NOTICE OF PROPOSED AMENDMENT (NPA) NO 2011-09

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

amending Decision No 2003/2/RM

of the Executive Director of the Agency of 17 October 2003

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

'Incorporation of generic SC and AMC CRIs in CS-25'

Executive summary

This NPA proposes an upgrade of CS-25 by introducing generic CRI (Certification Review Items) containing Special Conditions and/or Guidance Material, Means of Compliance.

The intent is to reflect the current certification practices and to facilitate future certification projects.

The following items are addressed: Lithium-Ion battery installation, Stalling speeds for structural design, Design manoeuvre requirements, Design dive speed, Side stick controls, Towbarless towing, Steep approach and landing, Protection of Essential Systems and Equipments in Class E Cargo Compartments, Removal of Need for Stretchers to Comply with CS 25.562, Inclusion of Engines at Ground Idle when Assessing Escape Slide Performance in Wind, Oxygen outlets in the galley work areas, Fireproofness of engine cowlings, Flight envelope protection, Reduced and derated take-off thrust, Go-around performance.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

TABLE OF CONTENTS

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

A. Explanatory Note

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending Decision No 2003/2/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for large aeroplanes (« CS-25 »). The scope of this rulemaking activity is outlined in the Terms of Reference (ToR) 25.070 Issue 2 (dated 19 October 2010) and is described in more detail below.

2. The European Aviation Safety Agency (hereinafter referred to as the 'Agency') is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation[1] which are adopted as 'Opinions' (Article 19(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 19(2)).

3. When developing rules, the Agency is bound to follow a structured process as required by Article 52(1) of the Basic Regulation. Such a process has been adopted by the Agency's Management Board and is referred to as 'The Rulemaking Procedure'[2].

4. This rulemaking activity is included in the Agency's Rulemaking Programme for 2011-2014. It implements the rulemaking task 25.070 'Incorporation of generic SC and AMC CRIs in CS-25'.

5. The text of this NPA has been developed by the Agency. It is submitted for consultation of all interested parties in accordance with Article 52 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.

II. Consultation

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

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

E-mail: Comments can be sent by e-mail only in case the use of CRT is prevented by technical problems. The(se) problem(s) should be reported to the CRT webmaster and comments sent by email to NPA@easa.europa.eu.

Correspondence: If you do not have access to internet or e-mail you can send your comment by mail to:
Process Support
Rulemaking Directorate

---

1 Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.03.2008, p. 1). Regulation as last amended by Commission Regulation (EC) No 1108/2009 of the European Parliament and of the Council of 21 October 2009 (OJ L 309, 24.11.2009, p. 51).

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

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

EASA
Postfach 10 12 53, D-50452 Cologne, Germany

Comments should be submitted by **31 August 2011**. If received after this deadline they might not be taken into account.

III. Comment response document

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

IV. Content of the draft decision

8. **General**

As explained in the Terms of Reference 25.070 Issue 2, the objective of this NPA is to propose an upgrade of CS-25 by introducing generic CRI (Certification Review Items) containing Special Conditions and/or Guidance Material, Means of Compliance. The intent is to reflect the current certification practices and to facilitate future certification projects.

Background and explanations are provided hereafter for each proposed item.

9. **Protection of aircraft systems and networks from internal and external unauthorised access threats**

Avionics item

Although the Agency initially (when publishing the ToR) considered that the objectives to be reached were clear and accepted by the industry, it appears that substantial discussions are still in progress since last year with regard to the requirements and means of compliance under the CRI process. This item is not considered to have the expected maturity in the frame of this NPA and it is therefore cancelled. The Agency will decide later on to either create a dedicated rulemaking group or to include them in the next generic CRI NPA to be planned.

10. **Lithium — Ion battery installation**

Electrical systems item

Lithium-Ion (Li-Ion) batteries have certain failure and operational characteristics as well as maintenance requirements that differ significantly from that of the nickel cadmium (Ni-Cd) and lead acid rechargeable batteries currently approved for installation on large aeroplanes. This amendment is being proposed to require that all characteristics of the Li-Ion battery and its installation which could affect safe operation of the aeroplane are addressed and that appropriate maintenance requirements are established to ensure the availability of electrical power from the batteries when needed. Furthermore Lithium polymer batteries have functionalities and characteristics similar to those of Li-Ion batteries and are subject to the same requirements.

The current requirements governing the installation of batteries in large aeroplanes are covered under CS 25.1353(c). Requirements from CS 25.1353(c)(1) to (4) are essentially unchanged from the initial JAR-25. An increase in incidents involving battery fires and failures that accompanied the increased use of Nickel-Cadmium (Ni-Cd) batteries in small aeroplanes resulted in additional rulemaking affecting the requirements for small and large aeroplanes. The result of these rulemaking activities on the battery requirements for large aeroplanes was the addition of CS 25.1353(c)(5) and (6) which apply only to Ni-Cd battery installations.

The proposed use of Li-Ion batteries on large aeroplanes has prompted EASA to review the adequacy of the existing battery requirements with respect to that chemistry. As a result of this review, EASA has determined that the existing requirements do not

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

adequately address several failure, operational and maintenance characteristics of Li-Ion batteries that could affect safety and reliability of those battery installations.

Regarding the use of Li-Ion rechargeable batteries in applications involving commercial aviation, as well as by other users of this technology ranging from wireless telephone manufacturers to electric vehicle industry, significant safety issues have been noted regarding the use of these types of batteries, some of which are described in the following paragraphs:

<u>Overcharging</u>

Li-Ion batteries in general are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (i.e. thermal runaway) than their Ni-Cd and lead-acid counterparts. This is especially true for overcharging, which can cause heating and destabilisation of the components of the cell, and formation of highly unstable metallic lithium which may ignite, resulting in a self-sustaining fire or explosion. Certain types of Li-Ion batteries pose a potential safety problem because of the instability and flammability of the organic electrolyte employed by the cells of those batteries. By increasing the battery capacity the severity of thermal runaway increases due to the higher amount of electrolyte in larger batteries.

<u>Over-discharging</u>

Discharge of some versions of the Li-Ion cell beyond a certain voltage can cause corrosion of the electrodes of the cell resulting in loss of battery capacity that cannot be reversed by recharging. This loss of capacity may not be detected by the simple voltage measurements commonly available to flight crews as a means of checking battery status, a problem shared with Ni-Cd batteries.

<u>Flammability of cell components</u>

Unlike Ni-Cd and lead-acid cells, some types of Li-Ion cells employ (in a liquid state) electrolytes that are known to be flammable. This material can serve as a source of fuel for an external fire in the event of a breach of the cell container.

The intent of the proposed amendment is to establish appropriate airworthiness standards for Li-Ion battery installations and to ensure, as required by CS 25.601, that these battery installations do not have hazardous or unreliable design characteristics. The proposed amendment adopts the following requirements as a means of addressing these concerns:

- Inclusion of those subparagraphs of CS 25.1353 that are applicable to Li-Ion batteries with adaptation to the perceived risk posed by those batteries.
- Inclusion of the flammable fluid fire protection requirements of CS 25.863. In the past, this requirement was not applied to the batteries of large aeroplanes since the electrolytes used in lead-acid and Ni-Cd batteries are not considered to be flammable.
- Addition of new requirements to address the potential hazards of overcharging and over-discharging that are unique to Li-Ion battery designs.
- Addition of maintenance requirements to ensure that batteries used as spares are maintained in an appropriate state of charge.

It is proposed to create a new CS 25.1353(c)(7).

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

11. **Stalling speeds for structural design**

Structure item

In the past, some applicants have used the minimum speed in the stall ($V_{s,min}$) rather than the 1-g stall speed (V_{s1g}) when establishing the structural design speeds V_{s0} and V_{s1} required by several CS-25 requirements. The 1-g stalling speed is far easier to demonstrate in flight with any degree of consistency, but tends to be somewhat higher than $V_{s,min}$, and therefore leads to higher loads. This has been the subject of a previous harmonisation activity between JAA and FAA, with harmonisation being achieved by establishing V_{s1g} as the appropriate stall reference speed for the structural design speeds V_{s0} and V_{s1}.

A new AMC 25.333(b) is proposed to introduce the results of this harmonisation effort.

12. **Design manoeuvre requirements**

Structure item

The existing design manoeuvre requirements of CS-25 were written to address aircraft with mechanical control systems. For aeroplanes with electronic flight controls — where the motion of the control surfaces does not bear a direct relationship to the motion of the cockpit control devices — these requirements are no longer adequate. Changes to CS 25.331, CS 25.349, CS 25.351 and new associated AMC are proposed to adequately address such aeroplanes. These proposals are based on several (generic) CRIs raised in the past for aeroplanes equipped with electronic flight controls.

13. **Design dive speed**

Structure item

High speed protection systems typically prevent the aircraft from fully performing the manoeuvre as required under CS 25.335(b)(1), and therefore this manoeuvre has to be redefined when such systems are installed. A new subparagraph CS 25.335(b)(2) is added to that effect, modifying the current 7.5 degrees dive condition as described in CS 25.335(b)(1), and introducing an additional 15 degrees dive condition. A new AMC 25.335(b)(2) is proposed to address the malfunction and failure conditions of such systems. This proposal is based on several (generic) CRIs raised in the past fur such high speed protection systems.

14. **Side stick controls**

Structure item

For aeroplanes equipped with a side stick instead of a conventional control stick, the current requirement of CS 25.397, which defines limit pilot forces and torques for conventional wheel or stick control, is not adequate. Therefore a new subparagraph (d) of CS 25.397 is proposed to define the limit pilot forces for side stick controls. This proposal is based on several (generic) CRIs raised in the past for such installations.

