to which the airplane is to be exported.

The European countries have developed a common airworthiness code for transport airplanes that is administered by the Joint Aviation Authorities (JAA) of Europe. This code is the result of a European effort to harmonize the various airworthiness codes of the European countries and is called the Joint Aviation Requirements (JAR)-25. It was developed in a format similar to 14 CFR part 25. Many other countries have airworthiness codes that are aligned closely to 14 CFR part 25 or to JAR-25, or they use these codes directly for their own certification purposes. Since 1988, the FAA and JAA have been working toward complete harmonization of JAR-25 and 14 CFR part 25.

The Aviation Rulemaking Advisory Committee (ARAC) was established by the FAA on February 15, 1991, with the purpose of providing information, advice, and recommendations to be considered in rulemaking activities. The FAA and JAA are continuing to work toward the harmonization of JAR-25 and 14 CFR part 25 by assigning ARAC specific tasks. By notice in the Federal Register (59 FR 30081, March 15, 1993), the FAA assigned several tasks to an ARAC Working Group of industry and government structural loads specialists from Europe, the United States, and Canada. Task 1 of this charter included design requirements for the strength of fuel tanks. Subsequently, by notice in the Federal Register (63 FR 45895, August 27, 1998) the FAA chartered the same group of specialists with additional related aspects of fuel tank protection. Task 15 of this charter included the design and construction aspects of fuel tank protection from landing gear failures including wheels-up landing conditions (§§ 25.721 and 25.994). The assigned tasks were to review the current requirements for fuel tanks in 14 CFR part 25 and JAR-25 in order to define harmonized regulations that would be suitable for inclusion in both 14 CFR part 25 and JAR-25. The ARAC Loads and Dynamics Harmonization working group has completed its work for this task and has made recommendations to the FAA by letter dated ______________.

The existing § 25.963(d) includes a requirement to account for fuel inertia loads in the design of fuel tanks within the fuselage contour, and requires those tanks to be protected such that they are not exposed to scraping action with the ground. JAR-25 has the same requirement, but annotated as JAR 25.963(e). In addition JAR 25.963(d) specifies design requirements for all fuel tanks that, if ruptured, could release fuel in or near the fuselage or near the engines in quantities sufficient to start a serious fire. Section 25.721 contains conditions to protect fuel tanks from the effects of a landing gear breaking away and also to protect fuel tanks in a wheels-up landing. Section 25.994 contains a requirement to protect fuel systems and components in engine nacelles and the fuselage in a wheels-up landing on a paved runway. Although §§25.721 and 25.994 are identical in the JAR and FAR, there have been differences in interpretations and application of these requirements between and within the civil aviation authorities.

The current 14 CFR part 25 airworthiness standards § 25.963(d) prescribe conditions that the structure of fuel tanks located within the fuselage contour must be designed to withstand during an emergency landing. These conditions cover the resistance to the inertia forces prescribed by § 25.561 and protection such that exposure to scraping action with the ground is unlikely. However, the rule does not apply to other fuel tanks, such as wing fuel tanks, that are outside the fuselage contour. Adequate strength and protection against rupture for fuel tanks outside the fuselage contour has been achieved on existing airplanes by application of other design requirements.

For many years the British Civil Airworthiness Requirements (BCAR) have included a design condition that requires fuel tanks inboard of the landing gear or inboard of, or adjacent to, the most outboard engine to have the strength to withstand fuel inertia loads appropriate to the emergency landing conditions. The BCAR also addresses protection of fuel tanks against rupture by the airplane sliding with its landing gear disarranged and against engine mounts tearing away. In developing the common European airworthiness requirements, the Joint Aviation Authorities (JAA) also recognized that crashworthiness criteria for wing fuel tanks is necessary to ensure an adequate level of safety and since October 1988, the European Joint Aviation Requirements (JAR-25) have included a design requirement for fuel tanks outside of the fuselage contour, that now supersedes the previously cited BCAR requirement.

Service experience with respect to rupture of fuel tanks due to fuel inertia pressure loads is good. From this service experience, it is concluded that current airplanes should have adequate strength to meet this condition. However, this may not always be the case, especially if new airplane designs are significantly different from past conventional configurations in terms of length and breadth of the wing fuel tanks, or design and location of engines, or other sources of ignition. Without specific emergency landing conditions for fuel tanks outside of the fuselage contour, the current fuel tank crashworthiness requirements may not guarantee that adequate levels of fuel tank structural integrity will always be present.

Section 25.721 "Landing gear – general", contains two design requirements. The first requirement in paragraph 25.721(a) was adopted by amendment 25-23 (35 FR 5665, April 8, 1970) and provides for protection of fuel systems from a landing gear breaking away. This is considered a local component design criterion to protect fuel tanks from rupture and puncture due to the failure of the landing gear and its supports. This requirement applies only to fuel systems inside the fuselage for airplanes with 9 seats or less and to all fuel systems for airplanes with 10 seats or more. Experience has shown that the landing gear malfunctions can lead to landing on the engine nacelles for some configurations, and this can result in the engine nacelle breaking away, creating much the same fuel tank rupture potential as the landing gear breaking away.

Paragraph 25.721(b) provides for the protection of fuel systems in a wheels-up landing due to any combination of gear not-extended. This condition is not intended to treat a collapsed gear condition, but is intended to cover cases in which one or more gear do not extend for whatever reason and the airplane must make a controlled landing on a paved runway in this condition. This requirement only applies to airplanes with 10 seats or more. At the time this paragraph was adopted (amendment 25-32, 37 FR 3969, Feb 24, 1972), § 25.561 "Emergency landing conditions - General" contained a landing descent speed of 5 feet per second as an alternative criteria that could allow a reduction in the specified vertical emergency landing design load factor. This alternative was removed by amendment 25-64 (53 FR 17646, May 17, 1988) in order to make the specified vertical design load factor the minimum design condition. However, the 5 feet per second descent speed of § 25.561 had, by design practice and interpretation, become the design descent velocity for the wheels-up landing conditions of §§ 25.721 and 25.994. By removing it, the quantitative definition of the wheels-up landing condition on a paved runway was lost.

Section 25.994 was adopted by amendment 25-23 (35 FR 5665, April 8, 1970) and further revised by amendment 25-57 (49 FR 6848, Feb 23, 1984) to clarify that the wheels-up landing condition was on a paved runway. Advisory Circular 25.994-1 was also issued in July 24, 1986 which specifically referred to § 25.561 for the design conditions which at that time, contained the 5 feet per second landing descent criteria.

Discussion

Investigation of various types of accidents that result in high impact forces on the airframe shows that it is necessary to consider only three flight phases in which accidents could have a potential for occupant survival. These are final approach, landing and take-off.

In 1982, the National Aeronautics and Space Administration (NASA) completed a study, of commercial transport aircraft accidents. This study, reported in FAA Report No. DOT-FAA-CT-82-70, "Transport Aircraft Accident Dynamics" by A. Cominsky, records a total of 109 impact survivable accidents in the period between 1960-1980. The breakdown of these accidents is reproduced in Table 1. An impact survivable accident is defined by NASA as one in which there were fatalities, but not all occupants received fatal injuries as a result of impact forces imposed during the crash sequence. Since aircraft impact during approach is likely to be equivalent to the aircraft flying into the ground, FAA considers that this is too severe a condition to be the subject of design requirements. Nevertheless the figures for approach accidents are given in Table 1 for completeness.

TABLE 1

Injury Survey - Survivable Accidents

Period 1960 to 1980, Commercial Transport Aircraft

Accident Group	Number Of Accidents	Number of Passengers and Crew					
		Total	Injuries	Fatalities			
			Serious/ Minor/ None	Impact Trauma	Fire	Drowned	Unknown
Approach	27	2,113	1,078	434	298	15	288
Landing	33	3,058	2,637	157	227	23	14
Take-off	49	4,798	4,419	92	146	78	63
Total	109	9,969	8,134	683	671	116	365

A significant conclusion drawn from study of these accident statistics is that there are 50 percent more fatalities due to fire than to impact trauma in the survivable landing and take-off accidents. The FAA believes that it is proper, therefore, that post impact fire accidents merit attention in respect of airworthiness action aimed at protection of occupants.

In regard to § 25.963(d), ARAC has determined that the safety record with respect to fuel tank rupture due solely to fuel inertia loads is excellent. Manufacturers' records of accidents and serious incidents to large transport airplanes show no event where significant loss of fuel occurred due to fuel inertia pressure. Fuel losses that did occur were due mainly to direct impact and to puncturing by external objects.

Nevertheless, ARAC believes, and the FAA agrees, that a fuel inertia criterion for wing fuel tanks is still needed to ensure that future designs meet the same level of safety achieved by the current fleet. In setting an appropriate standard for this proposal, ARAC have reviewed the structural capability of the existing fleet. In that review it was shown that the outboard fuel tanks of a large part of the fleet could not be shown, theoretically, to be able to withstand the fuel inertia pressures generated by a wing full of fuel, combined with the emergency landing load factors of § 25.561(b)(3). In fact the wing fuel tanks of many aircraft types were designed to a simple criterion in which fuel pressure was calculated using an inertia head equal to the local geometrical streamwise distance between the fuel tank solid boundaries. Service experience has shown this criterion to produce fuel tank designs with an acceptable safety level. Therefore it is appropriate that the future airworthiness standards for fuel tanks should require a similar level of design fuel pressure for similar fuel tank designs.

For fuel tanks within the fuselage contour, the existing fuel inertia load criterion as generally applied covers up to a full fuel tank, an inertia head equal to maximum pressure head, and inertia load factors equal to those of § 25.561(b)(3). ARAC believes, and the FAA accepts, that this level of rupture resistance for fuel tanks is entirely justified based upon occupant survivability considerations. Any fire occurring due to spilled fuel inside the fuselage poses an almost immediate threat to the occupants. Therefore the current minimum level of rupture resistance is proposed to be retained for fuel tanks within the fuselage contour. In this regard, the design factors specified for the fuel tank pressure boundaries inside the fuselage are equivalent to those that would be developed with the emergency landing load factors of § 25.561(b)(3). The phrase "within the fuselage contour" in paragraph 25.963(d) has been subject to a variety of interpretations in the past. Fuel tanks "not within the fuselage contour" are all fuel tanks where fuel spillage through any tank boundary would remain physically and environmentally isolated from occupied compartments by a barrier that is at least fire resistant. In this regard, cargo compartments that share the same environment with occupied compartments would be treated the same as if they were occupied.

ARAC has determined, and the FAA concurs, that the fuel pressure requirement of § 25.963(d) should not reference the emergency landing load factors of § 25.561(b)(3). The rationale is that the emergency landing load factors of § 25.561(b)(3) are based upon the restraint of fixed mass items and the response of a fluid during emergency landings is different and much more complex to quantify. Therefore, the proposed requirements for fuel tanks both within and outside of the fuselage contour have been simply formulated in terms of equations with factors that are justified based upon the satisfactory service experience of the existing fleet.

Section 25.721 would be completely rewritten to include a wheels up landing condition, an engine nacelle breakaway condition, and a landing gear breakaway condition. The new proposed paragraph 25.721(b) defines the descent velocity, airplane configurations, and sliding conditions for a wheels-up landing on a paved runway. Paragraph 25.721(c) would prescribe a new requirement for consideration of the engine nacelle(s) breaking away if they are likely to come into contact with the ground in a wheels-up landing condition. The new proposed paragraph 25.721(a) would contain the landing gear breakaway condition which is similar to the existing landing gear breakaway condition except it would apply to all landing gear, not just the main gear, and it would apply to all transport airplanes without regard to seating capacity.

Section 25.994 would be revised to reference § 25.721(b) for the conditions that must be considered for the protection of fuel systems and components in engine nacelles and in the fuselage in a wheels-up landing on a paved runway.

Section 25.561(c) would be revised in order to provide a requirement to consider cargo in the cargo compartment. This revision would require that if cargo in the cargo compartment located below or forward of all occupants in the airplane were to break loose, it would be unlikely to penetrate fuel tanks or lines or cause fire or explosion hazards by damaging adjacent systems. The current requirement only addresses items of cargo in the passenger compartment.

The new proposed requirements for fuel tank protection would apply to all transport airplanes. ARAC has determined, and the FAA concurs, that there is no technical justification for limiting the applicability of any of the fuel tank protection provisions based on a passenger seating capacity.

