Appendix
to ED Decision 2018/010/R

RELATED NPA 2017-18 — RMT.0397 — 5.11.2018

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1. Summary of the outcome of the consultation

EASA received 52 comments from 14 stakeholders via the CRT tool, as follows:

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The commentators included aeroplane manufacturers (Airbus, Boeing, Bombardier, Dassault, Embraer, Gulfstream, Textron), one flight test organisation (DGA Essais en vol), national aviation authorities (DGAC France, LBA Germany, TCCA Canada, CAA UK), Eurocontrol, and one individual (Professor at the Hochschule Osnabrück, Germany).

The most substantial comments came from some aeroplane manufacturers (Textron, Embraer, Airbus, Dassault, and Bombardier) who repeated their position with regard to the proposed new yaw manoeuvre load condition, i.e. recommending a single rudder pedal doublet instead of the double rudder pedal doublet proposed in NPA 2017-18. The position of these manufacturers corresponds to position 2 recorded in the FCHWG report; please refer to paragraph 4.1.1.2 in NPA 2017-18 for more details. Boeing and Gulfstream did not object to the EASA position, as was also the case during the consultation of the equivalent EASA Special Condition at the end of 2015. The comments received did not bring any new element that would justify a change of the EASA position, therefore EASA maintains the new CS 25.353 that includes a double rudder pedal doublet condition (which corresponds to position 3 in the FCHWG report).

Other comments were aimed at clarifying or improving the proposed changes, or at supporting the NPA.

EASA also liaised with the FAA, and this has led to a few additional changes to improve the regulatory text while seeking for harmonisation, without changing its essence.

In the end, the main changes made compared with the NPA proposal are:

— CS 25.353:

- Title has been amended to be consistent with the title of CS 25.351 ('load' deleted)
- Simplification of the first sentence of the introduction paragraph, concerning the description of the range of airspeeds to be used, to be consistent with CS 25.351;
- The addition of a new sentence (the second sentence of the introduction paragraph) specifying that permanent deformation resulting from the ultimate load conditions must not prevent continued safe flight and landing. In the NPA, this was contained in the AMC; however, it is preferred to be consistent with other CS-25 specifications using this statement in relation with ultimate conditions (e.g. CS 25.362).;

  - Sub-paragraph (a): the initial text of CS 25.353(a) referred to CS 25.351, and the whole meaning of the specification was then provided in paragraph 4.b of AMC 25.353. This meant that the AMC was somewhat repetitive, but provided a clearer meaning of what we wanted to specify. Therefore, CS 25.353(a) has been re-written in consistency with the content of CS 25.351, but without referring to it.

— AMC 25.353:

  - Simplification of the first sentence in paragraph 4.a(2), in line with the change made to CS 25.353;
  - Clarification on the conditions when failure scenarios do not need to be addressed in combination with the load conditions of CS 25.353, (paragraph 4.a(4));
  - Clarification on the investigation method regarding roll control in paragraph 4.b(1);
  - Deletion of the redundant text in relation to the change made to CS 25.353(a).

— AMC 25.1507: the creation of this AMC is cancelled.

2. Individual comments and responses

In responding to comments, a standard set of terminology has been applied to attest EASA's position. This terminology is as follows:

(a) **Accepted** — EASA agrees with the comment and any proposed amendment is wholly transferred to the revised text.

(b) **Partially accepted** — EASA either partially agrees with the comment, or agrees with it but the proposed amendment is only partially transferred to the revised text.

(c) **Noted** — EASA acknowledges the comment but no change to the existing text is considered necessary.

(d) **Not accepted** — The comment or proposed amendment is not shared by EASA.

2.1. CRD table of comments, responses and resulting text

(General Comments) -

comment	*27* comment by: *Prof. Dr.-Ing. Bernd Hamacher* This NPA contains terminology weaknesses and terminology errors as well as typing errors, which shoukd be cleaned up before publication. Details are indicated to the affected paragraphs subsequently. The agency should set-up a quality managment system for publications or evaluate the effectivness of the existing quality management system.
response	Noted.

comment	*36* comment by: *Luftfahrt-Bundesamt* LBA has no comments on NPA 2017-18.
response	Noted.

comment	*38* comment by: *DGAC France* Please note that DGAC France has no specific comment on this NPA.
response	Noted.

comment	*40* comment by: *UK CAA* Thank you for the opportunity to comment on NPA 2017-18, Unintended or inappropriate rudder usage - rudder reverals. The UK CAA would like to confirm that we support the revisions proposed in NPA.
response	Noted.

comment 51 comment by: *Textron Aviation*

TEXTRON AVIATION COMMENTS:

Textron Aviation has reviewed the proposed NPA 2017-18 addressing requirements to mitigate the risk posed by inappropriate rudder doublet inputs. The NPA lists as objectives the mitigation, through design changes, of risks posed by multiple rudder doublet inputs and the introduction of clarification statements highlighting the hazard posed by multiple successive control inputs at any speed including below maneuvering speed. Textron Aviation supports the second objective and proposed action as written and agrees with EASA's position in terms of cost and impact for its enactment. Therefore, comments provided below focus on the first objective and associated proposal for a "double doublet" design standard.