Flight test/flight controls item

The introduction of side stick controllers notably associated with electronic flight control systems has required the consistent application of additional requirements to CS 25 to accommodate their features. The following changes to CS-25 are proposed:

(1) CS 25.143 Controllability and Manoeuvrability

A new subparagraph CS 25.143(k) is proposed to address the following items:

a) CS 25.143(d) prescribes for conventional wheel type controls the maximum control forces permitted during the associated controllability and manoeuvrability testing. In addition, there are also specific pitch control force limits prescribed by CS 25.145(b) and 25.175(d). These standards are not applicable to side stick controllers which have

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

different stick force-deflection characteristics and are intended to be controlled with one hand. A new paragraph is proposed which replaces the prescribed stick force limits by requiring suitable side stick control forces for the expected the operating conditions.

b) It was recognised that piloting interaction with a side stick control device may be adversely affected in turbulence conditions and consequently a new paragraph is proposed requiring a test assessment in these conditions.

c) The use of side stick controllers together with electronic flight control systems which provide control augmentation and control deflection limiting systems could affect piloting awareness that the aircraft is approaching a control limited flight condition. It may be that return to normal flight condition and/or continuing of safe flight needs a specific crew action. In these circumstances a suitable flight control position annunciation is required to be provided to the crew, unless other existing indications are found adequate or sufficient to prompt that action.

(2) CS 25.777 Cockpit controls

Side stick controller force-deflection characteristics in pitch and roll together with displacement sensitivity and gains need to be evaluated. The intention is to show that normal inputs on one control axis will not cause significant unintentional inputs on the other. Consequently a new paragraph CS 25.777(i) is proposed requiring a suitable assessment.

15. **Towbarless towing**

Structure item

If an aeroplane is approved for ground handling operations with towbarless towing vehicles, special attention has to be paid to the consequences for the nose landing gear.

In contrast with more conventional ground handling operations with tow bars, where the loads acting on the nose landing gear are limited by tow bar shear pin provisions or similar features designed to shear at a pre-determined loading level, during towbarless towing operations the braking and acceleration loads of the towing vehicle are transmitted directly to the nose gear.

This system of towing the aeroplane may introduce higher static and/or fatigue loads into the nose landing gear and its support structure as currently considered in CS 25.509 and CS 25.571. Also, the point of load application may be different between towbarless towing operations and operations with tow bars.

Towbarless towing is currently not specifically covered by CS-25, and therefore a new AMC 25.509 is proposed to properly address this type of operation. This proposal is based on several (generic) CRIs raised in the past fur such operations.

Hydromechanical and flight controls systems item

CS 25.745(d) states that 'the design of the attachment for towing the aeroplane on the ground must be such as to preclude damage to the steering system'. This requirement originated at a time when the ground handling arrangements for aeroplanes typically included a towing attachment on the nose landing gear assembly. The intent of this requirement was to ensure that aeroplanes are designed such that any means to be used for ground manoeuvring of the aeroplane with the knowledge and/or approval of the manufacturer should not have the capability to cause damage to the steering system. For the last 20 years other means have been used for ground manoeuvres, typically referred to as 'towbarless towing' vehicles, which do not connect to the aeroplane nose landing gear via the protection device installed to ensure compliance with CS 25.745(d).

Consequently, if 'towbarless towing' devices are known to be used and/or have the approval of the manufacturer for ground manoeuvring of the aeroplane, some means must be provided within the design of the aeroplane that will give, at the very least, an

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

equivalent level of protection to the steering system as that which is available from the more conventional tow bar towing arrangements.

To address this issue at that time, JAA considered that a Special Condition and Interpretative Material were necessary and developed INT/POL 25/13 dated 1 June 2001.

This interim policy has been applied for nearly 10 years and EASA considers that this document is sufficiently mature to be published as a new certification specification.

We propose to amend the text of CS 25.745(d) and create a new AMC 25.745(d).

16. **Steep approach and landing**

Flight test and structure item

The scope of CS-25 does not cover steep approach and landing capability and consequently additional airworthiness requirements are required with provisions to enable an aeroplane to use an approach path angle greater than or equal to 4.5° (a gradient of 7.9 %). Certification Review Items have raised an appendix containing these additional requirements which have evolved over the years and the most recent standard is proposed here. The requirements of this appendix cover only CS-25 Subparts B and G and they apply in lieu of CS 25.121(d). They also apply in lieu of CS 25.125 if a reduced landing distance is sought, or if the landing procedure (speed, configuration, etc.) differs significantly from normal operation, or if the screen height is greater than 50 ft. It is therefore proposed to create a new Appendix Q in Book 1 and an AMC to Appendix Q in Book 2.

17. **Protection of Essential Systems and Equipments in Class E cargo compartments**

Cabin safety item

Ever since the Boeing B747-200C (Combi) aeroplane accident in 1987 involving fire, the Aviation Authorities have been aware of the need to provide adequate fire protection of essential systems. The accident investigation revealed that the lack of such protection may have contributed to the loss of the aeroplane. It was recognised that the same potential for damage existed on aeroplanes with Class E cargo compartments.

Based on the above, Special Conditions have been issued by individual authorities on many different projects to require the protection of essential systems/equipment within Class E cargo compartments against fire to a level equivalent to that of CS-25 Appendix F Part III.

As it has been considered essential for a long time now to issue such a Special Condition for all designs incorporating a Class E cargo compartment, it is proposed to amend CS-25 to this effect. A new subparagraph would be added to CS 25.855.

18. **Removal of need for stretchers to comply with CS 25.562**

Cabin safety item

CS 25.785(b) requires that each seat, berth, safety belt, harness and adjacent part of the aeroplane at each station designated as occupiable during take-off and landing must be designed in such a way that persons making proper use of those facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in § 25.561 and 25.562.

CS 25.562 specifies dynamic test conditions for qualification of occupant injury as well as structural criteria. The reason for implementation of CS 25.562 was to provide an overall increased level of passenger safety by reducing serious injuries which would affect the passengers' ability to evacuate the aircraft in a survivable accident.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

A cost/benefit analyses carried out under the auspices of the JAA (refer to document TGM/25/12) concluded that the increased level of safety that may be gained from installation of stretchers meeting the requirements of JAR 25.562 (now CS 25.562) was not compatible with the associated costs. Furthermore, it was recognised that stretchers for medical use were not considered in defining JAR 25.562 and in any case, appropriate injury criteria for a non-ambulant person occupying a stretcher do not exist for the time being.

The guidance in TGM/25/12 (i.e. that compliance to CS 25.562 is not required) has been used by EASA on many stretcher installation projects by means of Interpretative Material (IM) CRIs. It is now proposed to revise CS 25.785(b) to specify that stretchers intended only for carriage of medical patients need not to comply with CS 25.562.

These IM CRIs have also included the clarification that the cushion/mattress assemblies should conform to CS 25.853(c) (i.e. the 'oil burner' flammability test standard). This is because CS 25.853(c) specifically refers to 'seat cushions'. This has been a long running deficiency in that although 'berths' are mentioned in other parts of CS-25, the significant fire safety benefits to be gained from the oil burner test standard do not apply to them.

It has been suggested that this latter aspect, so far handled via IM CRI, should also be incorporated into CS-25 under this NPA. However, recent rulemaking activity has begun, under the auspices of the ARAC, to review the whole of CS/FAR 25.853. This activity will almost certainly result in a change to include cushion/mattress assemblies into the flammability standards, and for all, not just those for medical patient use.

It is therefore proposed to leave this flammability issue regarding stretchers to be handled via the wider ranging revision of CS 25.853.

19. Inclusion of engines at ground idle when assessing escape slide performance in wind

Cabin safety item

In the light of problems during in-service emergency evacuations it was recognised some time ago that engines may still be operating after an evacuation has commenced. There have been reports of escape slides being drawn towards running engines.

Therefore, an aircraft design which places the deployment envelope of any of the escape slides in proximity to an engine intake presents an additional safety risk, particularly in the case where wind conditions are also compounding the situation.

It is currently required by CS 25.810(a)(1)(iv) that escape slides have the capability to reliably deploy in wind conditions up to 46 km/hr and from the most critical angle.

Interpretative Material CRIs have been issued for many years now, on aircraft featuring escape slide deployment envelopes close to engine intakes, clarifying that the effects of engines running at ground idle should also be simultaneously considered when showing compliance to the requirements of CS 25.810(a)(1)(iv).

It is proposed to revise the text of CS 25.810(a)(1)(iv) to make this clear.

20. Control surface awareness electronic/flight control systems

Hydromechanical & flight control systems and structure item

This item was proposed in ToR 25.070 but it is cancelled. It will be addressed by EASA rulemaking task 25.029. The Agency will review the results of the Flight Controls Harmonisation Working Group (FCHWG) activity and will seek harmonisation with FAA as much as possible.

21. Oxygen outlets in the galley work areas

ECS & Ice protection and cabin safety item

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

The requirements of CS 25.1447(c)(3) specify that 'There must be at least two outlets and units of dispensing equipment of a type similar to that required by sub-paragraph (c)(1) of this paragraph in all other compartments or work areas that may be occupied by passengers or crew members during flight i.e. toilets, washrooms, galley work areas, etc.'.

Installation of additional oxygen masks in each and every individual area is not the only means of compliance. If crew members or passengers can see oxygen masks dropping in other areas in close proximity to where they are standing or working, compliance to CS 25.1447(c)(3) can be considered as achieved.

The commonly accepted interpretation of this rule, called the 'five feet/five second' interpretation, has been accepted as providing an oxygen dispensing outlet in support of the galley work areas if an attendant or a passenger is within five feet or within five seconds reach of the outlet and if the outlet drop in can be seen without ambiguity from anywhere of the remote area.

The proposed change is to create a new AMC 25.1447(c)(3).

22. **Fireproofness of engine cowlings**

Powerplant & fuel system item

CS 25.1193 Cowling and Nacelle skin

CS 25.1193(e)(3) requires fire zone skins be fireproof if a fire starts in the engine power or accessory sections. Nevertheless, it has been found that under some operating conditions having non-fireproof skins in some locations does not adversely affect safety. Consequently, in practice not all cowlings/nacelle skins 'subject to flame if a fire starts in the engine power or accessory sections' have been required to be fireproof under all operating conditions, but instead have been required to be fire resistant. Initially such non-fireproof skins were formally found to be 'equivalently safe' to compliance with the rule. Over time however these equivalent safety findings became inherent within traditionally accepted design practices.

It is proposed to amend CS 25.1193 (e)(3) to relax the fireproof requirement to fire resistant in some areas, conditioned by operational flight phases and engine installation geometry. This amendment will be consistent with previously accepted design practices and will help standardising those practices.

CS 25J1193 APU compartment

Similarly to engine cowlings/nacelle, the APU compartment is subject to the same requirement intent of being fireproof.