Regulatory Evaluation Summary

Preliminary Regulatory Evaluation, Initial Regulatory Flexibility Determination, and Trade Impact Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this rule: (1) would generate benefits that justify its costs and is not a "significant regulatory action" as defined in the Executive Order; (2) is not significant as defined in DOT's Regulatory Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

[To be completed]

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by Federal regulations. The RFA requires agencies to determine whether rules would have "a significant economic impact on a substantial number of small entities," and, in cases where they would, to conduct a regulatory flexibility analysis. " FAA Order 2100.1 4A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the affected small entities.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For airplane manufacturers, FAA Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no 14 CFR part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small airplane manufacturers.

International Trade Impact Assessment

The proposed rule would have no adverse impact on trade opportunities for U.S. manufacturers selling airplanes in foreign markets and foreign manufacturers selling airplanes in the U.S. market. Instead, by harmonizing the standards of the 14 CFR part 25 and the JAR 25, it would lessen restraints on trade.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Thus, in accordance with Executive Order 12612, it is determined that this proposal does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

Because the proposed changes to the fuel tank crashworthiness requirements are not expected to result in any substantial economic costs, the FAA has determined that this proposed regulation would not be significant under Executive Order 12866. Because this is an issue that has not prompted a great deal of public concern, the FAA has determined that this action is not significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 25, 1979). In addition, since there are no small entities affected by this rulemaking, the FAA certifies that the rule, if promulgated, would not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none would be affected. A copy of the regulatory evaluation prepared for this project may be examined in the Rules Docket or obtained from the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR part 25

Air transportation, Aircraft, Aviation safety, Safety.

The Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR part 25 of the Federal Aviation Regulations (FAR) as follows:

PART 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. app. 1347, 1348, 1354(a), 1357 (d)(2), 1372, 1421 through 1430, 1432, 1442, 1443, 1472, 1510, 1522, 1652(e), 1655(c), 1657(f), 49 U.S.C. 106(g)

2. To amend Section 25.561 by adding paragraph 25.561 (c) to read as follows:

(c) For equipment, cargo in the passenger <u>and cargo</u> compartments and any other large masses, the following apply:

(1) Except as provided in paragraph (c)(2) of this section, these items must be positioned so that if they break loose, they will be unlikely to:

(i) Cause direct injury to occupants;

(ii) Penetrate fuel tanks or lines or cause fire or explosion hazard by damage to adjacent systems; or

(iii) Nullify any of the escape facilities provided for use after an emergency landing.

(2) When such positioning is not practical (e.g. fuselage mounted engines or auxiliary power units) each such item of mass shall be restrained under all loads up to those specified in paragraph (b)(3) of this section. The local attachments for these items should be designed to withstand 1.33 times the specified loads if these items are subject to severe wear and tear through frequent removal (e.g. quick change interior items). <u>Cargo in cargo compartments located below or forward of all occupants in the airplane need comply only with c(1)(ii).</u>

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3. To amend Section 25.721 to read as follows:

(a) The landing gear system must be designed so that when it fails due to overloads during take-off and landing the failure mode is not likely to cause spillage of enough fuel to constitute a fire hazard. The overloads must be assumed to act in the upward and aft directions - in combination with side loads acting inboard and outboard up to 20% of the vertical load or 20% of the drag load, whichever is greater.

(b) The airplane must be designed to avoid any rupture leading to the spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway, under the following minor crash landing conditions:

(1) Impact at 5 fps vertical velocity, with the airplane under control, at Maximum Design Landing Weight, all gears retracted and in any other combination of gear legs not extended.

(2) Sliding on the ground, all gears retracted up to a 20°yaw angle and as a separate condition, sliding with any other combination of gear legs not extended with 0° yaw.

(c) For configurations where the engine nacelle is likely to come in contact with the ground, the engine pylon or engine mounting must be designed so that when it fails due to overloads (assuming the overloads to act predominantly in the upward direction and separately predominantly in the aft direction), the failure mode is not likely to cause the spillage of enough fuel to constitute a fire hazard.

4. To amend Section 25.963 by revising paragraph 25.963(d) to read as follows:

(d) Fuel tanks must, so far as is practical, be designed, located, and installed so that no fuel is released, in quantities sufficient to start a serious fire, in otherwise survivable emergency landing conditions; and:

(1) Fuel tanks must be able to resist rupture and to retain fuel under ultimate hydrostatic design conditions in which the pressure P within the tank varies in accordance with the formula:

$$P=0.34*K*L$$

where:

P = fuel pressure in psi at each point within the tank

L = a reference distance in feet between the point of pressure and the tank farthest boundary in the direction of loading..

K = 4.5 for the forward loading condition for fuel tanks outside the fuselage contour.

K = 9 for the forward loading condition for fuel tanks within the fuselage contour

K = 1.5 for the aft loading condition

K = 3.0 for the inboard and outboard loading conditions for fuel tanks within the fuselage contour

K = 1.5 for the inboard and outboard loading conditions for fuel tanks outside of the fuselage contour

K = 6 for the downward loading condition

K = 3 for the upward loading condition

(2) Fuel tank internal barriers and baffles may be considered as solid boundaries if shown to be effective in limiting fuel flow.

(3) For each fuel tank and surrounding airframe structure, the effects of crushing and scraping actions with the ground should not cause the spillage of enough fuel, or generate temperatures that would constitute a fire hazard under the conditions specified in §25.721(b).

(4) Fuel tank installations must be such that the tanks will not be ruptured by an engine pylon or engine mounting or landing gear, tearing away as specified in 25.721(a) and (c).

5. To amend § 25.994 to read as follows:

Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in § 25.721(b).

Issued in Washington D.C. on

DRAFT AC – NOT FOR PUBLIC RELEASE
Dated 31 May 2000.

Advisory Circular

U.S. Department of Transportation
Federal Aviation Administration

FUEL TANK STRENGTH IN EMERGENCY LANDING CONDITIONS	Date: Initiated by: ANM-110	AC No. 25.963-2 Change:

1. PURPOSE. This advisory circular (AC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of part 25 of the Federal Aviation Regulations (FAR) related to the strength of fuel tanks in emergency landing conditions.

2. RELATED FAR SECTIONS. Part 25,

Section 25.561, "Emergency Landing Conditions", 25.721 "Landing Gear – General"

3. BACKGROUND. For many years the Federal Aviation Regulations have required fuel tanks within the fuselage contour to be designed to withstand the inertial load factors prescribed for the emergency landing conditions as specified in § 25.561. These load factors have been developed through many years of experience and are generally considered conservative design criteria applicable to objects of mass that could injure occupants if they came loose in a minor crash landing.

a. A minor crash landing is a complex dynamic condition with combined loading. However, in order to have simple and conservative design criteria, the emergency landing forces were established as conservative static ultimate load factors acting in each direction independently.

b. Recognizing that the emergency landing load factors were applicable to objects of mass that could cause injury to occupants and that the rupture of fuel tanks in the fuselage could also be a serious hazard to the occupants, § 4b.420 of the Civil Air Regulations (CAR) part 4b (the predecessor of FAR part 25) extended the emergency landing load conditions to fuel tanks that are located within the fuselage contour. Even though the emergency landing load factors were originally intended for solid items of mass, they were applied to the liquid fuel mass in order to develop hydrostatic pressure loads on the fuel tank structure. The application of the inertia forces as a static load criterion (using the full static head pressure) has been considered a conservative criterion for the typical fuel tank configuration within the fuselage contour. This conservatism has been warranted considering the hazard associated with fuel spillage.

c. The Joint Aviation Requirements (JAR) paragraph 25.963 has required that fuel tanks, both in and near the fuselage, resist rupture under survivable crash conditions. The advisory material associated with JAR 25.963 specifies design requirements for all fuel tanks that, if ruptured, could release fuel in or near the fuselage or near the engines in quantities sufficient to start a serious fire.

d. In complying with the JAR requirement for wing tanks, several different techniques have been used by manufacturers to develop the fuel tank pressure loads due to the emergency landing inertia forces. The real emergency landing is actually a dynamic transient condition during which the fuel must flow in a very short period of time to re-establish a new level surface normal to the inertial force. For many tanks such as large swept wing tanks, the effect is that the actual pressure forces are likely to be much less than that which would be calculated from a static pressure based on a steady state condition using the full geometric pressure head. Because the use of the full pressure head results in unrealistically high pressures and creates a severe design penalty for wing tanks in swept wings, some manufacturers have used the local streamwise head rather than the full head. Other manufacturers have used the full pressure head but with less than a full tank of fuel. These methods of deriving the pressures for wing tanks have been accepted as producing design pressures for wing tanks that would more closely represent actual emergency landing condition. The service record has shown no deficiency in strength for wing fuel tanks designed using these methods.

e. The FAR, prior to amendment 25-___, did not contain a requirement to apply fuel inertia pressure requirements to fuel tanks outside the fuselage contour, however, the FAA has published Special Conditions under FAR Part 21, § 21.16, to accomplish this for fuel tanks located in the tail surfaces. The need for Special Conditions was justified by the fact that these tanks are located in a rearward position from which fuel spillage could directly affect a large portion of the fuselage, possibly on both sides at the same time.

4. <u>GENERAL</u> FAR 25.963(d) as revised by amendment 25- __ requires that fuel tanks must be designed, located, and installed so that no fuel is released in quantities sufficient to start a serious fire in otherwise survivable emergency landing conditions. The prescribed set of design conditions to be considered is as follows:

a. <u>Fuel tank pressure loads</u>. FAR paragraph 25.963(d)(1) provides a conservative method for establishing the fuel tank ultimate emergency landing pressures. The phrase "fuel tanks outside the fuselage contour", with respect to this amendment, is intended to include all fuel tanks where fuel spillage through any tank boundary would remain physically and environmentally isolated from occupied compartments by a barrier that is at least fire resistant as defined in CFR 14, Part 1. In this regard, cargo compartments that share the same environment with occupied compartments would be treated the same as if they were occupied. The ultimate pressure criteria are different depending on whether the fuel tank under consideration is inside, or outside the fuselage contour. For the purposes of this paragraph a fuel tank should be considered inside the fuselage contour if it is inside the fuselage pressure shell. If part of the fuel tank pressure boundary also forms part of the fuselage pressure boundary then that part of the boundary should be considered as being within the fuselage contour. Figures 1 and 2 show examples of an underslung wing fuel tank and a fuel tank within a moveable tailplane, respectively, both of which would be considered as being entirely outside of the fuselage contour.

The equation for fuel tank pressure uses a factor L, based upon fuel tank geometry. Figure 3 shows examples of the way L is calculated for fuel pressures arising in the forward loading condition, while Figure 4 shows examples for fuel pressures arising in the outboard loading condition.

Any internal barriers to free flow of fuel may be considered as a solid pressure barrier provided:

(1) It can withstand the loads due to the expected fuel pressures arising in the conditions under consideration; and

(2) The time "T" for fuel to flow from the upstream side of the barrier to fill the cell downstream of the barrier is greater than 0.5 second. "T" may be conservatively estimated as,

$$T = \frac{V}{\sum_{i=1}^{j} C_{d} a_i \sqrt{2 g h_i K}}$$

where:

V is the volume of air in the fuel cell downstream of the barrier assuming a full tank at 1g flight conditions. For this purpose a fuel cell should be considered as the volume enclosed by solid barriers. In lieu of a more rational analysis, 2% of the downstream fuel volume should be assumed to be trapped air.

j is the total number of orifices in baffle rib

Cd_i is the discharge coefficient for orifice i. The discharge coefficient may be conservatively assumed to be equal to 1.0 or it may be rationally based upon the orifice size and shape

a_i is the area for orifice i

g is the acceleration due to gravity

h_i is the hydrostatic head of fuel upstream of orifice i, including all fuel volume enclosed by solid barriers

K is the pressure design factor for the condition under consideration.

b. Protection against crushing and scraping action.(Compliance with 25.963(d)(3) and 25.721(b) and (c)) Each fuel tank should be protected against the effects of crushing and scraping action (including thermal effects) of the fuel tank and surrounding airframe structure with the ground under the following minor crash landing conditions:

(i) An impact at 5 fps vertical velocity on a paved runway at maximum landing weight, with all landing gears retracted and in any other possible combination of gear legs not extended The unbalanced pitching and rolling moments due to the ground reactions are assumed to be reacted by inertia and by immediate pilot control action consistent with the aircraft under control until other structure strikes the ground. It should be shown that the loads generated by the primary and subsequent impacts are not of a sufficient level to rupture the tank. A reasonable attitude should be selected within the speed range from V_{L1} to 1.25 V_{L2} based upon the fuel tank arrangement.