The proposed action for APU installation requirement would amend CS 25J1193 (e)(3) to make it consistent with the proposed action for engine installation.

Interpretative Material

Use of light alloys and/or composite materials in more recent aircraft was the reason for taking into account, with respect to fireproof characteristics, the effect of approach minimum speed ventilation due to external air flow on nacelle skin.

Furthermore, with respect to openings in the nacelle skin, it has to be demonstrated that either no flame can propagate through these openings, or there is no additional hazards to any other aircraft zone.

This interpretation of CS 25.1193(e) has been commonly applied in several past certification exercises through the release of Certification Review Items (CRI). In the past a JAA P-NPA 25E-266 was discussed during a workshop to propose an ACJ 25.1193(e) (Acceptable Means of Compliance) based on this interpretation and it was harmonised with FAA by the Powerplant Harmonization Working Group (PPIHWG). In parallel, FAA

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

initiated a Rulemaking Project Record Fast Track Harmonization Program (RPR# ANM-01-047-A) to:

— propose a rule amendment of § 25.1193(e), that in Part 25 covers both APU and Engine installations, and to

— announce the drafting of an Advisory Circular for § 25.1193(e).

We propose introducing interpretative material from P-NPA 25E-266/RPR ANM-01-047-A into CS-25 Book 2 by creating a new AMC 25.1193(e) applicable to both CS 25.1193(e) and CS 25J1193(e).

23. **Stalling and scheduled operating speeds**

Flight test and flight controls item

This item was proposed in ToR 25.070 but it is cancelled. Special Conditions (SC) exist; however they have been applied to Airbus products only. The Agency reviewed this item and concluded that it is premature attempting to generalise the SC requirements. In addition, discussions are still in progress with other aviation authorities in order to set up a harmonisation working group to agree on the credit and requirements of Angle of Attack (AOA) protection systems.

24. **Flight envelope protection**

Flight test, flight control and structure item

In the Controllability and Manoeuvrability section of CS-25 Subpart B, CS 25.143 requirements assume that a conventional non fly-by-wire aeroplane can generate sufficient aerodynamic lift to provide sufficient manoeuvrability with regard to the normal load factor envelope. This capability ensures adequate manoeuvrability to effect sudden changes to the flight path which may be required to avoid obstacles, terrain or the capture of level-off altitudes following climb or descent. For structural or other reasons, certain electronic flight control system designs embody a normal load factor limiting system which can restrict the achievable load factor envelope within that which would have been available taking full credit for the aerodynamic performance of the aeroplane.

To ensure that a sufficient manoeuvre capability remains it is proposed to add a subparagraph (l) to CS 25.143 which defines a minimum normal load factor envelope.

25. **Reduced and derated take-off thrust**

Flight test item

CS-25 AMC 25-13 entitled 'Reduced And Derated Take-Off Thrust (Power) Procedures' provides Acceptable Means of Compliance (AMC) for the certification and use of reduced thrust (power) for take-off and derated take-off thrust (power) on turbine-powered transport category aeroplanes.

Derated take-off thrust, for an aeroplane, is a take-off thrust less than the maximum take-off thrust for which exists in the AFM a set of separate and independent, or clearly distinguishable, take-off limitations and performance data that complies with all the take-off requirements of CS-25. When operating with a derated take-off thrust, the value of the thrust setting parameter, which establishes thrust for take-off, is presented in the AFM and is considered a normal take-off operating limit.

Reduced take-off thrust, for an aeroplane, is a take-off thrust less than the take-off (or derated take-off) thrust. The aeroplane take-off performance and thrust setting are established by approved simple methods, such as adjustments, or by corrections to the take-off or derated take-off thrust setting and performance. When operating with a

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

reduced take-off thrust, the thrust setting parameter, which establishes thrust for take-off, is not considered a take-off operating limit.

Paragraph 5 of AMC 25-13, entitled 'Reduced Thrust', provides Acceptable Means of Compliance relating to the use of reduced thrust and under 5a(4) states that the reduced take-off thrust setting is at least 75 % of the take-off thrust, or derated take-off thrust if such is the performance basis, for the existing ambient conditions, with no further reduction below 75 % resulting from ARP credit. For derated thrust there is no equivalent restriction which applies and furthermore these procedures can be combined with reduced thrust. Typically derated thrust levels down to 75 % of the available take-off thrust have been selected by applicants and when combined with reduced thrust procedures can result in an overall thrust reduction of around 55 % of the take-off thrust available for the existing ambient conditions. Certain turbojet designs utilise systems which do not enable the combination of derated and reduced thrust procedures and are therefore restricted in comparison.

The assumed temperature method relating to reduced thrust procedures contains inherent conservatism due to the fact that the performance levels used are based on the higher assumed temperature whereas the take-off is made at the actual colder temperature which provides higher thrust levels and lower true airspeeds and this conservatism increases with wider differences between the assumed and the actual temperature. Consequently the removal of the reduced take-off thrust setting to be at least 75 % of the take-off thrust for the existing ambient conditions will result in simplifying procedures, increasing conservatism and use of similar overall thrust reductions as currently employed. However, this change must be mitigated by requiring an applicant to demonstrate compliance with the appropriate performance requirements for these lower reduced thrust levels as thoroughly as for an approved take-off thrust rating. The proposal is to amend AMC 25-13 paragraph 5 to remove the 75 % restriction. It is also proposed to take this opportunity to change the 'ARP' references to 'ATTCS' to be consistent with CS 25 Appendix I entitled 'Automatic Takeoff Thrust Control System (ATTCS)'. Changes are proposed in AMC 25-13 and AMC 25.21(g).

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

26. **Go-around performance**

Flight test item

CS 25.101(g) requires that the procedures for the execution of missed approaches associated with the conditions prescribed in CS 25.121(d) must be established. Whilst an aircraft may be able to demonstrate the required climb gradient capability associated with the conditions prescribed in CS 25.121(d), it may not be able to achieve it quickly enough or avoid striking the ground particularly when operating using decision heights below 200 ft. Neither of the above rules has advisory material providing compliance methods to ensure that any proposed go-around procedure remains safe.

The speeds and flap configurations assumed in the scheduling of landing weight, altitude and temperature (WAT) limits to comply with the minimum climb gradient requirements of CS 25.121(d) need to be consistent with the speeds and flap configurations specified for go-around in the AFM operating procedures.

In order to demonstrate the acceptability of recommended procedures in compliance with CS 25.101(h), the established procedures must:

(1) be able to be consistently executed in service by crews of average skill,

(2) use methods or devices that are safe and reliable, and

(3) include allowance for any time delays in the execution of the procedures that may reasonably be expected in service.

Additional Acceptable Means of Compliance is proposed associated with CS 25.101(g), in order to ensure that any proposed go-around procedure, in particular when combined with a low decision height, is safe.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

V. Regulatory Impact Assessment

1. Process and consultation

The RIA was prepared by the Agency.

2. Issue analysis and risk assessment

2.1. Issue which the NPA is intended to address and sectors concerned

During project certification, the Agency uses CRIs (Certification Review Items) to introduce new requirements called 'Special Conditions' (SC), and/or Guidance Material, Means of Compliance (associated to the SC or to existing Certification Specifications requirements).

Retaining generic SC and/or Guidance Material, Means of Compliance in Certification Review Items (CRI) is not in compliance with the Basic Regulation (refer to Article 19 of Regulation (EC) No 216/2008) and does not facilitate transparent and open regulation.

Sectors concerned: Large Aeroplane manufacturers, STC applicants/holders, EASA.

The proposed task will publish generic CRIs that have already been used in at least one certification project, and which are already known by industry.

2.2. What are the risks (probability and severity)?

Some safety risks were identified and addressed by the Agency through the CRI process. Therefore retaining the generic CRIs or incorporating them in the CS-25 is neutral in term of risk.

3. Objectives

The objective of this NPA is to propose an update of CS-25 by introducing generic CRIs (Certification Review Items) containing Special Conditions and/or Guidance Material, Means of Compliance. The intent is to reflect the current certification practices and to facilitate future certification projects.

4. Options identified

1. Do nothing and retain the existing CRIs.

2. Amend CS-25 by introducing generic CRIs.

5. Methodology and data requirements (only for full RIA)

N/A

6. Analysis of the impacts

6.1. Safety impacts

Considering the fact that the Option 2 proposal will only incorporate generic CRIs into CS-25 that are already used during certification exercise, the associated safety impact is expected to be neutral.

6.2. Social impacts

None identified.

6.3. Economic impacts

An economic benefit is expected from Option 2 because:

— This will reduce the number of CRIs to be managed by EASA and the applicants, which will save time and resources for everyone.

— The applicants will benefit from prior awareness of EASA expectations by having the corresponding material directly available in the CS-25. This may prevent

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

development of unacceptable designs in the early stage of projects; in the end, both applicants and EASA would save the time which could have been wasted in discussing and correcting the unacceptable designs.

6.4. Environmental impacts

None identified.

6.5. Proportionality issues

None identified. Option 2 would give all concerned sectors the same benefit in terms of clarity and legal certainty about the certification specifications and AMC considered acceptable by the Agency.

6.6. Impact on regulatory coordination and harmonisation

<u>Status of the harmonisation with FAA:</u>

<u>Lithium-Ion battery installation:</u> The FAA has recently published a draft memorandum on the introduction of a Policy Paper regarding a Part-25 policy statement on rechargeable lithium batteries and rechargeable lithium-battery systems permanently installed on aircraft. This FAA Memorandum contains similar requirements to those proposed in this NPA.

<u>Stalling speeds for structural design:</u> Full harmonisation has been achieved with the FAA. The FAA however has not published similar guidance material as proposed in this NPA, because the FAA, to the understanding of EASA, believes that based on the manoeuvring envelope defined in 25.333(b) it is already sufficiently clear that Vs1g should be used for structural loads analysis.

<u>Design manoeuvre requirements:</u> For aeroplanes equipped with electronic flight controls, the FAA has issued in the past Issue Papers with similar (although not identical) content as proposed in this NPA.

<u>Design dive speed:</u> For aeroplanes equipped with a high speed protection function, the FAA has issued in the past Issue Papers with similar (although not identical) content as proposed in this NPA.

<u>Side stick controls:</u>

Structure item: EASA is not aware of the FAA position on this subject.

Flight test/flight controls item: It is the understanding of EASA that the FAA has adopted these requirements through their validation of European products and to this extent the requirements have reflected a harmonised approach.

<u>Towbarless towing:</u>

Structure item: a previous harmonisation effort between JAA and FAA only resulted in a recommendation to make a minor amendment to Appendix H of CS-25, but more extensive proposals contained in this NPA are deemed necessary by EASA to properly address this type of towing operation.

Hydromechanical and flight controls systems item: FAR Part 25 has currently no equivalent to CS 25.745.

<u>Steep approach and landing:</u>

Harmonisation with FAA requirements was explored within the JAA Flight Steering Group but this effort was not successful and significant differences remain.

<u>Protection of Essential Systems and Equipments in Class E Cargo Compartments:</u>

The FAA also uses a ‘generic’ Special Condition approach for this case to impose similar requirements. However, cockpit voice and flight data recorders have not been included.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

This proposed change to CS-25 is thus partially harmonised with FAA practice.

Removal of Need for Stretchers to Comply with CS25.562:

The FAA have the practice of issuing exemptions to FAR 25.562 for cases where a 'berth' is intended to provide transport for medical needs, i.e. the same case as covered by the proposed change to CS-25.

This proposed change to CS-25 is thus harmonised with FAA practice.

Inclusion of Engines at Ground Idle when Assessing Escape Slide Performance in Wind:

FAA use the same approach to this issue, i.e. Interpretative Material Issue Papers are issued with the same intent and content as described in the EASA CRIs.

This proposed change to CS-25 is thus harmonised with FAA practice.

Oxygen outlets in the galley work areas: FAR Part 25 does not have a requirement equivalent to CS 25.1447(c)(3). However, FAR Part 25.1447(c)(1) requires 'at least two oxygen dispensing units connected to oxygen terminals in each lavatory'.

Fireproofness of engine cowlings:

FAA has not yet amended FAR Part 25, § 25.1193 and has not published the corresponding AC; however it is expected that such tasks should be launched in the near future, following the harmonisation activity done in the past by the PPIHWG.

Flight envelope protection:

It is the understanding of EASA that the FAA has adopted these requirements through their validation of European products and to this extent the requirements have reflected a harmonised approach. However, EASA is not aware that FAA is currently planning to embody these proposed requirements in FAR 25.

Reduced and derated take-off thrust:

The Agency is aware of an FAA Issue Paper allowing reduced thrust down to 60% of the full rated thrust although FAA AC 25-13 requires the reduced takeoff thrust setting is at least 75% of the takeoff thrust, or derated takeoff thrust if such is the performance basis, for the existing ambient conditions. The Issue Paper specifies that the applicant must show that the aeroplane complies with all the applicable performance requirements, including the criteria in AC 25-13, at the thrust available with a reduced thrust option as low as 60% of full rated thrust. Therefore FAA policy appears consistent with the Agency proposal.

Go-around performance:

This proposal has not yet been harmonised with FAA.

7. Conclusion and preferred option

After due consideration, the Agency prefers option 2.

Large aeroplane manufacturers, STC applicants/holders and EASA would all equally benefit from a more complete CS-25, which will facilitate the certification process for everyone.

By implementing this option the Agency also fulfils its obligations as stated in Article 19 of Regulation (EC) No 216/2008 (Basic Regulation) — to assure that the documents it developed and issued, including Acceptable Means of Compliance, 'shall reflect the state of the art and the best practices in the fields concerned and be updated taking into account worldwide aircraft experience in service, and scientific and technical progress'.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

B. Draft Opinion(s) and/or Decision(s)

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

1. deleted text is shown with a strike through: ~~deleted~~
2. new text is highlighted with grey shading: new
3. … indicates that remaining text is unchanged in front of or following the reflected amendment.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

I. Draft Decision CS-25

BOOK 1

SUBPART B — FLIGHT

Create a new CS 25.143(k) as follows:

CS 25.143 General

…

(k) Side stick controllers

In lieu of the maximum control forces provided in CS 25.143 (d) for pitch and roll, and in lieu of specific pitch force requirements of 25.145 (b) and 25.175 (d), it must be shown that the temporary and maximum prolonged force levels for side stick controllers are suitable for all expected operating conditions and configurations, whether normal or non-normal.

It must be shown by flight tests that turbulence does not produce unsuitable pilot-in-the-loop control problems when considering precision path control/tasks.

When a flight case exists where, without being commanded by the crew, control surfaces are coming so close to their limits that return to normal flight condition and/or continuing of safe flight needs a specific crew action, a suitable flight control position annunciation shall be provided to the crew, unless other existing indications are found adequate or sufficient to prompt that action.

Create a new CS 25.143(l) as follows:

CS 25.143 General

…

(l) Electronic flight control systems

For electronic flight control systems (EFCS) which embody a normal load factor limiting system and in the absence of other limiting factors:

1) The positive limiting load factor must not be less than:

   i) 2.5 g for the EFCS normal state with high lift devices retracted;

   ii) 2.0 g for the EFCS normal state with the high lift devices extended.

2) The negative limiting load factor must be equal to or more negative than:

   i) Minus 1.0 g for the EFCS normal state with high lift devices retracted;

   ii) 0 g for the EFCS normal state with high lift devices extended.

…

Create a new CS 25.177(i) as follows:

CS 25.777 Cockpit controls

…

(i) Pitch and roll control forces and displacement sensitivity shall be compatible, so that normal inputs on one control axis will not cause significant unintentional inputs on the other.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

SUBPART C — STRUCTURE

Amend CS 25.331(c) as follows:

CS 25.331 Symmetric manoeuvring conditions

…

(c)(1) …

(See AMC 25.331(c)(1))

(c)(2) …

(See AMC 25.331(c)(2))

Amend CS 25.333(b) as follows:

CS 25.333 Flight manoeuvring envelope

…

(b) *Manoeuvring envelope*

(See AMC 25.333(b))

Amend CS 25.335(b)(1) as follows:

CS 25.335 Design airspeeds

…

(b) Design dive speed, V_D. V_D must be selected so that V_C/M_C is not greater than 0.8 V_D/M_D, or so that the minimum speed margin between V_C/M_C and V_D/M_D is the greater of the following values:

(1) (i) For aeroplanes not equipped with a high speed protection function: From an initial condition of stabilised flight at V_C/M_C, the aeroplane is upset, flown for 20 seconds along a flight path 7.5º below the initial path, and then pulled up at a load factor of 1.5 g (0.5 g acceleration increment). The speed increase occurring in this manoeuvre may be calculated if reliable or conservative aerodynamic data issued. Power as specified in CS 25.175(b)(1)(iv) is assumed until the pull up is initiated, at which time power reduction and the use of pilot controlled drag devices may be assumed;

(ii) For aeroplanes equipped with a high speed protection function: In lieu of subparagraph (b)(1)(i), the speed increase above V_C/M_C resulting from the greater of the following manoeuvres must be established:

(A) From an initial condition of stabilised flight at V_C/M_C, the aeroplane is upset so as to take up a new flight path 7.5° below the initial path. Control application, up to full authority, is made to try and maintain this new flight path. Twenty seconds after initiating the upset manual recovery is made at a load factor of 1.5 g (0.5 g acceleration increment), or such greater load factor that is automatically applied by the system with the pilot's pitch control neutral. The speed increase occurring in this manoeuvre may be calculated if reliable or conservative aerodynamic data is used. Power as specified in CS 25.175(b)(1)(iv) is assumed until

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

recovery is made, at which time power reduction and the use of pilot controlled drag devices may be assumed.

(B) From a speed below V_C/M_C, with power to maintain stabilised level flight at this speed, the aeroplane is upset so as to accelerate through V_C/M_C at a flight path 15° below the initial path (or at the steepest nose down attitude that the system will permit with full control authority if less than 15°). Pilot controls may be in neutral position after reaching V_C/M_C and before recovery is initiated. Recovery may be initiated 3 seconds after operation of high speed, attitude or other alerting system by application of a load factor of 1.5 g (0.5 g acceleration increment), or such greater load factor that is automatically applied by the system with the pilot's pitch control neutral. Power may be reduced simultaneously. All other means of decelerating the aeroplane, the use of which is authorised up to the highest speed reached in the manoeuvre, may be used. The interval between successive pilot actions must not be less than 1 second (See AMC 25.335(b)(1)(ii)).

…

Amend CS 25.349(a) as follows:

CS 25.349 Rolling conditions

…

(a) *Manoeuvring*. The following conditions, speeds, ~~and~~ aileron deflections and cockpit roll control motions (except as the deflections and the motions may be limited by pilot effort) must be considered in combination with an aeroplane load factor of zero and of two-thirds of the positive manoeuvring factor used in design. For aeroplanes equipped with electronic flight controls, where the motion of the control surfaces does not bear a direct relationship to the motion of the cockpit control devices, these conditions must be considered in combination with an aeroplane load factor ranging from zero to two thirds of the positive manoeuvring factor used in design. In determining the required or resulting aileron deflections, the torsional flexibility of the wing must be considered in accordance with CS 25.301 (b):

(1) Conditions corresponding to steady rolling velocities must be investigated. In addition, conditions corresponding to maximum angular acceleration must be investigated for aeroplanes with engines or other weight concentrations outboard of the fuselage, and for aeroplanes equipped with electronic flight controls, where the motion of the control surfaces does not bear a direct relationship to the motion of the cockpit control devices. For the angular acceleration conditions, zero rolling velocity may be assumed in the absence of a rational time history investigation of the manoeuvre.

…

(5) For aeroplanes equipped with electronic flight controls, where the motion of the control surfaces does not bear a direct relationship to the motion of the cockpit control devices, in lieu of subparagraphs (a)(2), (a)(3) and (a)(4) the following applies:

(i) At V_A, movement of the cockpit roll control up to the limit is assumed. The position of the cockpit roll control must be maintained until a steady roll rate is achieved and then must be returned suddenly to the neutral position.

(ii) At V_C, the cockpit roll control must be moved suddenly and maintained so as to achieve a roll rate not less than that obtained in subparagraph (a)(2) of this paragraph.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(iii) At V_D, the cockpit roll control must be moved suddenly and maintained so as to achieve a roll rate not less than one third of that obtained in subparagraph (a)(2) of this paragraph.