(ii) Sliding on the ground starting from a speed equal to V_{L1} up to complete stoppage, all gears retracted up to a 20° yaw angle and as a separate condition, sliding with any other possible combination of gear legs not extended with a 0° yaw angle. The effects of runway profile need not be considered.

(iii) The impact and subsequent sliding phases may be treated as separate analyses or as one continuous analysis. Rational analyses that take into account the pitch response of the aircraft may be utilized, however care must be taken to assure that abrasion and heat transfer effects are not inappropriately reduced at critical ground contact locations.

(iv) For aircraft with wing mounted engines, if failure of engine mounts, or failure of the pylon or its attachments to the wing occurs during the impact or sliding phase, the subsequent effect on the integrity of the fuel tanks should be assessed. Trajectory analysis of the engine/pylon subsequent to the separation is not required.

(v) The above emergency landing conditions are specified at maximum landing weight, where the amount of fuel contained within the tanks may be sufficient to absorb the frictional energy (when the aircraft is sliding on the ground)without causing fuel ignition. When lower fuel states exist in the affected fuel tanks these conditions should also be considered in order to prevent fuel-vapor ignition.

c. Engine / Pylon separation. (Compliance with 25.721(c) and 25.963(d)(4))

For configurations where the nacelle is likely to come in contact with the ground, failure under overload should be considered. Consideration should be given to the separation of an engine nacelle (or nacelle + pylon) under predominantlyupward loads and under predominantly aft loads. The predominantly upward load and the predominantly aft load conditions should be analyzed separately.It should be shown that at engine/pylon failure that the fuel tank itself is not ruptured at or near the engine/pylon attachments.

d. Landing gear separation. (Compliance with 25.721(a) and 25.963(d)(4))

Failure of the landing gear under overload should be considered, assuming the overloads to act in any reasonable combination of vertical and drag loads, in combination with side loads acting both inboard and outboard up to 20% of the vertical load or 20% of the drag load, whichever is greater. It should be shown that at the time of separation the fuel tank itself is not ruptured at or near the landing gear attachments. The assessment of secondary impacts of the airframe with the ground following landing gear separation is not required. If the subsequent trajectory of a separated landing gear would likely puncture an adjacent fuel tank, design precautions should be taken to minimize the risk of fuel leakage.

e. Compliance with the provisions of this paragraph may be shown by analysis or tests, or both.

5. RELATED FAR SECTION AND ADVISORY CIRCULAR

a. Supporting structure. In accordance with § 25.561(c) all large mass items that could break loose and cause direct injury to occupants must be restrained under all loads specified in § 25.561(b). To meet this requirement, the supporting structure for fuel tanks, should be able to withstand each of the emergency landing load conditions, as far as they act in the 'cabin occupant sensitive directions', acting statically and independently at the tank center of gravity as if it were a rigid body. Where an empennage includes a fuel tank, the empennage structure supporting the fuel tank should meet the restraint conditions applicable to large mass items in the forward direction.

b. Auxiliary fuel tanks. FAA Advisory Circular 25-8 "Auxiliary Fuel System Installations", provides additional information applicable to auxiliary fuel tanks carried within the fuselage. This AC 25.963-2 supersedes the emergency landing fuel pressure criteria from AC 25-8.

Figure 1: Diagram of Fuel Tank in Underslung Wing that is Outside of the Fire Resistant Boundary

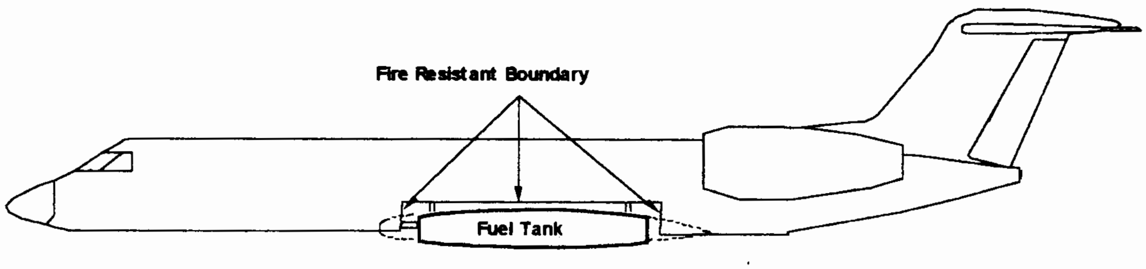


Figure 2: Diagram of Fuel Tank Within a Movable Tailplane

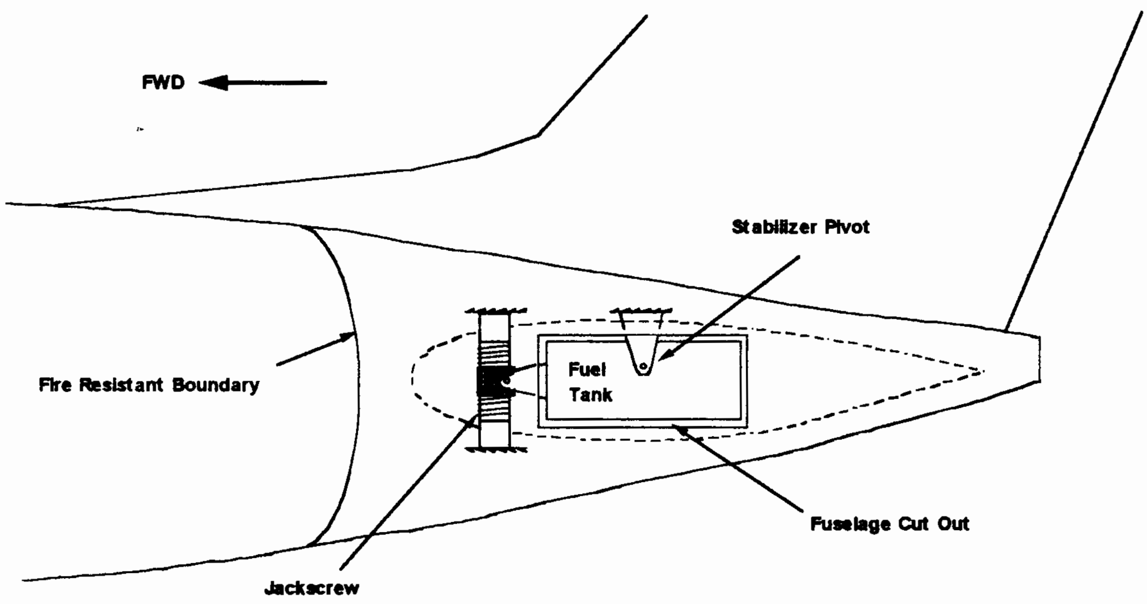
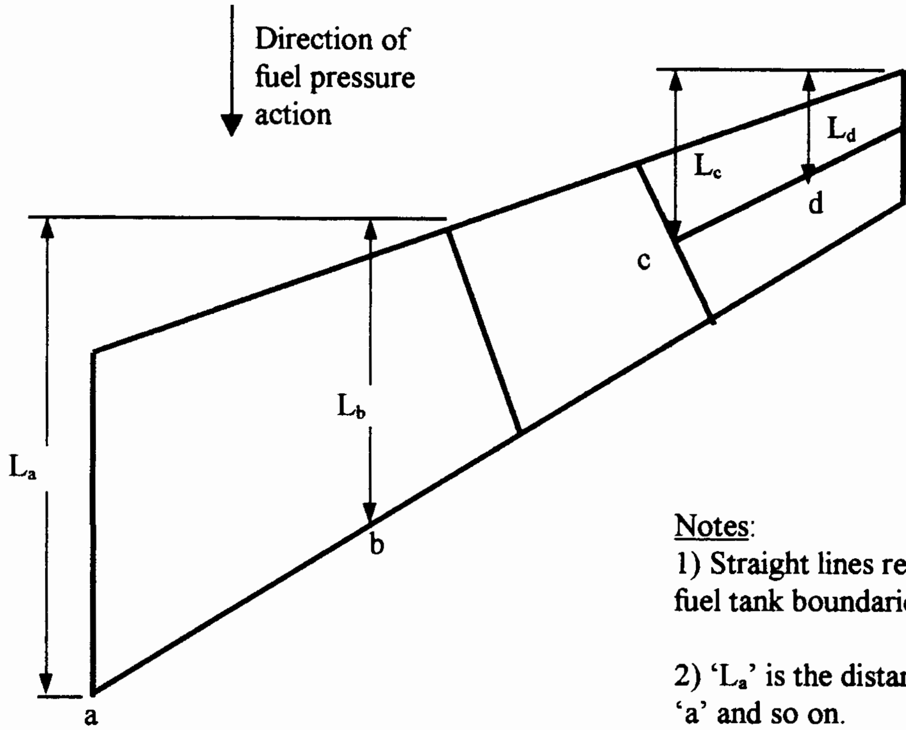


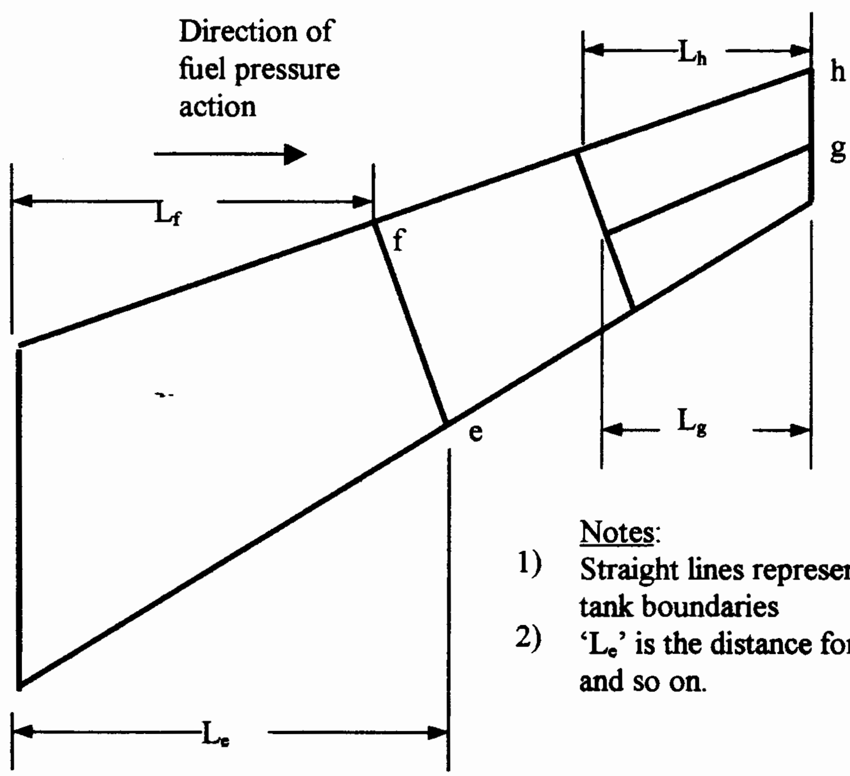
Figure 3- Example of Distances For Fuel Forward Acting Design Pressure Calculations



Notes:
1) Straight lines represent solid fuel tank boundaries.

2) 'L_a' is the distance for point 'a' and so on.

Figure 4 - Example of Distances For Fuel Outboard Acting Design Pressure Calculations



Notes:
1) Straight lines represent solid fuel tank boundaries
2) 'L_e' is the distance for point 'e' and so on.

Comments Received from L&D HWG as of 19 June 2000 on Fuel Tank Documents Submitted to TAEIG

Note: each member of the L&D HWG was provided the opportunity to comment on the WG report, NPRM and AC. Each was given 4 options:

A. I have no comments and I accept the document as written.
B. I object to the document going forward, for reasons given in the attached comments.
C. I can accept the document, but suggest improvements in the attached comments.
D. I do not fully agree with the document for reasons given in the attached comments, but I agree not to object to the proposal.