(See AMC 25.349(a))

…

Create a new CS 25.351(e) as follows:

CS 25.351 Yaw manoeuvre conditions

…

(e) For aeroplanes equipped with electronic flight controls where the motion of the control surfaces does not bear a direct relationship to the motion of the cockpit control devices, with the aeroplane in un-accelerated flight at zero yaw, it must be assumed in subparagraph (a) of this paragraph that the cockpit rudder control is suddenly displaced (with critical rate) to the maximum deflection, as limited by the control system or control surface stops.

(See AMC 25.351(e))

Create a new CS 25.397 (d) as follows:

CS 25.397 Control system loads

…

(d) For aeroplanes equipped with side stick controls, designed for forces to be applied by one wrist and not by arms, the limit pilot forces are as follows:

(1) For all components between and including the handle and its control stops:

PITCH		ROLL	
Nose up	890 N (200 lbf)	Nose left	445 N (100 lbf)
Nose down	890 N (200 lbf)	Nose right	445 N (100 lbf)

(2) For all other components of the side stick control assembly, but excluding the internal components of the electrical sensor assemblies, to avoid damage as a result of an in-flight jam:

PITCH		ROLL	
Nose up	556 N (125 lbf)	Nose left	222 N (50 lbf)
Nose down	556 N (125 lbf)	Nose right	222 N (50 lbf)

Amend CS 25.509 as follows:

CS 25.509 Towing loads

(See AMC 25.509)

…

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

SUBPART D — DESIGN AND CONSTRUCTION

Amend CS 25.745(d) as follows:

CS 25.745 Nose-wheel steering

…

(d) ~~The design of the attachment for towing the aeroplane on the ground must be such as to preclude damage to the steering system.~~

The nose-wheel steering system, towing attachment(s), and associated elements must be designed or protected by appropriate means such that during ground manoeuvring operations effected by means independent of the aeroplane:

(1) Damage affecting the safe operation of the nose-wheel steering system is precluded, or

(2) A flight crew alert is provided, before the start of taxiing, if damage may have occurred (see AMC 25.1322).

(See AMC 25.745(d))

Amend CS 25.785(b) as follows:

CS 25.785 Seats, berths, safety belts and harnesses

…

(b) Each seat, berth, safety belt, harness, and adjacent part of the aeroplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in CS 25.561 and CS 25.562. However, stretchers intended only for the carriage of medical patients need not to comply with the requirements of CS 25.562.

Amend CS 25.810(a)(1)(iv) as follows:

CS 25.810 Emergency egress assist means and escape routes

…

(a) …

(1) …

(iv) It must have the capability, in 46 km/hr (25-knot) winds directed from the most critical angle, simultaneously with any engine(s) running at ground idle, to deploy and, with the assistance of only one person, to remain usable after full deployment to evacuate occupants safely to the ground.

…

Amend CS 25.855 as follows:

CS 25.855 Cargo or baggage compartments

…

(d) Cockpit voice and flight data recorders, windows and systems or equipment within Class E cargo compartments shown to be essential for continued safe flight and landing

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

according to CS 25.1309 must be adequately protected against fire. If protective covers are used they must meet the requirements of Appendix F, Part III.

(~~d~~e) All other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in Part I of Appendix F, or other approved equivalent methods.

(~~e~~f) No compartment may contain any controls, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that –

(1) They cannot be damaged by the movement of cargo in the compartment; and

(2) Their breakage or failure will not create a fire hazard.

(~~f~~g) There must be means to prevent cargo or baggage from interfering with the functioning of the fire protective features of the compartment.

(~~g~~h) Sources of heat within the compartment must be shielded and insulated to prevent igniting the cargo or baggage.

(~~h~~i) Flight tests must be conducted to show compliance with the provisions of CS 25.857 concerning –

(1) Compartment accessibility;

(2) The entry of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers; and

(3) The dissipation of the extinguishing agent in Class C compartment or, if applicable, in Class F compartment.

(~~i~~j) During the above tests, it must be shown that no inadvertent operation of smoke or fire detectors in any compartment would occur as a result of fire contained in any other compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously.

(~~j~~k) Cargo or baggage compartment electrical wiring interconnection system components must meet the requirements of CS 25.1721.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

SUBPART E — POWERPLANT

Amend CS 25.1193(e)(3) as follows:

CS 25.1193 Cowling and nacelle skin

…

(e) Each aeroplane must -

…

(3) For in-flight operations, ~~H~~have fireproof skin in areas subject to flame if a fire starts in ~~the~~ an engine fire zone ~~power or accessory sections~~; and, for ground operation, have fireproof skin protecting areas of the aeroplane critical during ground operation, and have skin that is either fire-resistant or complies with subparagraph (e)(1) of this paragraph in other areas.

(See AMC 25.1193 (e))

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

SUBPART F — EQUIPMENT

Amend CS 25.1353(c) as follows:

CS 25.1353 Electrical equipment and installations

…

(c) …

(7) Lithium-Ion (Li-Ion) battery installations

In lieu of CS 25.1353(c)(1) through (c)(4), Li-Ion batteries and battery installations (including Lithium Polymer batteries) must be designed and installed as follows:

(i) Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition, or during any failure of the charging or battery monitoring system not shown to be extremely remote. The Li-Ion battery installation must be designed to preclude explosion in the event of those failures.

(ii) Batteries must be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

(iii) No explosive or toxic gases emitted by any Li-Ion battery in normal operation or as the result of any failure of the battery charging or monitoring system, or battery installation not shown to be extremely remote, may accumulate in hazardous quantities within the aeroplane.

(iv) Li-Ion battery installations must meet the requirements of CS 25.863(a) through (d).

(v) No corrosive fluids or gases that may escape from any Li-Ion battery may damage surrounding structure or any adjacent systems, equipment or EWIS, of the aeroplane in such a way as to cause a major or more severe failure condition in accordance with CS 25.1309(b).

(vi) Each battery installation must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

(vii) Battery installations must have a system to control the charging rate of the battery automatically so as to prevent battery overheating or overcharging, and

(A) A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over-temperature condition, or

(B) A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.

(viii) Any Li-Ion battery installation whose function is required for the safe operation of the aeroplane, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crew members whenever the state of charge of the batteries has fallen below the levels considered acceptable for dispatch of the aeroplane.

(ix) The Instructions for Continued Airworthiness required by CS 25.1529 must contain maintenance instructions for measurements of battery capacity at appropriate intervals to ensure that batteries whose function is required for the safe operation of the aeroplane will perform their intended function as long as the batteries are installed in the aeroplane. The Instructions for Continued

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

Airworthiness must also contain maintenance procedures for Li-Ion batteries in spares storage to prevent the replacement of batteries whose function is required for safe operation of the aeroplane, with batteries that have experienced degraded charge retention ability or other damage due to prolonged storage at low state of charge.

Amend CS 25.1447 (c)(3) as follows:

CS 25.1447 Equipment standards for oxygen dispensing units

…

(c) …

(See AMC 25.1447 (c)(3))

…

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

SUBPART J — AUXILIARY POWER UNIT INSTALLATIONS

Amend CS 25J1193 as follows:

CS 25J1193 APU compartment

…

(e) Each aeroplane must:

…

(3) For in-flight operations, ~~H~~have fireproof skin in areas subject to flame if a fire starts in the APU compartment; and, for ground operation, have fireproof skin protecting areas of the aeroplane critical during ground operation, and have skin that is either fire-resistant or complies with (e)(1) in other areas.
(See AMC 25.1193 (e))

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

APPENDICES

Create a new Appendix Q as follows:

Appendix Q

Additional Airworthiness Requirements for Approval of a Steep Approach Landing (SAL) Capability

(SAL) 25.1 Applicability

This appendix contains airworthiness requirements that enable an aeroplane to obtain approval for a steep approach landing capability using an approach path angle greater than or equal to 4.5° (a gradient of 7.9 %).

The requirements of this appendix cover only CS-25 Subparts B and G and they apply in lieu of CS 25.121(d). They also apply in lieu of CS 25.125 if a reduced landing distance is sought, or if the landing procedure (speed, configuration, etc.) differs significantly from normal operation, or if the screen height is greater than 50 ft. Additional requirements may apply with respect to aeroplane systems or equipment or other relevant items such as autopilot, flight guidance or GPWS. It is likely that the GPWS mode 1 (sink rate) envelope will need modification to prevent nuisance alerts. Also, the structural implications of the increased probability of high rates of descent at touchdown must be considered.

If a steep approach approval is required for flight in icing conditions, substantiation must be provided accordingly for the steep approach condition.

An applicant may choose to schedule information for an all-engines approach or for an approach with one engine inoperative. If an all-engines approach is scheduled, it is assumed that a diversion is required if an engine failure occurs prior to the decision to land.

(SAL) 25.2 Definitions

For the purposes of this Appendix:

— Steep Approach Landing: An approach to land made using a glide path angle greater than or equal to 4.5°, as selected by the applicant.

— Screen Height: The reference height above the runway surface from which the landing distance is measured. The screen height is a height selected by the applicant, at 50 ft or another value from 35 to 60 ft.

— $V_{REF(SAL)}$ is the calibrated airspeed selected by the applicant used during the stabilised approach at the selected approach path angle and maintained down to the screen height defined above. $V_{REF(SAL)}$ may not be less than 1.23 V_{SR}, V_{MCL}, or a speed that provides the manoeuvring capability specified in CS 25.143(g), whichever is greater and may be different to the V_{REF} used for standard approaches.

— $V_{REF(SAL)-1}$ is the calibrated airspeed selected by the applicant used during the stabilised one-engine-inoperative approach at the selected approach path angle and maintained down to the screen height defined above. $V_{REF(SAL)-1}$ may not be less than $V_{REF(SAL)}$.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(SAL) 25.3 Steep Approach Landing Distance (Applicable only if a reduced landing distance is sought, or if the landing procedure (speed, configuration, etc.) differs significantly from normal operation, or if the screen height is greater than 50 ft.)