All responders selected A except for the following who had additional comments and thus selected "C" - I can accept the document, but suggest improvements in the attached comments. **The one exception is Boeing. They have selected "B" - I object to the document going forward, for reasons given in the attached comments.** Boeing comments are at the end of this document.

1. WG Report

a) Christian Beaufils – Airbus Industrie

PROPOSED WG report for 25.561,25.721,25.963 & 25.994

Airbus comments on draft dated 13 June 2000-06-16

The following improvements are proposed, as indicated in bold.

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed?

The JAA has an ACJ 25.963(d) to require additional items under a broad interpretation of JAR 25.963(d) and JAR 25.721. In addition Certification Review Items have been use to provide additional criteria. **Recognizing that the local fuel head has been used in the past to justify crash capabilities of fuel tanks, JAA issued an interim policy in 1991 (INT/POL/25/9) allowing such an interpretation, in replacement of ACJ 25.963(d).**

The FAA has imposed fuel inertia loading condition on tailplane tanks outside the fuselage contour by use of a Special Condition:

Tailplane Tank Emergency Landing Loads. In addition to the requirements of § 25.963(d), the following applies;
(a) The tailplane tank in the horizontal stabilizer must be able to resist rupture and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in § 25.561.

(b) For the side load condition the quantity of fuel need not exceed 85 percent when determining pressure loads outside the fuselage contour for the 3g lateral direction.

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in?:

The main difference derives from JAR Paragraph 25.963(d) and the interpretations for 25.963(d) in ACJ 25.963(d) **and INT/POL/25/9**.

ACJ 25.963(d) **and INT/POL/25/9** provide that the tanks outside the fuselage but inboard of the landing gear, or adjacent to the most outboard engine support the support the emergency landing loads of 25.561. ~~**All tanks outside the fuselage contour are assumed to be 85 percent full.**~~

ACJ 25.963(d) **and INT/POL/25/9** also provide that fuel tank installations should be such that the tanks will not be ruptured by the airplane sliding with its landing gear retracted, nor an engine mounting tearing away.

4 - What, if any, are the differences in the current means of compliance?

ACJ 25.963(d), **INT/POL/25/9** and a JAA Certification review items provide the means of compliance with 25.963(d) and also impacts 25.721 and 25.994. This includes fuel inertia loading for tanks outside the fuselage contour, considerations of sliding on the runway with combinations of landing gear not extended, additional landing gear breakaway criteria, and conditions of nacelles breaking away.

In compliance with the ACJ interpretation of JAR 25.963(d)**, prior issuance of INT/POL/25/9,** the US manufacturers have used a chordwise head to determine fuel pressure under emergency landing load factors. The European manufacturers have used 85 percent of the maximum permissible volume

7 – How does this proposed standard address the underlying safety issue (identified under #1)?

- The proposed change to 25.561 would ensure fuel tanks **and lines** would be protected from cargo shifting in the cargo compartment under emergency landing condition.

8 – Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain.

An increase in the level of safety because it adds fuel tank pressure load criteria to fuel tanks outside the fuselage contour, provides additional break-away criteria for nacelles, and a requirement to consider **a wheels-up landing condition including the** fuel tank heating **in case of fuel tank scraping action with the ground**.

17. - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

Advisory Circular AC 25~~.783-1A~~ **963-2** is submitted with full consensus of the working group **(LCH note – this has been corrected in copy submitted to TAEIG)**

C.Beaufils. (Airbus)
16 June 2000

b) Jack Grabowski - Transport Canada

To: Larry Hanson/SAV/GAC@GAC
cc:

Subject: RE: Fuel Tank Sign -Off

Larry,
I will be signing all three sign-off sheets as C (with comments). My comments are in the nitpicking category - wording, typos etc.
I think that we should be careful with the phrases 'minor crash', 'wheels up' and where they are used since there are already existing definitions for the above and the additional uses implied may cause confusion. The comments below are placed under the three topics that we are signing for even though they may be repetitious.

Working Group Report.

Question 6 Item 2. Amend Section 25.721........

(b) The airplane must be designed to avoid any rupture leading to the spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway under the following minor crash landing conditions:

Question 6 Item 4. Amend Section 25.994........

Fuel system .... to constitute a fire hazard as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in 25.721(b).

Justification for removal: 25.721 specifies more than a simple 'wheels-up' condition

Question 7 Bullet 6.

A decent descent rate of 5 fps for the minor crash landing condition is established for the purposes of protecting fuel tanks in emergency landing conditions.

Question 7 Bullet 10.

The minor crash landing conditions is clarified for section 25.994 are clarified by referencing 25.721(b).

Question 17

Advisory Circular 25.783-1 addresses doors etc, Surely this is an incorrect reference. **(LCH Note: this has been corrected in the AC submittal to TAEIG)**

Question 20

The answer 'Yes' is ambiguous since there are two questions asked and no explanation provided.

2. NPRM

a) Christian Beaufils Airbus- Industrie

Proposed NPRM for 25.561,25.721,25.963 & 25.944

Airbus comments on draft dated 31 May 2000

The following improvement is proposed:

Add ' unless the landing gear configuration is shown to be extremely improbable' at end of sentences from 25.721(b)(1) and (b)(2).

Rationale:

The issue is about protection of fuel tanks against risk of fuel spillage which could lead to a fire hazard, in abnormal landing conditions where none or only some of the landing gear legs are extended.

The 5fps 'minor crash landing condition' prescribed in 25.721(b), with the proposed AC 25.963-2 interpretation, has been agreed by the LDHWH as one acceptable requirement condition to address this issue.

Airbus confirms agreement with this prescribed condition but emphasizes that this should be only ONE way, and we should not exclude for future a/c an alternative which would increase the level of safety compared with current standards. This alternative would be to design the landing gear systems so that all or some gear-up configurations would be extremely improbable, thus avoiding the landing gear configurations which could lead to risk of fuel spillage at landing.

This would lead to an increase of the a/c level of safety as instead of relying on a 'simplistic' 5fps minor crash condition, as proposed in 25.721(b), the landing gear configuration would be avoided.

Without such an alternative in the rule, there will be no incentive to promote such design improvement in the future.

C.Beaufils (Airbus)
16 June 2000

b) Jack Grabowski - Transport Canada

To: Larry Hanson/SAV/GAC@GAC
cc:

Subject: RE: Fuel Tank Sign -Off

Larry,
I will be signing all three sign-off sheets as C (with comments). My comments are in the nitpicking category - wording, typos etc.
I think that we should be careful with the phrases 'minor crash', 'wheels up' and where they are used since there are already existing definitions for the above and the additional uses implied may cause confusion. The comments below are placed under the three topics that we are signing for even though they may be repetitious.

Draft NPRM under Proposed Amendments.

3. To amend Section 25.721 to read as follows:

(b) The airplane .... as a result of a wheels-up landing on a paved runway under the following minor crash landing conditions:

(1) *********

(2) *********

(c) for configurations where .... so that when it fails failure occurs due to overloads ....

4. To amend Section 25.963 ......

(d)(4) Fuel tank installations ....or landing gear, tearing away separating as specified in 25.721(a) and (c).

5. To amend Section 25.994 to read as follows:

Fuel systems components ...... as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in 25.721(b).

3. AC

a) Christian Beaufils Airbus – Industrie

Proposed AC on 'Fuel Tank Strength in Emergency Landing Conditions'

Airbus comments on draft dated 31 May 2000

The following improvement is proposed.

§ 4(b) (I) and (ii)

Add ' **unless the landing gear configuration is shown to be extremely improbable**' within these paragraphs, in line with the proposed change for 25.721(b)(1) and (b)(2).

Rationale: see comments to NPRM

§ 4(b) (i)

It is better to keep the last sentence as agreed in Munich :

'Considering the fuel tank arrangement, a reasonable aircraft attitude and speed within the speed range from VL to 1.25 VL2 should be selected'.

§ 4(b)(iv)

It is not clear when the analysis should stop, in case of pylon/engine mounts failure. As the engine/pylon trajectory analysis is not required after engine/pylon separation, it seems illogical to go beyond this point in time.

Therefore, it is proposed to add the following sentence:
' **The assessment of secondary impacts of the airframe with the ground following engine/pylon separation is not required.**'

C.Beaufils (Airbus)
16 June 2000

b) Jack Grebowski - Transport Canada

To: Larry Hanson/SAV/GAC@GAC
cc:

Subject: RE: Fuel Tank Sign -Off

Larry,
I will be signing all three sign-off sheets as C (with comments). My comments are in the nitpicking category - wording, typos etc.
I think that we should be careful with the phrases 'minor crash', 'wheels up' and where they are used since there are already existing definitions for the above and the additional uses implied may cause confusion. The comments below are placed under the three topics that we are signing for even though they may be repetitious.

Draft AC under Section 4 GENERAL.

(b) Protection against crushing ....
Each fuel tank should be protected ...... with the ground under the following minor crash landing conditions

(b)(iv) and (c) appear to cover the same general area although (c) refers to overload specifically. Therefore, use (b)(iv) for the situation where separation does not occur.

(iv) For aircraft with wing mounted engines, if failure of engine mounts, pylon or its attachments to the wing occurs without separation during the impact or sliding phases, the subsequent effect on the integrity of the fuel tanks in the associated wing structure should be assessed.

(c) Engine/Pylon Separation (Compliance with 25.721(c) and 25.963(d)(4).

For configurations where the nacelle/powerplant is likely to come in contact with the ground, failure under overload should be assessed. Consideration should be given to the separation of the engine nacelle (or nacelle + pylon) from its supporting structure under predominantly upward loads and predominantly aft loads acting separately. It should be shown that, at separation, the fuel tanks in that supporting structure are not ruptured at or near the engine/pylon attachments. Trajectory analysis of the engine/pylon subsequent to separation is not required.

c) Tony Linsdell – Bombardier Aerospace

To: Larry Hanson/SAV/GAC@GAC
cc: al064591@eng.canadair.ca

Subject: Fuel Tank Sign-off

Larry,

Comment on proposed AC 25.963-2
"FUEL TANK STRENGTH IN EMERGENCY LANDING CONDIOTIONS"

The AC is a very good document.

However the last sentence in para 4.b.(i) might lead to a variety of interpretations. I propose 1 additional sentence to help clarification.

In para 4.b.(i) I propose to add the following to the end of the paragraph,

" For example, a reasonable attitude would be as described in the wheels-up-landing procedure in the aircraft flight manual."

regards

Tony Linsdell
Bombardier Aerospace

d) Abe Jibril - Learjet

See suggested change in last sentence below:

b. Protection against crushing and scraping action. (Compliance with 25.963(d)(3) and 25.721(b) and (c)) Each fuel tank should be protected against the effects of crushing and scraping action (including thermal effects) of the fuel tank and surrounding airframe structure with the ground under the following minor crash landing conditions:

(i) An impact at 5 fps vertical velocity on a paved runway at maximum landing weight, with all landing gears retracted and in any other possible combination of gear legs not extended The unbalanced pitching and rolling moments due to the ground reactions are assumed to be reacted by inertia and by immediate pilot control action consistent with the aircraft under control until other structure strikes the ground. It should be shown that the loads generated by the primary and subsequent impacts are not of a sufficient level to rupture the tank. A ~~reasonable~~ **normal landing** attitude should be selected within the speed range from V_{L1} to 1.25 V_{L2}. ~~based upon the fuel tank arrangement.~~

4) General comments

a) Michael Lischke - DASA

DASA Comments on Fuel Tanks draft WG report, NPRM and AC
for 25.561, 25.721, 25.963, 25.944

From: Michael Lischke – DASA

To: Larry Hanson – Gulfstream

Larry,

of course the design of an airplane should avoid a fire hazard after a landing gear system failure as mentioned in 25.721.
The discussion about landing gear failures leads directly to the question of the probability of such a failure, as we discussed very intensively at the last WG meeting in Munich.
From my point of view this is in line with the 25.302 which talks about the probability of system failures in general.
Therefore the WG report, NPRM and AC should be limited to conditions **not extremely improbable.**

Michael Lischke
DASA
16.06.2000

b) Wim Doeland - JAA / RLD

To: Larry Hanson/SAV/GAC@GAC
cc: '"Andrew Goudie"' <andrew.goudie@srg.caa.co.uk>, '"Christophe Vuillot"' <vuillot_christophe@sfact.dgac.fr>

Subject: Submittals to TAEIG

Larry,

On Fuel Tank Crashworthiness (25.721/25.963) it's JAA position that we could accept the rules and advisory material as currently drafted by the L&DHWG. However, we also feel that the quality of the proposed advisory material (i.e. on the minor crash conditions to be considered) may benefit from further discussions by the L&DHWG.

Wim Doeland

c) Michael Green - Boeing

AVIATION RULEMAKING ADVISORY COMMITTEE

LOADS AND DYNAMICS HARMONIZATION WORKING GROUP

RECORD OF TECHNICAL CONSULTATION

Date 13 June 2000

PROPOSED NPRM FOR 25.561,25.721, 25.963, &25.944 Draft Dated: 31 May 2000

TITLE: **Revised Requirements for Structural Integrity of Fuel Tanks**

The referenced **NPRM** has been issued for consultation, and reviewed both at and subsequent to the Munich meeting.

In the opinion of the Chairman this document is ready for final acceptance.

As a member of the L&D HWG, please sign below, along with indicating the company that you represent plus a selection of a category from A through D below.

A. I have no comments and I accept the **NPRM** as written.
B. I object to the **NPRM** going forward, for reasons given in the attached comments.
C. I can accept the **NPRM**, but suggest improvements in the attached comments.
D. I do not fully agree with the **NPRM** for reasons given in the attached comments, but I agree not to object to the proposal.

Name	Signature	Company	Category A-D
Michael A. Green		Boeing	B (see attached comments)

AVIATION RULEMAKING ADVISORY COMMITTEE

LOADS AND DYNAMICS HARMONIZATION WORKING GROUP

RECORD OF TECHNICAL CONSULTATION
Date 13 June 2000

PROPOSED AC DATE OF DRAFT: 31 May 2000

AC NUMBER: 25.963-2

TITLE: **Fuel Tank Strength In Emergency Landing Conditions**

The referenced AC has been issued for consultation, and reviewed both at and subsequent to the Munich meeting. In the opinion of the Chairman this document is ready for final acceptance.

As a member of the L&D HWG, please sign below, along with indicating the company that you represent plus a selection of a category from A through D below.

A. I have no comments and I accept the AC as written.
B. I object to the AC going forward, for reasons given in the attached comments.
C. I can accept the AC, but suggest improvements in the attached comments.
D. I do not fully agree with the AC for reasons given in the attached comments, but I agree not to object to the proposal.

Name	Signature	Company	Category A-D
Michael A. Green		Boeing	B (see attached comments)

PROPOSED NPRM AND AC FOR 25.561,25.721, 25.963, &25.944 Draft Dated: 31 May 2000

Boeing Comments

The NPRM and AC being proposed are a more rigid interpretation of current requirements that do not recognize nor allow for the continuation of previous good design practices, and imply costly and extensive analyses in order to satisfy these requirements.

The proposed NPRM requires a wheels up landing analysis with a descent rate of 5 feet per second (fps). While we agree that requirements for protection of fuel tanks are necessary, the strict application of a 5-fps wheels up landing scenario may go beyond the intent of the proposed rule. It is clear that the proposed rule is not intended to address a safety problem in the existing fleet, but rather to clarify the existing requirements, eliminate the use of special conditions and certification review items, and maintain an existing level of safety for future designs. The current requirements for fuel tank protection do not specify a descent rate for the wheels up condition. Five feet per second has, in the past, appeared in paragraph 25.561(b)(3)(iv) as an alternate means of determining the downward minor crash landing load factors only (the 5 fps alternative was removed at Amendment 64). Five feet per second descent rate for wheels up landing has never been a specific requirement. The requirement for protection of fuel tanks during minor crash landings has been levied by Certification Review Items on Boeing airplanes, where the 5 fps descent rate has been specified as "an acceptable interpretation", not as the only means of compliance. The accepted means of compliance has been to maintain and demonstrate equivalent levels of safety by continuing with design features that have a proven safety record. The Boeing fleet, through extensive fleet history, has a proven design philosophy providing robustness between safe separation of nacelles and fuel tank protection for wheels up landing. The Boeing design philosophy does not specifically include an analysis at 5 fps descent speed, but instead includes a qualitative assessment of the design that ensures an equivalent level of safety with existing proven designs.

The proposed AC provides a means of compliance that implies detailed analyses of specific wheels up landing and sliding scenarios. While tools exist which may be used to simulate these complex scenarios, we are not confident in the design implications or the cost impacts of such analyses. There are no alternate means of compliance discussed which would allow for demonstration of good design practice based on extensive fleet history and proven design techniques.

Therefore, we feel that the proposals, without further investigation of analysis techniques and allowances for design practices, should not go forward at this time.

Rules and Regulations

Federal Register

Vol. 79, No. 191

Thursday, October 2, 2014

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No.: FAA–2013–0109; Amdt. No. 25–139]

RIN 2120–AK13

Harmonization of Airworthiness Standards—Miscellaneous Structures Requirements

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This final rule amends certain airworthiness regulations for transport category airplanes, based on recommendations from the FAA-sponsored Aviation Rulemaking Advisory Committee (ARAC). This amendment eliminates regulatory differences between the airworthiness standards of the FAA and the European Aviation Safety Agency (EASA). This final rule does not add new requirements beyond what manufacturers currently meet for EASA certification and does not affect current industry design practices. This final rule revises the structural test requirements necessary when analysis has not been found reliable; clarifies the quality control, inspection, and testing requirements for critical and non-critical castings; adds control system requirements that consider structural deflection and vibration loads; expands the fuel tank structural and system requirements regarding emergency landing conditions and landing gear failure conditions; adds a requirement that engine mount failure due to overload must not cause hazardous fuel spillage; and revises the inertia forces requirements for cargo compartments by removing the exclusion of compartments located below or forward of all occupants in the airplane.

DATES: Effective December 1, 2014.

ADDRESSES: For information on where to obtain copies of rulemaking documents and other information related to this final rule, see ''How to Obtain Additional Information'' in the **SUPPLEMENTARY INFORMATION** section of this document.

FOR FURTHER INFORMATION CONTACT: For technical questions concerning this action, contact Todd Martin, Airframe and Cabin Safety Branch, ANM–115, Transport Airplane Directorate, Aircraft Certification Service, Federal Aviation Administration, 1601 Lind Avenue SW., Renton, WA 98057–3356; telephone (425) 227–1178; facsimile (425) 227–1232; email *Todd.Martin@faa.gov.*

For legal questions concerning this action, contact Sean Howe, Office of the Regional Counsel, ANM–7, Federal Aviation Administration, 1601 Lind Avenue SW., Renton, Washington 98057–3356; telephone (425) 227–2591; facsimile (425) 227–1007; email *Sean.Howe@faa.gov.*

SUPPLEMENTARY INFORMATION:

Authority for This Rulemaking

The FAA's authority to issue rules on aviation safety is found in Title 49 of the United States Code. Subtitle I, Section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

This rulemaking is promulgated under the authority described in Subtitle VII, Part A, Subpart III, Section 44701, ''General Requirements.'' Under that section, the FAA is charged with promoting safe flight of civil aircraft in air commerce by prescribing regulations and minimum standards for the design and performance of aircraft that the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority. It prescribes new safety standards for the design of transport category airplanes.

I. Overview of Final Rule

The FAA is amending Title 14, Code of Federal Regulations (14 CFR) 25.307(a), 25.621, 25.683, 25.721, 25.787(a), 25.963(d), and 25.994 as described below. This action harmonizes part 25 requirements with the corresponding requirements in Book 1 of the EASA Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes (CS–25).

1. Section 25.307(a), ''Proof of structure,'' currently requires structural strength testing, unless the applicant has demonstrated that analysis alone is reliable. Paragraph (a) is revised to clarify the load levels to which testing is required, when such testing is required.

2. Section 25.621, ''Casting factors,'' is revised to clarify the quality control, inspection, and testing requirements for critical and non-critical castings.

3. Section 25.683, ''Operation tests,'' is revised to add a requirement that—

- The control system must remain free from jamming, friction, disconnection, and permanent damage in the presence of structural deflection and
- Under vibration loads, no hazard may result from interference or contact of the control system with adjacent elements.

4. Section 25.721, ''Landing Gear—General,'' is revised to—

- Expand the landing gear failure conditions to include side loads, in addition to up and aft loads, and expand this requirement to include nose landing gear in addition to the main landing gear,
- Specify that the wheels-up landing conditions are assumed to occur at a descent rate of 5 feet per second,
- Add a sliding-on-ground condition, and
- Require the engine mount be designed so that, when it fails due to overload, this failure does not cause the spillage of enough fuel to constitute a fire hazard.

5. Section 25.787, ''Stowage compartments,'' is revised to expand the inertia forces requirements for cargo compartments by removing the exclusion of compartments located below or forward of all occupants in the airplane.

6. Section 25.963, ''Fuel tanks: general,'' is revised to—

- Require that fuel tanks be designed so that no fuel is released in or near the fuselage, or near the engines, in quantities that would constitute a fire hazard in otherwise survivable emergency landing conditions,
- Define fuel tank pressure loads for fuel tanks located within and outside the fuselage pressure boundary and near the fuselage or near the engines, and

• Specify the wheels-up landing conditions and landing gear and engine mount failure conditions that must be considered when evaluating fuel tank structural integrity.

7. Section 25.994, ''Fuel system components,'' is revised to specify the wheels-up landing conditions to be considered when evaluating fuel system components.

II. Background

A. Statement of the Problem

Part 25 of 14 CFR prescribes airworthiness standards for type certification of transport category airplanes, for products certified in the United States. EASA CS–25 Book 1 prescribes the corresponding airworthiness standards for products certified in Europe. While part 25 and CS–25 Book 1 are similar, they differ in several respects. To resolve those differences, the FAA tasked ARAC through the Loads and Dynamics Harmonization Working Group (LDHWG) and the General Structures Harmonization Working Group (GSHWG) to review existing structures regulations and recommend changes that would eliminate differences between the U.S. and European airworthiness standards. The LDHWG and GSHWG developed recommendations, which EASA has incorporated into CS–25 with some changes. The FAA agrees with the ARAC recommendations as adopted by EASA, and this final rule amends part 25 accordingly.

B. Summary of the NPRM

On February 14, 2013, the FAA issued a Notice of Proposed Rulemaking (NPRM), Notice No. 25–137, Docket No. FAA–2013–0109, to amend §§ 25.307(a), 25.621, 25.683, 25.721, 25.787(a), 25.963(d), and 25.994. That NPRM was published in the **Federal Register** on March 1, 2013 (78 FR 13835). (The NPRM Notice No. was corrected to ''13–03'' in the **Federal Register** on April 16, 2014 (79 FR 21413)). In the NPRM, the FAA proposed to (1) revise the structural test requirements necessary when analysis has not been found reliable; (2) clarify the quality control, inspection, and testing requirements for critical and non-critical castings; (3) add control system requirements that consider structural deflection and vibration loads; (4) expand the fuel tank structural and system requirements regarding emergency landing conditions and landing gear failure conditions; (5) add a requirement that engine mount failure due to overload must not cause hazardous fuel spillage; and (6) revise the inertial forces requirements for cargo compartments by removing the exclusion of compartments located below or forward of all occupants in the airplane. The FAA proposed these changes to eliminate regulatory differences between the airworthiness standards of the FAA and EASA. The NPRM comment period closed on May 30, 2013.

C. General Overview of Comments

The FAA received 16 comments from 5 commenters. All commenters generally support the proposal, but they suggested changes discussed more fully below. The FAA received comments on each of the sections being changed, as follows:

- Section 25.307(a)—four comments
- Section 25.621—four comments
- Section 25.683—one comment
- Section 25.721—one comment
- Section 25.787(a)—two comments
- Section 25.963(d)—three comments
- Section 25.994—one comment

III. Discussion of Public Comments and Final Rule

A. Section 25.307, Proof of Structure

In the NPRM, the FAA proposed revising paragraph (a) of § 25.307 to require that, when structural analysis has not been shown to be reliable, substantiating tests must be made to load levels that are sufficient to verify structural behavior up to limit and ultimate loads of § 25.305.