(a) The steep approach landing distance is the horizontal distance necessary to land and to come to a complete stop from the landing screen height and must be determined (for standard temperatures, at each weight, altitude and wind within the operational limits established by the applicant for the aeroplane) as follows:

(1) The aeroplane must be in the all-engines-operating or one-engine-inoperative steep approach landing configuration, as applicable.

(2) A stabilised approach, with a calibrated airspeed of $V_{REF(SAL)}$ or $V_{REF(SAL)-1}$ as appropriate, and at the selected approach angle must be maintained down to the screen height.

(3) Changes in configuration, power or thrust, and speed must be made in accordance with the established procedures for service operation (see AMC 25.125(b)(3)).

(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over or ground loop and with a vertical touchdown velocity not greater than 6 ft/sec.

(5) The landings may not require exceptional piloting skill or alertness.

(b) The landing distance must be determined on a level, smooth, dry, hard-surfaced runway (see AMC 25.125(c)). In addition -

(1) The pressures on the wheel braking systems may not exceed those specified by the brake manufacturer.

(2) The brakes may not be used so as to cause excessive wear of brakes or tyres (see AMC 25.125(c)(2)).

(3) Means other than wheel brakes may be used if that means

(i) Is safe and reliable;

(ii) Is used so that consistent results can be expected in service; and

(iii) Is such that exceptional skill is not required to control the aeroplane.

(c) Reserved.

(d) Reserved.

(e) The landing distance data must include correction factors for not more than 50 % of the nominal wind components along the landing path opposite to the direction of landing, and not less than 150 % of the nominal wind components along the landing path in the direction of landing.

(f) If any device is used that depends on the operation of any engine, and if the landing distance would be noticeably increased when a landing is made with that engine assumed to fail during the final stages of an all-engines-operating steep approach, the steep approach landing distance must be determined with that engine inoperative unless the use of compensating means will result in a landing distance not more than that with each engine operating.

(SAL) 25.4 Climb: One-engine-inoperative

In a configuration corresponding to the normal all-engines-operating procedure in which V_{SR} for this configuration does not exceed 110 % of the V_{SR} for the related all-engines-

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

operating steep approach landing configuration, the steady gradient of climb may not be less than 2.1 % for two-engined aeroplanes, 2.4 % for three-engined aeroplanes, and 2.7 % for four-engined aeroplanes, with:

(a) The critical engine inoperative, the remaining engines at the go-around power or thrust setting;

(b) The maximum landing weight;

(c) A climb speed of $V_{REF(SAL)}$; and

(d) The landing gear retracted.

(SAL) 25.5 Safe operational and flight characteristics

(a) It must be demonstrated that it is possible to complete a stabilised approach in calm air down to the commencement of the landing flare, followed by a touchdown and landing without displaying any hazardous characteristics for the following conditions (see AMC to Appendix Q, (SAL) 25.5):

(1) The selected approach path angle at $V_{REF(SAL)}$ or $V_{REF(SAL)-1}$ as appropriate;

(2) An approach path angle 2° steeper than the selected approach path angle, at $V_{REF(SAL)}$ or $V_{REF(SAL)-1}$ as appropriate; and

(3) The selected approach path angle at $V_{REF(SAL)}$ minus 5 knots or $V_{REF(SAL)-1}$ minus 5 knots as appropriate.

For conditions (1), (2) and (3):

(i) The demonstration must be conducted at the most critical weight and centre of gravity, either with all-engines-operating or with the critical engine inoperative, as appropriate;

(ii) The rate of descent must be reduced to 3 feet per second or less before touchdown;

(iii) Below a height of 200 ft no action shall be taken to increase power or thrust apart from those small changes which are necessary to maintain an accurate approach;

(iv) No nose depression by use of longitudinal control shall be made after initiating the flare other than those small changes necessary to maintain a continuous and consistent flare flight path; and

(v) The flare, touchdown and landing may not require exceptional piloting skill or alertness.

For conditions (1) and (3), the flare must not be initiated above the screen height.

For condition (2), it must be possible to achieve an approach path angle 2° steeper than the selected approach path angle in all configurations which exist down to the initiation of the flare, which must not occur above 150 % of the screen height. The flare technique used must be substantially unchanged from that recommended for use at the selected approach path angle.

(b) All-engines-operating steep approach. It must be demonstrated that the aeroplane can safely transition from the all-engines-operating steep landing approach to the one-engine-inoperative approach climb configuration with one engine having been made inoperative for the following conditions:

(1) The selected steep approach angle;

(2) An approach speed of $V_{REF(SAL)}$;

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(3) The most critical weight and centre of gravity; and

(4 For propeller-powered aeroplanes, the propeller of the inoperative engine shall be at the position it automatically assumes following an engine failure at high power.

(c) In addition, for propeller-powered aeroplanes, it must be demonstrated that controllability is maintained following an engine failure at approach power and with the propeller at the position it automatically assumes.

(d) The height loss during the manoeuvre required by subparagraph (SAL) 25.5(b) must be determined.

(e) It must be demonstrated that the aeroplane is safely controllable during a landing with one engine having been made inoperative during the final stages of an all-engines-operating steep approach for the following conditions:

(1) The selected steep approach angle;

(2) An approach speed of $V_{REF(SAL)}$;

(3) The most critical weight and centre of gravity; and

(4) For propeller-powered aeroplanes, the propeller of the inoperative engine shall be at the position it automatically assumes following an engine failure at approach power.

(f) One-engine-inoperative steep approach. It must be demonstrated that the aeroplane can safely transition from the one-engine-inoperative steep landing approach to the approach climb configuration for the following conditions:

(1) The selected steep approach angle;

(2) An approach speed of $V_{REF(SAL)-1}$;

(3) The most critical weight and centre of gravity; and

(4) For propeller-powered aeroplanes the propeller of the inoperative engine may be feathered.

(SAL) 25.6 Aeroplane Flight Manual

The AFM supplement for steep approach landing shall include the following:

(a) The steep approach landing distance determined in accordance with paragraph (SAL) 25.3 of this appendix for the selected screen height and aeroplane configuration. The landing distance data may additionally include correction factors for runway slope and temperature other than standard, within the operational limits of the aeroplane, and may provide the required landing field length including the appropriate factors for operational variations prescribed in the relevant operating regulation.

(b) The more limiting of the landing weight, altitude and temperature (WAT) limits derived in accordance with:

(1) CS 25.119, and

(2) The one-engine-inoperative approach climb requirement of paragraph (SAL) 25.4 of this appendix.

(c) Appropriate limitations and detailed normal, non-normal and emergency procedures. Where an aeroplane is not approved for deliberate one-engine-inoperative steep approach landings, this limitation shall be stated.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(d) A statement that the presentation of the steep approach limitations, procedures and performance reflects the capability of the aeroplane to perform steep approach landings but that it does not constitute operational approval.

(e) A statement of headwind and crosswind limitations if they are different from those for non-steep approaches. The tailwind limitation is 5 knots, unless test evidence shows that more than 5 knots is acceptable.

(f) The reference steep approach glide slope angle and the screen height used for determination of the landing distance must be specified.

(g) The height loss during a go-around from the all-engines-operating steep landing approach to the approach climb configuration with one engine made inoperative, determined in accordance with (SAL) 25.5(d).

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

BOOK 2

AMC — SUBPART B

Amend AMC 25.21(g) as follows:

AMC 25.21(g) Performance and handling characteristics in icing conditions contained in Appendix C of CS-25

…

4.7 …

h. Installed thrust. This includes operation of ice protection systems when establishing acceptable power or thrust setting procedures, control, stability, lapse rates, rotor speed margins, temperature margins, ~~Automatic Reserve Power (ARP)~~ Automatic Takeoff Thrust Control System (ATTCS) operation, and power or thrust lever angle functions.

…

Create a new AMC 25.101(g) as follows:

AMC 25.101(g)
Go-around

In showing compliance with CS 25.101(g), it should be shown at the landing weight, altitude and temperature (WAT) limit, by test or calculation, that a safe go-around can be made from the minimum decision height with:

— the critical engine inoperative and, where applicable, the propeller feathered,
— a configuration and a speed initially set for landing and then in accordance with the go-around procedures, using actual time delays and, except for movements of the primary flying controls, not less than 1 second between successive crew actions,
— the power available,
— the landing gear selection to the 'up' position being made after a steady positive rate of climb is achieved.

It should be noted that for Category 3 operation the system will ensure the aircraft is over the runway, so any go-around will be safe with the aircraft rolling on the runway during the manoeuvre. Hence AMC 25.101(g) is only relevant or necessary for decision heights down to Category 2 operations.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

AMC — SUBPART C

Create a new AMC 25.331(c)(1) as follows:

AMC 25.331(c)(1)

Maximum pitch control displacement at V_A

The physical limitations of the aircraft from the cockpit pitch control device to the control surface deflection, such as control stops position, maximum power and displacement rate of the servo controls, and control law limiters, may be taken into account.

Create a new AMC 25.331(c)(2) as follows:

AMC 25.331(c)(2)

Checked manoeuvre between V_A and V_D

The physical limitations of the aircraft from the cockpit pitch control device to the control surface deflection, such as control stops position, maximum power and displacement rate of the servo controls, and control law limiters, may be taken into account.

The circular frequency of the movement of the cockpit control 'ω' shall be varied to establish the effect of the input period and amplitude on the resulting aeroplane loads.

Create a new AMC 25.333(b) as follows:

AMC 25.333(b)

Manoeuvring envelope

For calculation of structural design speeds, the stalling speeds V_{s0} and V_{s1} should be taken to be the 1-g stalling speeds in the appropriate flap configuration. This structural interpretation of stalling speed should be used in connection with the paragraphs CS 25.333(b), CS 25.335, CS 25.335(c)(d)(e), CS 25.479(a), and CS 25.481(a)(1).

Create a new AMC 25.335(b)(1) as follows:

AMC 25.335(b)(1)(ii)

Design Dive Speed — High speed protection function

In any failure condition affecting the high speed protection function, the conditions as defined in CS 25.335(b)(2) still remain applicable.

It implies that a specific value, which may be different from the V_D/M_D value in normal configuration, has to be associated with this failure condition for the definition of loads related to V_D/M_D as well as for the justification to CS 25.629. However, the strength and speed margin required will depend on the probability of this failure condition, according to the criteria of CS 25.302.