One commenter stated that § 25.305 includes both limit and ultimate loads, so it is unclear which ''loads'' were intended by this change. More importantly, ''up to'' could mean any load level below limit or below ultimate and as such is indefinite. For example, an applicant could choose a load level of 10 percent of limit load and be in compliance with the proposed rule. The commenter proposed changing ''up to loads specified in § 25.305'' to ''at least limit load as specified in § 25.305.''

The FAA believes the wording proposed in the NPRM is correct, and no change is necessary. The phrase ''up to'' does not apply to the test load level; it applies to the design load level—the loads specified in § 25.305, including ultimate loads—which must be verified. The intent of the rule is that, when analysis has not been shown to be reliable, tests must be conducted to ''sufficient'' load levels. Normally, testing to ultimate load levels is required, but when previous relevant test evidence can be used to support the analysis, a lower level of testing may be accepted. The rule allows this intermediate level of testing. Advisory Circular (AC) 25.307–1, ''Proof of Structure,'' which the FAA is issuing concurrently with the final rule, provides detailed guidance on means of compliance with the rule.

Another commenter recommended changing the word ''reliable'' in the proposed rule to ''dependable and conservative.'' The term ''reliable'' has been in place since this rule was originally published in 1965. As stated in the NPRM, while the rule has changed, the rule intent remains the same. We believe ''reliable'' is appropriate and clear, and no change is necessary.

The same commenter also recommended noting that, where justified, test load levels may be less than ultimate. We do not believe this change is necessary because it is already expressed in the rule that substantiating tests must be made to load levels that are sufficient to verify structural behavior up to loads specified in § 25.305.

The same commenter also recommended the FAA add further explanation about the absolute need to validate models and when lack of validation might be acceptable. We do not believe it is necessary to revise the rule to address validation, since that subject relates to the acceptability of an applicant's showing of compliance rather than to the airworthiness standard itself. This subject is thoroughly addressed in the accompanying AC 25.307–1. We have not revised the final rule in this regard.

B. Section 25.621, Casting Factors

With this rulemaking, the FAA clarifies ''critical castings'' as each casting whose failure could preclude continued safe flight and landing of the airplane or could result in serious injury to occupants. One commenter agreed that improved foundry methods have resulted in higher quality castings but not to the point where a casting factor less than 1.25 is justified. The commenter recommended to either (1) eliminate the option for casting factors of 1.0 for critical castings, or (2) ensure that the characterization of material properties that are equivalent to those of wrought alloy products of similar composition includes the effect of defects in the static strength, fatigue, and damage tolerance requirements. The commenter provided the following examples of defects that could affect material properties: shell defects, hard-alpha contamination, shrink, porosity, weld defects, grain size, hot tears, incomplete densifications, and prior particle boundaries, among others.

The FAA does not agree with the commenter's first recommendation to eliminate the option for using a casting factor of 1.0 for critical castings. The criteria specified in the final rule will ensure product quality that is sufficient to justify using a casting factor of 1.0. According to the rule, to qualify for a casting factor of 1.0, the applicant must demonstrate, through process qualification, proof of product, and process monitoring, that the casting has coefficients of variation of the material properties that are equivalent to those of wrought alloy products of similar composition. The rule requires process monitoring that includes testing of coupons and, on a sampling basis, coupons cut from critical areas of production castings. In addition, the applicant must inspect 100 percent of the casting surface of each casting, as well as structurally significant internal areas and areas where defects are likely to occur. The applicant must also test one casting to limit and ultimate loads. The purpose of the minimum casting factor of 1.25 in the current rule is to increase the strength of the casting to account for variability in the casting process. In the final rule, the additional process, inspection, and test requirements required to use a casting factor less than 1.25 ensure a more consistent product and maintain the same level of safety as the existing standards. AC 25.621–1, ''Casting Factors,'' provides detailed guidance on the premium casting process necessary to allow a casting factor of 1.0, and the FAA is issuing that AC concurrently with this final rule.

The FAA partially agrees with the commenter's second recommendation, which is to ensure that the characterization of material properties that are equivalent to those of wrought alloy products of similar composition includes the effect of defects in the static strength, fatigue, and damage tolerance requirements. The rule requires that the characterization of material properties includes the effect of defects with regard to static strength. If any type of defect is discovered during process qualification, proof of product, or process monitoring, or by any inspection or static strength test, such that the coefficients of variation of the material properties are not equivalent to those of wrought alloy products of similar composition, then that casting would not qualify for a casting factor of 1.0. These defects include each of the examples identified by the commenter, as well as any other type of defect that could affect material properties. In addition, as noted previously, AC 25.621–1, which the FAA is issuing concurrently with the final rule, provides detailed guidance on the premium casting process necessary to allow a casting factor of 1.0. The AC includes reference to and addresses defects as proposed by the commenter.

We do not, however, agree that the characterization of material properties to determine the appropriate casting factor should include the effect of defects on fatigue and damage tolerance properties. Since casting factors apply only to strength requirements, rather than fatigue and damage tolerance requirements, the comparison of cast material to wrought material should only be based on material strength properties, rather than fatigue and damage tolerance characteristics.

Section 25.621(c)(2)(ii)(B) specifies a factor of 1.15 be applied to limit load test values to allow an applicant to use a casting factor of 1.25. Section 25.621(c)(3)(ii)(B) also specifies a factor of 1.15 be applied to limit load test values to allow a casting factor of 1.5. One commenter recommended that the 1.15 test factor in § 25.621(c)(3)(ii)(B) be scaled up by a factor of 1.2 (1.5/1.25), so as to align with the corresponding ultimate requirement. The 1.15 limit load test factor in § 25.621(c)(3)(ii)(B) would then be 1.38 (i.e., $1.5/1.25 \times 1.15$; 1.15 being required already in conjunction with the 1.25 casting factor for ultimate).

The FAA does not agree that for critical castings with a casting factor of 1.25 or 1.5, the limit load test factor should be linked to the ultimate load test factor. The ultimate and limit load tests have different purposes. The ultimate load test confirms ultimate load capability, while the limit load test confirms that no deformation will occur up to a much lower load level. Therefore, we see no reason to link the two test factors, and we believe the 1.15 factor specified in § 25.621(c)(3)(ii)(B) is appropriate, as recommended by ARAC and as currently specified in EASA CS 25.621.

The same commenter recommended modifying § 25.621(c) by adding a reference to § 25.305 for clarity—that each critical casting must have a factor associated with it for showing compliance with the strength and deformation requirement ''of § 25.305.'' We agree and have revised the final rule as recommended.

The same commenter noted that § 25.621 only refers to static testing and does not include any requirements for fatigue testing. The commenter stated that critical castings should also comply with § 25.571 concerning fatigue and damage tolerance. The commenter recommended including information to remind manufacturers of this requirement. The FAA agrees with the commenter that § 25.571 applies to critical castings. We believe the current wording in § 25.571 and the new wording in § 25.621 is sufficiently clear on this point, and no changes to these requirements are necessary.

No other public comments were received on § 25.621. However, after further FAA review, we revised the rule in several places to specify ''visual inspection and liquid penetrant or equivalent inspection methods.'' This change is to clarify ''equivalent inspection methods'' refers to the liquid penetrant inspection, and not the visual inspection. Although there is some textual difference between this and CS 25.621, there is no substantive difference between the two harmonized rules.

C. Section 25.683, Operation Tests

A commenter noted that the control systems to which § 25.683(b) applies are those control systems that obtain the pitch, roll, and yaw limit maneuver loads of the airplane structure. For example, an applicant must take into account the elevator, rudder, and aileron because these control surfaces obtain the referenced maneuver loads, while high lift systems do not need to be considered under § 25.683(b). The commenter suggested that we clarify this in the preamble to the final rule. The FAA agrees and hereby clarifies that § 25.683 only applies to those control systems that are loaded to obtain the specified maneuver loads. No change to the final rule text is necessary.

No other public comments were received on § 25.683. We would like to explain what is meant by ''where necessary'' as used in § 25.683(b). The rule states: ''It must be shown by analysis and, *where necessary,* by tests, that in the presence of deflections of the airplane structure,'' the control system operates without jamming, excessive friction, or permanent damage. The FAA may accept analysis alone to comply with this requirement. However, the FAA or the applicant may determine that, in certain cases, some testing is necessary to verify the analysis. For example, some testing may be necessary if the structure or control system is significantly more complex than a previous design, or if the analysis shows areas where the control system could be susceptible to jamming, friction, disconnection or damage. Testing may include component testing or full-scale tests.

D. Section 25.721, Landing Gear—General

A commenter proposed to add a paragraph (d) to § 25.721 to state that the conditions in paragraphs (a) through (c) must be considered regardless of the corresponding probabilities. The FAA does not believe this addition is necessary. The various failure conditions in the rule are stated directly, and the FAA intended no implication that the probability of these failure conditions may be taken into account. However, because the FAA proposed that a failure mode *not be likely* to cause the spillage of enough fuel to constitute a fire hazard, the proposal may have implied that an applicant should take probability into account to determine whether the failure conditions would lead to fuel spillage. The FAA did not intend this. Probability should not be taken into account to determine whether the failure mode will lead to fuel spillage.

No other public comments were received on § 25.721. However, after further FAA review, we revised § 25.721(b) to clarify its intent. We removed the phrase ''as separate conditions,'' which was proposed in § 25.721(b)(1)(i) and (b)(2)(i), because we believe that phrase is confusing. In § 25.721(b)(1)(ii) and (b)(2)(ii), we also changed the proposed phrase ''any other combination of landing gear legs not extended'' to ''any one or more landing gear legs not extended'' which is the same phrase used in § 25.721(b) at Amendment 25–32. We made this change to ensure that applicants are required to address every possible combination of landing gear legs not extended, including single landing gear legs not extended. This is consistent with the way EASA has applied its rule.

Both §§ 25.721(b) and 25.994 final rules use the phrase ''wheels-up landing.'' This phrase has been used in § 25.994 since that rule was adopted at Amendment 25–23. A ''wheels-up landing'' includes every possible combination of landing gear legs not extended, including single landing gear legs not extended, and all gears fully retracted.

E. Section 25.787, Stowage Compartments

To date, § 25.787(a) has required that cargo compartments be designed to the emergency landing conditions of § 25.561(b), but excluded compartments located below or forward of all occupants in the airplane. The FAA now revises § 25.787(a) to include compartments located below or forward of all occupants in the airplane. This change would ensure that, in these compartments, inertia forces in the up and aft direction will not injure passengers, and inertia forces in any direction will not cause penetration of fuel tanks or lines, or cause other hazards.

A commenter recommended revising the text to clarify that only those specific emergency landing conditions that would result in one of the three listed effects need to be considered. The FAA agrees, and we have revised the text to clarify this intent.

The same commenter suggested that fires only need to be protected against if they can result in injury to occupants, and the rule text should be revised to clarify that intent. The FAA does not agree that fires only need to be protected against if they can result in injury to occupants. The FAA believes that the wording proposed in the NPRM is correct, and no change is necessary. The requirement intends protection against any fire or explosion on the airplane. Although the FAA agrees the objective of the rule is to prevent injuries to occupants, the FAA considers any fuel tank fire or explosion in an otherwise survivable landing as potentially injury-causing.

F. Section 25.963, Fuel Tanks: General

One commenter suggested that exactly the same wording be used in § 25.963(d) and CS 25.963(d). EASA CS 25.963(d) requires that no fuel be released in quantities ''sufficient to start a serious fire'' in otherwise survivable emergency landing conditions. Proposed § 25.963(d) would have required that no fuel be released in quantities ''that would constitute a fire hazard.'' The FAA stated in the NPRM that the two phrases have the same meaning, and that proposed § 25.963(d) was more consistent with the wording of the other related sections.

The FAA is adopting the wording proposed in the NPRM as more appropriate. As noted in the NPRM, the two phrases have the same meaning, and the latter phrase is consistent with the wording in CS 25.721/§ 25.721, CS 25.963(d)(4)/§ 25.963(d)(4), and CS 25.994/§ 25.994. In addition, EASA agrees with and supports the NPRM. In recent special conditions, the FAA has defined a hazardous fuel leak as ''a running leak, a dripping leak, or a leak that, 15 minutes after wiping dry, results in a wetted airplane surface exceeding 6 inches in length or diameter.'' We regard this as an appropriate definition of the amount of fuel that would ''constitute a fire hazard'' as specified in §§ 25.721, 25.963, and 25.994.

Another commenter suggested modifying § 25.963(d)(5) to reference landing gear before engine mounts in the rule text, since these are referred to respectively in § 25.721(a) and (c). The FAA agrees and the recommended change has been made.

EASA CS 25.963(e)(2) provides the fire protection criteria for fuel tank access covers. A commenter recommended that § 25.963(e)(2) be revised to match CS 25.963(e)(2), which the commenter believes is clearer. The FAA notes that this paragraph was not addressed in the NPRM and so will not be addressed in this final rule. The FAA might consider harmonizing this paragraph in the future.

No other public comments were received on § 25.963. However, after further FAA review, we determined that further explanation of the various requirements in § 25.963(d) would be beneficial. Section 25.963(d), as revised by Amendment 25-**, requires that ''Fuel tanks must, so far as it is practicable, be designed, located, and installed so that no fuel is released in or near the fuselage, or near the engines, in quantities that would constitute a fire hazard in otherwise survivable emergency landing conditions. . . .'' In addition to this primary requirement, § 25.963(d)(1) through (d)(5) provide minimum quantitative criteria. Survivable landing conditions may occur that exceed, or are not captured by, the conditions specified in § 25.963(d)(1) through (d)(5). Therefore, to meet the introductory requirement in § 25.963(d), every practicable consideration should be made to ensure protection of fuel tanks in more severe crash conditions, especially tanks located in the fuselage below the main cabin floor.

The fuel tank pressure loads specified in § 25.963(d) vary depending on whether the fuel tank is within or outside the pressure boundary. For certification of unpressurized airplanes, all fuel tanks should be considered to be ''within'' the fuselage pressure boundary, unless a fire resistant barrier exists between the fuel tank and the occupied compartments of the airplane.

Finally, the FAA notes that, for future rulemaking, we plan to consider specific crashworthiness requirements that would exceed the quantitative criteria specified in §§ 25.561, 25.721, and 25.963. Also, the FAA has recently applied special conditions on certain airplanes that require a crashworthiness evaluation at descent rates up to 30 feet per second.

G. Section 25.994, Fuel System Components

To date, § 25.994 has required that fuel system components in an engine nacelle or in the fuselage be protected from damage that could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway. We proposed to revise § 25.994 to specify that the wheels-up landing conditions that must be considered are those prescribed in § 25.721(b).

A commenter proposed two changes to what the FAA proposed: (1) Add a reference to § 25.721(c), and (2) change the order in which the nacelles and the fuselage are referenced, based on the order the fuselage and nacelle are addressed in § 25.721. We do not agree with the proposed changes. Adding a reference to § 25.721(c) would not be correct because wheels-up landing conditions are only listed in § 25.721(b). Since § 25.721(c) is not referenced in § 25.994, and since § 25.721(b) does not refer to the fuselage or nacelles, there is no reason to change the order in which the fuselage and nacelles are specified in § 25.994.

H. Advisory Material

On March 13, 2013, the FAA published and solicited public comments on three proposed ACs that describe acceptable means for showing compliance with the proposed regulations in the NPRM. The comment period for the proposed ACs closed on June 14, 2013. Concurrently with this final rule, the FAA is issuing the following new ACs to provide guidance material for the regulations adopted by this amendment:

- AC 25–30, ''Fuel Tank Strength in Emergency Landing Conditions.'' (AC 25–30 would provide guidance for the fuel tank structural integrity requirements of §§ 25.561, 25.721, and 25.963.)
- AC 25.307–1, ''Proof of Structure.''
- AC 25.621–1, ''Casting Factors.''

IV. Regulatory Notices and Analyses

A. Regulatory Evaluation

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 and Executive Order 13563 direct that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, the Trade Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this final rule.

Department of Transportation Order DOT 2100.5 prescribes policies and procedures for simplification, analysis, and review of regulations. If the expected cost impact is so minimal that a proposed or final rule does not warrant a full evaluation, this order permits that a statement to that effect and the basis for it be included in the preamble if a full regulatory evaluation of the cost and benefits is not prepared. Such a determination has been made for this final rule. The reasoning for this determination follows.

The FAA is amending certain airworthiness standards for transport category airplanes. Adopting this final rule would eliminate regulatory differences between the airworthiness standards of the FAA and the EASA. This final rule does not add new requirements as U.S. manufacturers currently meet EASA requirements. Meeting two sets of certification requirements imposes greater costs for developing new transport category airplanes with little to no increase in safety. In the interest of fostering international trade, lowering the cost of manufacturing new transport category airplanes, and making the certification process more efficient, the FAA, EASA, and several industry working groups came together to create, to the maximum extent possible, a single set of certification requirements that would be accepted in both the United States and Europe. Therefore, as a result of these harmonization efforts, the FAA is amending the airworthiness regulations described in section I of this final rule, ''Overview of the Final Rule.'' This action harmonizes part 25 requirements with the corresponding requirements in EASA CS–25 Book 1.

In order to sell their aircraft in Europe, all manufacturers of transport category airplanes, certificated under part 25 must be in compliance with the EASA certification requirements in CS–25 Book 1. Since future certificated transport airplanes are expected to meet CS–25 Book 1, and this rule simply adopts the same EASA requirements, manufacturers will incur minimal or no additional cost resulting from this final rule. Therefore, the FAA estimates that there are no additional costs associated with this final rule.

In fact, manufacturers could receive cost savings because they will not have to build and certificate transport category airplanes to two different authorities' certification specifications and rules. Further, harmonization of these airworthiness standards, specifically § 25.621 may benefit manufacturers by providing another option in developing aircraft structures. The final rule permits use of a lower casting factor for critical castings, provided that tight controls are established for the casting process, inspection, and testing, which lead to cost savings in terms of aircraft weight. These additional controls are expected to at least maintain an equivalent level of safety as provided by existing regulations for casting factors.

The FAA has not attempted to quantify the cost savings that may accrue from this final rule, beyond noting that, while they may be minimal, they contribute overall to a potential harmonization savings. The agency concludes that because the compliance cost for this final rule is minimal and there may be harmonization cost savings, further analysis is not required.

During the public comment period, the Agency received 16 comments from 5 commenters. There were no comments regarding costs to this final rule; however, one commenter raised concern for safety in § 25.621. Details of this comment and the FAA's response can be found in the ''General Overview of Comments'' section. These harmonization efforts ensure that the current level of safety in transport category airplanes is maintained while encouraging the use of modern casting process technology.

The agency concludes that the changes would eliminate regulatory differences between the airworthiness standards of the FAA and EASA resulting in potential cost savings and maintaining current levels of safety. The FAA has, therefore, determined that this final rule is not a ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866, and is not ''significant'' as defined in DOT's Regulatory Policies and Procedures.

B. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

However, if an agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify, and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

The FAA believes that this final rule does not have a significant economic impact on a substantial number of small entities for the following reasons. The net effect of this final rule is minimum regulatory cost relief, as the rule would adopt EASA requirements that the industry already meets. Further, all United States transport category aircraft manufacturers exceed the Small Business Administration small-entity criteria of 1,500 employees. The Agency received no comments regarding the Regulatory Flexibility Act during the public comment period.

If an agency determines that a rulemaking will not result in a significant economic impact on a substantial number of small entities, the head of the agency may so certify under section 605(b) of the RFA. Therefore, as provided in section 605(b), the head of the FAA certifies that this rulemaking will not result in a significant economic impact on a substantial number of small entities.

C. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub. L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards. The FAA has assessed the potential effect of this final rule and determined that it is in accord with the Trade Agreements Act as the final rule uses European standards as the basis for United States regulation.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (in 1995 dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $151 million in lieu of $100 million. This final rule does not contain such a mandate; therefore, the requirements of Title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. The FAA has determined that there would be no new requirement for information collection associated with this final rule.

F. International Compatibility and Cooperation

(1) In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to conform to International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has reviewed the corresponding ICAO Standards and Recommended Practices and has identified no differences with these regulations.

(2) Executive Order (EO) 13609, Promoting International Regulatory Cooperation, (77 FR 26413, May 4, 2012) promotes international regulatory cooperation to meet shared challenges involving health, safety, labor, security, environmental, and other issues and reduce, eliminate, or prevent unnecessary differences in regulatory requirements. The FAA has analyzed this action under the policy and agency responsibilities of Executive Order 13609, Promoting International Regulatory Cooperation. The agency has determined that this action would eliminate differences between U.S. aviation standards and those of other civil aviation authorities by creating a single set of certification requirements for transport category airplanes that would be acceptable in both the United States and Europe.

G. Environmental Analysis

FAA Order 1050.1E identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 312f of Order 1050.1E and involves no extraordinary circumstances.

V. Executive Order Determinations

A. Executive Order 13132, Federalism

The FAA has analyzed this final rule under the principles and criteria of Executive Order 13132, Federalism. The agency determined that this action will not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, does not have Federalism implications.

B. Executive Order 13211, Regulations That Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this final rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). The agency has determined that it is not a ''significant energy action'' under the executive order and it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

VI. How To Obtain Additional Information

A. Rulemaking Documents

An electronic copy of a rulemaking document may be obtained by using the Internet—

1. Search the Federal eRulemaking Portal (*http://www.regulations.gov*),

2. Visit the FAA's Regulations and Policies Web page at *http://www.faa.gov/regulations_policies/,* or

3. Access the Government Printing Office's Web page at *http://www.gpo.gov/fdsys/.*

Copies may also be obtained by sending a request (identified by notice, amendment, or docket number of this rulemaking) to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267–9680.

B. Comments Submitted to the Docket

Comments received may be viewed by going to *http://www.regulations.gov* and following the online instructions to search the docket number for this action. Anyone is able to search the electronic form of all comments received into any of the FAA's dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

C. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires the FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document, may contact its local FAA official, or the person listed under the **FOR FURTHER INFORMATION CONTACT** heading at the beginning of the preamble. To find out more about SBREFA on the Internet, visit *http://www.faa.gov/regulations_policies/rulemaking/sbre_act/.*

List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends chapter I of title 14, Code of Federal Regulations, as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

■ 1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, and 44704.

■ 2. Amend § 25.307 by revising paragraph (a) to read as follows:

§ 25.307 Proof of structure.

(a) Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition. Structural analysis may be used only if the structure conforms to that for which experience has shown this method to be reliable. In other cases, substantiating tests must be made to load levels that are sufficient to verify structural behavior up to loads specified in § 25.305.

* * * * *

■ 3. Amend § 25.621 by revising paragraphs (a), (c), and (d) to read as follows:

§ 25.621 Casting factors.

(a) *General.* For castings used in structural applications, the factors, tests, and inspections specified in paragraphs (b) through (d) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to any structural castings, except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.

* * * * *

(c) *Critical castings.* Each casting whose failure could preclude continued safe flight and landing of the airplane or could result in serious injury to occupants is a critical casting. Each critical casting must have a factor associated with it for showing compliance with strength and deformation requirements of § 25.305, and must comply with the following criteria associated with that factor:

(1) A casting factor of 1.0 or greater may be used, provided that—

(i) It is demonstrated, in the form of process qualification, proof of product, and process monitoring that, for each casting design and part number, the castings produced by each foundry and process combination have coefficients of variation of the material properties that are equivalent to those of wrought alloy products of similar composition. Process monitoring must include testing of coupons cut from the prolongations of each casting (or each set of castings, if produced from a single pour into a single mold in a runner system) and, on a sampling basis, coupons cut from critical areas of production castings. The acceptance criteria for the process monitoring inspections and tests must be established and included in the process specifications to ensure the properties of the production castings are controlled to within levels used in design.

(ii) Each casting receives:

(A) Inspection of 100 percent of its surface, using visual inspection and liquid penetrant or equivalent inspection methods; and

(B) Inspection of structurally significant internal areas and areas where defects are likely to occur, using radiographic or equivalent inspection methods.

(iii) One casting undergoes a static test and is shown to meet the strength and deformation requirements of § 25.305(a) and (b).

(2) A casting factor of 1.25 or greater may be used, provided that—

(i) Each casting receives:

(A) Inspection of 100 percent of its surface, using visual inspection and liquid penetrant or equivalent inspection methods; and

(B) Inspection of structurally significant internal areas and areas where defects are likely to occur, using radiographic or equivalent inspection methods.