Create a new AMC 25.349(a) as follows:

AMC 25.349(a)

Rolling conditions

For aeroplanes equipped with electronic flight controls, where the motion of the control surfaces does not bear a direct relationship to the motion of the cockpit control devices, the rolling manoeuvre of CS 25.349(a) should be considered in the following manner:

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(a) The aircraft is considered to be initially in a wings level attitude corresponding to a symmetrical pull up or push over, over the range of normal acceleration from zero to two thirds of the positive limit manoeuvring load factor.

(b) At V_A, a sudden movement of the cockpit roll control up to the limit is assumed.

The cockpit roll control should be maintained until steady roll rate is achieved and then be returned suddenly to the neutral position.

(c) At V_C, the cockpit control should be moved suddenly and maintained so that a roll rate not less than that achieved in subparagraph (b) is achieved.

(d) At V_D, the cockpit control should be moved suddenly and maintained so that a roll rate not less than one third of that in subparagraph (b) is achieved.

These conditions should be considered:

— with yaw control held steady, and separately;

— with corrective yaw control action to reduce sideslip as far as possible.

In addition, the physical limitations of the aircraft from the cockpit roll control device to the control surface deflection, such as control stops position, maximum power and displacement rate of the servo controls, and control law limiters, may be taken into account.

Create a new AMC 25.351(e) as follows:

AMC 25.351(e)

Yaw manoeuvre conditions

The physical limitations of the aircraft from the cockpit yaw control device to the control surface deflection, such as control stops position, maximum power and displacement rate of the servo controls, and control law limiters, may be taken into account.

Create a new AMC 25.509 as follows:

AMC 25.509

Towbarless towing

(a). General

Towbarless towing vehicles are generally considered as ground equipment and are as such not subject to direct approval by the (aircraft) certifying agencies. However, these vehicles should be qualified in accordance with the applicable SAE ARP documents and the static and dynamic (including fatigue) loads resulting from these qualification tests should be shared with the aircraft manufacturer to ensure that the nose landing gear and supporting structure is not being overloaded during towbarless towing operations with these vehicles.

(b) Limit static load cases

For the limit static load cases, the investigation may be conducted by rational analysis supported by test evidence. The investigation must take into account the influence on the towing loads of the tractive force of the towing vehicle including consideration of its weight and pavement roughness.

Furthermore, the investigation must include, but may not be limited to, the following towbarless towing operation scenarios:

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(1). Pushback towing: Moving a fully loaded aircraft (up to Maximum Ramp Weight (MRW)) from the parking position to the taxiway. Movement includes: pushback with turn, a stop, and short tow forward to align aircraft and nose wheels. Engines may or may not be operating. Aeroplane movement is similar to a conventional pushback operation with a towbar.

(2). Maintenance towing: The movement of an aeroplane for maintenance/remote parking purposes (e.g. from the gate to a maintenance hangar). Aircraft is typically unloaded with minimal fuel load.

(3) Dispatch (operational) towing: Towing a revenue aircraft (loaded with passengers, fuel, and cargo up to Maximum Ramp Weight (MRW)) from the terminal gate/remote parking area to a location near the active runway. The movement may cover several kilometres with speeds according to SAE ARP 5983 technical standards, with several starts, stops and turns. Replaces typical taxiing operations prior to takeoff.

Operations that are explicitly prohibited need not to be addressed.

(c) Fatigue evaluation

Fatigue evaluation of the impact of towbarless towing on the airframe must be conducted under the provision of CS 25.571 and CS 25.1529.

Specifically, the contribution of the towbarless towing operational loads to the fatigue load spectra for the nose landing gear and its support structure needs to be evaluated. The impact of the towbarless towing on the certified life limits of the landing gear and supporting structure needs to be determined.

The fatigue spectra used in the evaluation should consist of typical service loads encountered during towbarless towing operations, which cover the loading scenarios noted above for static considerations. Furthermore, the spectra should be based on measured statistical data derived from simulated service operation or from applicable industry studies.

(d) Other considerations

Specific combinations of towbarless towing vehicle(s) and aircraft that have been assessed as described above and have been found to be acceptable, along with any applicable towing instructions and/or limitations will have to be specified in the Aeroplane Maintenance Manual and/or in the Aeroplane Flight Manual.

Aircraft braking, while the aircraft is under tow, may result in loads exceeding the aircraft's design load and may result in structural damage and/or nose gear collapse. For these reasons, appropriate steps to preclude aircraft braking during normal towbarless towing should be taken. The aircraft manufacturer should ensure that the appropriate information is provided in the Aeroplane Maintenance Manual and in the Aeroplane Flight Manual.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

AMC — SUBPART D

Create a new AMC 25.745(d) as follows:

AMC 25.745(d)

Nose-wheel steering

CS 25.745(d) provides for the two following options:

1. A 'no damage' situation exists, because damage is precluded.

2. Damage can occur, but indication to the flight crew is provided.

(a) General consideration to CS 25.745(d)(1) and (2)

Some damage may occur during ground manoeuvring activities that can be considered acceptable and judged to be normal wear and tear. It is not intended that such damage needs necessarily to be precluded or that it should initiate a flight crew alert.

(b) To comply with CS 25.745(d)(1) the following applies:

The aeroplane may be designed in such a way that under all ground manoeuvring operations by any towing means no damage affecting the steering system can occur.

Examples are:

(1) The steering system is designed sufficiently strong to resist any applied towing input.

(2) The steering system is designed to allow 360 degrees rotation.

(3) The steering system is disconnected either automatically or by operational procedure.

(4) The steering system is protected by shear sections installed on the nose landing gear.

(c) To comply with CS 25.745(d)(2) the following applies:

When protection is afforded by the flight crew alerting system, the damage detection means should be independent of the availability of aeroplane power supplies and should be active during ground manoeuvring operations effected by means independent of the aeroplane. If damage may have occurred, a latched signal should be provided to the flight crew alerting system.

(d) Alternative Acceptable Means of Compliance to CS 25.745(d)(1) and (2):

In the case where the aeroplane design does not comply with CS 25.745(d)(1) and (d)(2) the following applies:

(1) The Aeroplane Flight Manual, in the Section Limitations, should include a statement that 'Towbarless towing is prohibited', or

(2) The Aeroplane Flight Manual, in the Section Limitations, should include a statement that:

'Towbarless towing is prohibited, unless the towbarless towing operations are performed in compliance with the appropriate operational regulation using towbarless towing vehicles that are designed and operated to preclude damage to the aeroplane nose wheel steering system, or which provide a reliable and unmistakable warning when damage to the steering system has occurred.

Towbarless towing vehicles that are specifically accepted for this type of aeroplane must be listed in the documentation provided by the aeroplane manufacturer.'

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(3) The acceptance by the aeroplane manufacturer of the applicable towbarless towing vehicles and its reliability of the oversteer protection and/or indication system as referred to in subparagraph (b) above should be based on the following:

(i). The aeroplane Nose Wheel Steering Failure Analysis should include the effects of possible damage caused by towbarless towing operations.

(ii). If the Nose Wheel Steering Failure Analysis shows that damage to the steering system by the use of towbarless towing may result in a Failure Condition that can be classified as Hazardous or Catastrophic (refer to CS 25.1309), the acceptance of a towing vehicle oversteer protection and/or indication system should be based on an aeroplane safety analysis, encompassing the reliability of that vehicle system, in order to meet the aeroplane safety objectives.

(iii). If the Nose Wheel Steering Failure Analysis shows that damage to the steering system by the use of towbarless towing may result in a Failure Condition that can be classified as Major or less severe, the aeroplane manufacturer can accept the design of the towing vehicle oversteer indication — and/or protection system based on a 'Declaration of Compliance', issued by the towbarless towing vehicle manufacturer. This declaration will state that the vehicle design complies with the applicable standards (SAE ARPs, Aeroplane Towing Assessment Criteria Document) and that it is designed and built under ISO 9001 quality standards or equivalent.

Such a declaration must be made regarding all Towbarless Towing Vehicles to be used for ground manoeuvring of CS-25 certificated aeroplanes.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

AMC — SUBPART E

Create a new AMC 25.1193 (e) as follows:

AMC 25.1193(e)
Engine cowling, nacelle and APU compartment skin

(a) PURPOSE

This AMC provides guidance for showing compliance with the certification requirement relating to fire withstanding capability of engine nacelle fire zone skin and APU compartment fire zone skin in consideration of potential hazard levels associated to operating conditions (flight/ground).

(b) RELATED CERTIFICATION SPECIFICATIONS

CS 25.1193 (e), CS 25J1193 (e)

(c) APPLICABILITY

This interpretative material is applicable to engine and APU cowlings and nacelle (fixed and/or removable)

(d) BACKGROUND

CS 25.1193(e) requires the firewall, including fire zone skins, be fireproof if a fire starts in the engine power or accessory sections. During past type-certification projects it has been found that having non-fireproof skins in some locations under some operating conditions does not adversely affect safety. Consequently, in practice, not all cowlings/nacelle skins 'subject to flame if a fire starts in the engine power or accessory sections' have been required to be fireproof under all operating conditions but required to be fire resistant. As it represented a rule relaxation, such non-fireproof skins were formally found to be 'equivalently safe' to comply with the rule. Over time, however, these equivalent safety findings became inherent within traditionally accepted design practices. Certification Review Item (CRI) released to cover the relaxation included also interpretations for zone definitions and operating conditions to be considered for fireproofness or fire-resistance compliance demonstration.

(e) FIRE WITHSTANDING REQUIREMENTS, OPERATING CONDITIONS AND POTENTIAL HAZARDS

(1) General
The required level of ability to withstand the effects of fire varies with the potential hazard level associated with different flight and ground operating conditions, as follows:

(2) Flight Conditions
For flight conditions from airspeed above minimum V1 until minimum touchdown speed in approved normal or abnormal operations, the cowling and nacelle skin in areas subject to flame if a fire starts in an engine or APU fire zone shall be demonstrated to be fireproof. The conditions for demonstrating the fireproof capabilities of the cowling should be consistent with the critical operating conditions. Where engine power can affect conditions on the cowling (including max engine power, min engine power and propeller feathering), these should be examined and the most critical should be determined. These conditions should be applied for 5 minutes, with the remaining 10 minutes under windmilling conditions for engine and stopped conditions for the APU.

(3) Ground conditions

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(i) Engine operation — Requirements for ability of the skin in areas subject to flame if a fire starts in an engine or APU fire zone to withstand the effects of fire under ground operating conditions apply with either the engine operating or not operating, whichever is the more critical.

(ii) Nacelle areas where fireproof skins are required — The portion of cowling and nacelle skin in areas subject to flame if a fire starts in an engine or APU fire zone, and located so that not containing the effects of the fire could result in serious injuries to crew, passengers or ground personnel, should be fireproof under all conditions. Serious hazards include, but are not limited to, events such as fuel tank explosion, hazardous spread of fire to flammable fluid sources outside the fire zone or fuselage penetration.

(A) Pod-mounted engines: The portion of the nacelle skin, which is required to be fireproof on ground, varies by installation. A design is considered acceptable when it is demonstrated that the fireproof area protects the pylon strut and other portions of the aircraft considered to be put at a serious hazard risk if burn through occurs. Factors to consider within the analysis and to use when substantiating the design are: the engine location — wing or aft mounted, the coupling distance of the nacelle to the wing, the airflow characteristics, the fluid migration scheme and the fire plume patterns. After the initial analysis, a similarity demonstration may be used when appropriate. Analyses have demonstrated that the typical area of concern ranges from 90° (± 45°) to 180° (± 90°). This area may increase or decrease depending on the analysis results. For example, most wing mounted engines not closely coupled to the wing have been found acceptable with a ± 45° protection while more closely coupled installations and those with other unique design features have required ± 90° protection. The symmetry of the protection may also vary. Wing mounted engines usually have symmetrical protection while aft mounted engines may have non-symmetrical protection in order to cover more of the inboard area.

(B) Turboprops and APUs and other non-pod-mounted engines: Due to the wide variations in installation configurations each installation should be evaluated to determine if not containing the effects of a fire would cause a serious hazard such as the examples above. If so, the affected area of the fire zone skin should be fireproof.

(iii) Other nacelle areas: For the remaining portions of skin in areas subject to flame, if a fire starts in an engine or APU fire zone, the degree of fire resistance can be lower than ‘fireproof’ due to less serious or less probable hazard to the crew, passengers and ground personnel under the critical operating conditions.

(A) Fire-resistant skins provide adequate fire protection for those areas as they provide sufficient time to stop the aeroplane and evacuate it.

(B) A lower than ‘fire-resistant’ degree of fire protection has been used by applicants in the past without adverse service experience and can be considered under the following conditions:

— Cowling/nacelle skin should have the ability to withstand fire at least equivalent to 0.040" (1 mm) aluminium;
— Applicants must substantiate that this lower fire protection level will not lead to hazardous effects such as:

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

- o Upon burn through of the lower than ‘fire-resistant’ area, both the fire-resistant and/or fire-proof areas shall not have their fire withstanding capability affected.
- o Liberation of parts that would affect the evacuation procedure or reduce the efficiency of fire protection means.
- o Reduction in flammable fluid drainage capability such that fire severity would be increased (magnitude, residual presence, propagation to surrounding area).
- o Reduction in evacuation capability due to proximity to escape routes or due to the visibility of the fire hindering the ability of the passengers to evacuate the aeroplane in a rapid and orderly manner.

Note: There is some hazard involving passenger evacuation even in the absence of burn through due to such concerns as smoke and flaming liquids exiting from openings. Burn through of nacelle skin should not significantly increase these hazards.

- o Reduction in fire detection capability such that the flight crew would not be aware of the fire, especially in a situation involving taxiing prior to take-off.
- o Reduction in fire extinguishing capability which could cause or aggravate one of the potential hazards listed above.

(f) SPECIFIC CONFIGURATION CONSIDERATIONS

(1) Multiple skin layers: For some specific fire zones, a fire originating in that zone will have to pass through several layers of skin or cowling before burning through the nacelle external skin. This may be the case, for example, for the core zone of some turbofan installations. In such cases, credit may be taken for multiple layers, having regard to the location of the fire source and the likely direction of propagation from that location, providing burn through of the inner layer does not produce other hazardous effects and it does not invalidate other certification requirements such as fire extinguishing capability. The corresponding compliance substantiation should take into account particular geometrical configuration with respect to the risk of flame propagation, as well as critical systems or structures.

(2) Inlet skins: External inlet skins, which enclose fire zones, should meet the same criteria discussed. Inlet ducts should meet the requirements of CS 25.1103/CS 25J1103.

(3) Openings: The following considerations are applicable to openings in a fire zone skin whether the openings are of fixed size, variable or controllable size, or normally closed, such as access or inspection doors, or pressure relief doors.

(i) Openings should be located such that flame exiting the opening would not enter any other region where it could cause a hazard in flight or a serious hazard on the ground as per subparagraph 5.c. Exception is made for covered openings which meet the same criteria for ability to withstand the effects of fire as the surrounding cowl skin, and which are not expected to become open under fire conditions. Since pressure relief doors may open during some fire conditions, they should be located such that flames exiting the door will not cause a hazard. However, doors that will remain closed during most fire conditions, or will tend to re-close following initial opening, have traditionally been assumed to be closed for the purposes of evaluating fire detection and extinguishing.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

(ii) Openings should have the same ability to withstand the effects of fire as the adjacent skin with respect to becoming enlarged under fire conditions. Some enlargement, such as burning away of louvers or doublers surrounding the opening or gapping of covered openings, is acceptable provided that the hazard is not significantly increased by a reduction in fire extinguishing or detection capability, increased airflow causing increase in fire size or intensity, or increase in probability of a hazardous spread of fire to other regions.

(4) Hinges, Fittings and Latches: Fitting means attaching the nacelle/cowling between them or to the aircraft/engine/APU structure shall have the same ability to withstand the effect of fire as the surrounding skin.

(g) COMPLIANCE DEMONSTRATION

Compliance should be substantiated per CS 25.1207. Substantiation involving airflow patterns may include analytical methods such as Computational Fluid Dynamics, test methods or other flow visualisation methods or a combination of these methods. Fire testing should be accomplished according to the guidance of ISO 2685 with considerations of applications of representative conditions (airflow, loads, vibrations) and establishment of appropriate pass/fail criteria (burn through, elongation, dislocation).

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

AMC — SUBPART F

Create a new AMC 25.1447(c)(3) as follows:

AMC 25.1447(c)(3)

Equipment standards for oxygen dispensing units

If oxygen outlets are not provided in a dedicated area, called here remote area, the applicant shall demonstrate that oxygen dispensing outlets are within ‘five feet/five seconds’ reach of the remote area(s) and shall show that no visual obstruction exists between the potential oxygen users and the outlets, such as curtains or partitions.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

AMC — APPENDICES

Create a new AMC to Appendix Q as follows:

AMC to Appendix Q

(SAL) 25.5 Safe operational and flight characteristics

(a) For the approach demonstrations required by (SAL) 25.5(a), due account should be taken of:

(1) The systems' aspects of the power/thrust levers being at idle (e.g. arming of ground lift dump);

(2) The most adverse flight idle power/thrust (e.g. effects of engine bleeds or FADEC idle power/thrust control); and

(3) The effects on controllability from the use of auxiliary drag devices such as flight spoilers (e.g. increased stall warning and stall speeds, loss of manoeuvrability).

(b) For the flare, touchdown and landing demonstrations required by (SAL) 25.5(a), there should not be any occurrence of:

(1) Stall warning;

(2) Tail strike; or

(3) Any other characteristic that would interfere with the completion of the landing (e.g. automatic thrust increase).

(c) For the go-around demonstrations required by (SAL) 25.5(b) and (f), due account should be taken of time delays associated with automatic or manual retraction of auxiliary drag devices.

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.

GENERAL

ACCEPTABLE MEANS OF COMPLIANCE — AMC

Amend AMC 25-13 as follows:

5 *Reduced Thrust:* (Acceptable Means of Compliance)

…

a. The reduced take-off thrust setting –

…

(4) Is at least 75% of the take-off thrust, or derated take-off thrust if such is the performance basis, for the existing ambient conditions, with no further reduction below 75% resulting from ~~ARP~~ Automatic Takeoff Thrust Control System (ATTCS) credit. However, the reduced take-off thrust setting may be less than 75% of the take-off thrust for the existing ambient conditions provided that compliance with the applicable performance requirements is demonstrated as thoroughly as for an approved take-off rating.

…

(6) Enables compliance with CS-25 Appendix I in the event of an engine failure during take-off, for aeroplanes equipped with an ~~Automatic Reserve Performance system~~ ATTCS.

…

b. Relevant speeds (VEF, VMC, VR, and V2) used for reduced thrust takeoffs are not less than those which will comply with the required airworthiness controllability criteria when using the takeoff thrust (or derated takeoff thrust, if such is the performance basis) for the ambient conditions, including the effects of an ~~Automatic Reserve Performance (ARP) system~~ ATTCS. It should be noted, as stated in paragraph c. below, that in determining the takeoff weight limits, credit can be given for an operable ~~ARP system~~ ATTCS.

c. The aeroplane complies with all applicable performance requirements, including the criteria in paragraphs a. and b. above, within the range of approved takeoff weights, with the operating engines at the thrust available for the reduced thrust setting selected for takeoff. However, the thrust settings used to show compliance with the takeoff flight path requirements of CS 25.115 and the final takeoff climb performance requirements of CS 25.121(c) should not be greater than that established by the initial thrust setting. In determining the takeoff weight limits, credit can be given for an operable ~~ARP system~~ ATTCS.

…

e. A periodic take-off demonstration is conducted using the aeroplane's takeoff thrust setting without ~~ARP~~ ATTCS, if fitted, and the event is logged in the aeroplane's permanent records. An approved engine maintenance procedure or an approved engine condition monitoring programme may be used to extend the time interval between takeoff demonstrations.

f. The AFM states, as a limitation, that take-offs utilising reduced take-off thrust settings –

…

(4) Are authorised for aeroplanes equipped with an ~~ARP System~~ ATTCS, whether operating or not.

…

TE.RPRO.00034-002© European Aviation Safety Agency. All rights reserved.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.