(ii) Three castings undergo static tests and are shown to meet:

(A) The strength requirements of § 25.305(b) at an ultimate load corresponding to a casting factor of 1.25; and

(B) The deformation requirements of § 25.305(a) at a load of 1.15 times the limit load.

(3) A casting factor of 1.50 or greater may be used, provided that—

(i) Each casting receives:

(A) Inspection of 100 percent of its surface, using visual inspection and liquid penetrant or equivalent inspection methods; and

(B) Inspection of structurally significant internal areas and areas where defects are likely to occur, using radiographic or equivalent inspection methods.

(ii) One casting undergoes a static test and is shown to meet:

(A) The strength requirements of § 25.305(b) at an ultimate load corresponding to a casting factor of 1.50; and

(B) The deformation requirements of § 25.305(a) at a load of 1.15 times the limit load.

(d) *Non-critical castings.* For each casting other than critical castings, as specified in paragraph (c) of this section, the following apply:

(1) A casting factor of 1.0 or greater may be used, provided that the requirements of (c)(1) of this section are met, or all of the following conditions are met:

(i) Castings are manufactured to approved specifications that specify the minimum mechanical properties of the material in the casting and provides for demonstration of these properties by testing of coupons cut from the castings on a sampling basis.

(ii) Each casting receives:

(A) Inspection of 100 percent of its surface, using visual inspection and liquid penetrant or equivalent inspection methods; and

(B) Inspection of structurally significant internal areas and areas where defects are likely to occur, using radiographic or equivalent inspection methods.

(iii) Three sample castings undergo static tests and are shown to meet the strength and deformation requirements of § 25.305(a) and (b).

(2) A casting factor of 1.25 or greater may be used, provided that each casting receives:

(i) Inspection of 100 percent of its surface, using visual inspection and liquid penetrant or equivalent inspection methods; and

(ii) Inspection of structurally significant internal areas and areas where defects are likely to occur, using radiographic or equivalent inspection methods.

(3) A casting factor of 1.5 or greater may be used, provided that each casting receives inspection of 100 percent of its surface using visual inspection and liquid penetrant or equivalent inspection methods.

(4) A casting factor of 2.0 or greater may be used, provided that each casting receives inspection of 100 percent of its surface using visual inspection methods.

(5) The number of castings per production batch to be inspected by non-visual methods in accordance with paragraphs (d)(2) and (3) of this section may be reduced when an approved quality control procedure is established.

■ 4. Revise § 25.683 to read as follows:

§ 25.683 Operation tests.

(a) It must be shown by operation tests that when portions of the control system subject to pilot effort loads are loaded to 80 percent of the limit load specified for the system and the powered portions of the control system are loaded to the maximum load expected in normal operation, the system is free from—

(1) Jamming;

(2) Excessive friction; and

(3) Excessive deflection.

(b) It must be shown by analysis and, where necessary, by tests, that in the presence of deflections of the airplane structure due to the separate application of pitch, roll, and yaw limit maneuver loads, the control system, when loaded to obtain these limit loads and operated within its operational range of deflections, can be exercised about all control axes and remain free from—

(1) Jamming;

(2) Excessive friction;

(3) Disconnection; and

(4) Any form of permanent damage.

(c) It must be shown that under vibration loads in the normal flight and ground operating conditions, no hazard can result from interference or contact with adjacent elements.

■ 5. Revise § 25.721 to read as follows:

§ 25.721 General.

(a) The landing gear system must be designed so that when it fails due to overloads during takeoff and landing, the failure mode is not likely to cause spillage of enough fuel to constitute a fire hazard. The overloads must be assumed to act in the upward and aft directions in combination with side loads acting inboard and outboard. In the absence of a more rational analysis, the side loads must be assumed to be up to 20 percent of the vertical load or 20 percent of the drag load, whichever is greater.

(b) The airplane must be designed to avoid any rupture leading to the spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway, under the following minor crash landing conditions:

(1) Impact at 5 feet-per-second vertical velocity, with the airplane under control, at Maximum Design Landing Weight—

(i) With the landing gear fully retracted; and

(ii) With any one or more landing gear legs not extended.

(2) Sliding on the ground, with—

(i) The landing gear fully retracted and with up to a 20° yaw angle; and

(ii) Any one or more landing gear legs not extended and with 0° yaw angle.

(c) For configurations where the engine nacelle is likely to come into contact with the ground, the engine pylon or engine mounting must be designed so that when it fails due to overloads (assuming the overloads to act predominantly in the upward direction and separately, predominantly in the aft direction), the failure mode is not likely to cause the spillage of enough fuel to constitute a fire hazard.

■ 6. Amend § 25.787 by revising paragraph (a) to read as follows:

§ 25.787 Stowage compartments.

(a) Each compartment for the stowage of cargo, baggage, carry-on articles, and equipment (such as life rafts), and any other stowage compartment, must be designed for its placarded maximum weight of contents and for the critical load distribution at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to those emergency landing conditions of § 25.561(b)(3) for which the breaking loose of the contents of such compartments in the specified direction could—

(1) Cause direct injury to occupants;

(2) Penetrate fuel tanks or lines or cause fire or explosion hazard by damage to adjacent systems; or

(3) Nullify any of the escape facilities provided for use after an emergency landing.

If the airplane has a passenger-seating configuration, excluding pilot seats, of 10 seats or more, each stowage compartment in the passenger cabin, except for under seat and overhead compartments for passenger convenience, must be completely enclosed.

* * * * *

■ 7. Amend § 25.963 by revising paragraph (d) to read as follows:

§ 25.963 Fuel tanks: general.

* * * * *

(d) Fuel tanks must, so far as it is practicable, be designed, located, and installed so that no fuel is released in or near the fuselage, or near the engines, in quantities that would constitute a fire hazard in otherwise survivable emergency landing conditions, and—

(1) Fuel tanks must be able to resist rupture and retain fuel under ultimate hydrostatic design conditions in which the pressure P within the tank varies in accordance with the formula:

$$P = K\rho gL$$

Where—

P = fuel pressure at each point within the tank

ρ = typical fuel density

g = acceleration due to gravity

L = a reference distance between the point of pressure and the tank farthest boundary in the direction of loading

K = 4.5 for the forward loading condition for those parts of fuel tanks outside the fuselage pressure boundary

K = 9 for the forward loading condition for those parts of fuel tanks within the fuselage pressure boundary, or that form part of the fuselage pressure boundary

K = 1.5 for the aft loading condition

K = 3.0 for the inboard and outboard loading conditions for those parts of fuel tanks within the fuselage pressure boundary, or that form part of the fuselage pressure boundary

K = 1.5 for the inboard and outboard loading conditions for those parts of fuel tanks outside the fuselage pressure boundary

K = 6 for the downward loading condition

K = 3 for the upward loading condition

(2) For those parts of wing fuel tanks near the fuselage or near the engines, the greater of the fuel pressures resulting from paragraphs (d)(2)(i) or (d)(2)(ii) of this section must be used:

(i) The fuel pressures resulting from paragraph (d)(1) of this section, and

(ii) The lesser of the two following conditions:

(A) Fuel pressures resulting from the accelerations specified in § 25.561(b)(3) considering the fuel tank full of fuel at maximum fuel density. Fuel pressures based on the 9.0g forward acceleration may be calculated using the fuel static head equal to the streamwise local chord of the tank. For inboard and outboard conditions, an acceleration of 1.5g may be used in lieu of 3.0g as specified in § 25.561(b)(3).

(B) Fuel pressures resulting from the accelerations as specified in § 25.561(b)(3) considering a fuel volume beyond 85 percent of the maximum permissible volume in each tank using the static head associated with the 85 percent fuel level. A typical density of the appropriate fuel may be used. For inboard and outboard conditions, an acceleration of 1.5g may be used in lieu of 3.0g as specified in § 25.561(b)(3).

(3) Fuel tank internal barriers and baffles may be considered as solid boundaries if shown to be effective in limiting fuel flow.

(4) For each fuel tank and surrounding airframe structure, the effects of crushing and scraping actions with the ground must not cause the spillage of enough fuel, or generate temperatures that would constitute a fire hazard under the conditions specified in § 25.721(b).

(5) Fuel tank installations must be such that the tanks will not rupture as a result of the landing gear or an engine pylon or engine mount tearing away as specified in § 25.721(a) and (c).

* * * * *

■ 8. Revise § 25.994 to read as follows:

§ 25.994 Fuel system components.

Fuel system components in an engine nacelle or in the fuselage must be protected from damage that could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway under each of the conditions prescribed in § 25.721(b).

Issued under authority provided by 49 U.S.C. 106(f), 44701(a), and 44703 in Washington, DC, on September 24, 2014.

Michael P. Huerta,

Administrator.

[FR Doc. 2014–23373 Filed 10–1–14; 8:45 am]

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. FAA–2014–0366; Special Conditions No. 25–564–SC]

Special Conditions: Embraer S.A.; Model EMB–550 Airplane; Flight Envelope Protection: High Incidence Protection System

Correction

In rule document 2014–20893 appearing on pages 52165 through 52169 in the issue of Wednesday, September 3, 2014, make the following corrections:

1. On page 52169, in the first column, the 27th line from the bottom should read: ''In lieu of § 25.107(c) and (g) we propose the following requirements, with additional sections (c') and (g'):''

2. On page 52169, in the first column, the 11th line from the bottom should read: ''(c') In icing conditions with the ''takeoff ice'' accretion defined in part 25, appendix C, V2 may not be less than—''

3. On page 52169, in the second column, the eighth line from the top should read: ''(g') In icing conditions with the ''final takeoff ice'' accretion defined in part 25, appendix C, V_{FTO}, may not be less than—''

[FR Doc. C1–2014–20893 Filed 10–1–14; 8:45 am]

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DEPARTMENT OF HOMELAND SECURITY

Coast Guard

33 CFR Part 117

[Docket No. USCG–2014–0848]

Drawbridge Operation Regulation; Sacramento River, Rio Vista, CA

AGENCY: Coast Guard, DHS.

ACTION: Notice of deviation from drawbridge regulation.

SUMMARY: The Coast Guard has issued a temporary deviation from the operating schedule that governs the Rio Vista Drawbridge across Sacramento River, mile 12.8, at Rio Vista, CA. The deviation is necessary to allow the bridge owner to make necessary bridge maintenance repairs. This deviation allows the bridge to open on four hours advance notice during the deviation period.

DATES: This deviation is effective without actual notice from October 2, 2014 through 6 a.m. on October 17, 2014. For the purposes of enforcement, actual notice will be used from 9 p.m. on September 22, 2014, until October 2, 2014.

ADDRESSES: The docket for this deviation, [USCG–2014–0848], is available at *http://www.regulations.gov.* Type the docket number in the ''SEARCH'' box and click ''SEARCH.'' Click on Open Docket Folder on the line associated with this deviation. You may also visit the Docket Management Facility in Room W12–140 on the ground floor of the Department of Transportation West Building, 1200 New Jersey Avenue SE., Washington, DC 20590, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: If you have questions on this temporary deviation, call or email David H. Sulouff, Chief, Bridge Section, Eleventh Coast Guard District; telephone 510–437–3516, email *David.H.Sulouff@uscg.mil.* If you have questions on viewing the docket, call Cheryl Collins, Program Manager, Docket Operations, telephone 202–366–9826.

SUPPLEMENTARY INFORMATION: The California Department of Transportation has requested a temporary change to the operation of the Rio Vista Drawbridge, mile 12.8, over Sacramento River, at Rio Vista, CA. The drawbridge navigation span provides 18 feet vertical clearance above Mean High Water in the closed-to-navigation position. In accordance with 33 CFR 117.5, the draw opens on signal. Navigation on the waterway is commercial, search and rescue, law enforcement, and recreational.

A four-hour advance notice for openings is required from 9 p.m. to 6 a.m. daily, from September 22, 2014 to October 17, 2014, to allow the bridge owner to repair the concrete vertical lift span deck. This temporary deviation has been coordinated with the waterway users. No objections to the temporary deviation were raised.

Vessels able to pass through the bridge in the closed position may do so at any time. The bridge will be able to open for emergencies with four hour advance notice. No alternative route is available for navigation. The Coast Guard will inform waterway users of