Need for new design requirements and proposed CS 25.353 standard:

Textron Aviation participated in the ARAC FCHWG effort seeking to address the AA587 accident and other incidents related to inappropriate use of the rudder. Textron Aviation supports the OEM position put forward that future rulemaking should consider the single doublet condition only. The rationale for this position is included below with edits appropriate to specific points on the NPA:

- Significant rudder control reversal events appear to be very rare, on the order of 10^{-8}/FH.·
- Onlyone accident, AA587, has a unique pedal and control wheel activity, with erroneous training procedures. It should not serve as a design standard.
- The conservative single full-stroke rudder control doublet covers all other known incidents of multiple rudder control reversals investigated and addresses the NPA's aim for providing condition coverage for recovery from non-zero sideslips (single full stroke application from initial maximum sideslip) which is missing in the existing 25.351 rule.
- For some types of aircraft, overly severe criteria, including multiple full-stroke doublets, would lead to structural strengthening, a weight penalty, and/or system changes that could be detrimental to normal operations.
- Enhanced training (as recommended by FCHWG) is the single most effective countermeasure to inappropriate rudder control reversals.
- Therefore, the conservative single full-stroke rudder control doublet is sufficiently severe.

Cost / benefit assessment of proposed "double-doublet" CS 25.353 design standard

Textron Aviation disagrees with a number of EASA's points in terms of the impact of the proposed rule, as well as some of the basic assumptions behind their assessments:

- Use of existing "trend in designs to move away from mechanical systems and towards electronic control systems" as justification for "creating little or no economic impact in most cases.":

	- The above general statement disregards differentiation among the various classes of transport (large) airplanes. Incorporation of electronic control systems imposes a significant burden to the unit cost and development complexity for small and mid-size general aviation airplanes (approximately 19,000 – 35,000 lb). These airplanes represent a small subset of the total transport aircraft fleet, but add up to a sizable portion of the turbine powered General Aviation installed base. • Mitigation effects of "unswampable" yaw dampers: - The text of the NPA offers the use of all normally available systems (yaw dampers, normal flight control laws, etc) in the analysis of the new proposed 25.353 design condition. Furthermore, the proposed accompanying AMC text specifically exempts the doublet conditions from consideration in combination with other failure scenarios. The system effects section of the AMC, however, The NPA text in both its environmental and economic impact highlights the conservative nature of the environmental and cost impact of omitting the use of the yaw damper for non-electronic flight control systems. The above assessment, however, indicates that omission of this damper system is appropriate in the assessment. • Suitability of single doublet event to address inadvertent conditions: - The NPA safety impact assessment correctly points out that multiple doublets would result in either higher loads or a more severe test to any functionality engineered into the aircraft to minimize loads produced by repeated rudder pedal reversals. The single doublet test, however, does bring in the desired protection against corrections from a sideslip. Though a large percentage of existing airplanes already comply with this requirement in terms of structural capability, the standard provides a check against tolerance to multiple reversals in future aircraft. • Prior application of FAA issue papers imposing a "double doublet" standard as additional justification for minimal cost and technical issues: - Application of this standard for smaller transport airplanes imposes a substantial technical and/or cost burden as outlined above. The relatively recent nature of the practice of issuing the Issue Paper as a 25.601 means of compliance has limited its application to few, if any, airplanes in this lower weight class and is therefore not indicative of the impact to all transport airplanes.
response	Not accepted. Please refer to Section 4.4.1. Safety impact of the NPA. Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario;

EASA believes that it is necessary to protect against such scenarios.

Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

It is the role of the applicant to propose a design solution that complies with the applicable rule. Nevertheless, EASA believes that the incorporation of electronic control systems is not the only possible solution; structural strengthening and/or an improved yaw damper system could also be used.

The comment on the 'unswampable' yaw dampers is not understood. The regulatory impact assessment of the NPA conservatively does not take credit from the associated benefit of considering the yaw damper for the economic and environmental impact. However, credit from the yaw damper can be taken when demonstrating compliance with the new rule.

comment *54* comment by: *EUROCONTROL*

The EUROCONTROL Agency welcomes the publication of EASA Notice of Proposed Amendment 2017-18 on 'the unintended or inappropriate rudder usage by pilots of large aeroplanes'. It also thanks EASA for the opportunity that has been given to submit comments. However, the subject of the amendment is considered outside the scope of activities of EUROCONTROL. In addition, despite the fact that it has no comments to make, the EUROCONTROL Agency would like to confirm that it will read with interest the comments on this NPA received from stakeholders and the responses given to them by EASA in its future comment-response document (CRD). Like for NPA 2017-18, EUROCONTROL staff will be given access to CRD 2017-18, for information.

response Noted.

General comments p. 1

comment *48* comment by: *Embraer S.A.*

The Embraer still supports the single rudder control doublet requirement proposed during the deliberations of the ARAC Flight Control Harmonization Working Group. It sufficiently addresses foreseeable control use, while not being overly penalizing nor providing an incentive to implement additional limits on rudder authority which could have unanticipated adverse safety implications.

response Not accepted.

Please refer to Section4.4.1. Safety impact of the NPA.

Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario;

EASA believes that it is necessary to protect against such scenarios.

Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

2. In summary — why and what	p. 4-5

comment | 14 comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 5, 2nd paragraph, 2nd subparagraph

Terminology ambiguity: „weight“
Weight is used as an ambiguous term here.

If mass times acceleration (M * a) is meant, “weight” should be replaced by “weightforce”
If mass (M) is meant, “weight” should be replaced by “mass”.

Explanation:

Despite the fact that colloquially “weight” and “mass” are often used synonymously, it should be noted that from a flight physics perspective, weight and mass are different concepts.
A synonoumous usage is not in line with scientific standards.

EASA should not use a colloquial terminology in official documents.

response | Noted.

The comment is technically correct. However, the term ‘weight’ has been used for a long time by the aviation stakeholders and is still used in various places in regulations (EASA, FAA, and others).

comment | 17 comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 5 objectives:

The objective of the agency "that applicants should use the minimum manoeuvring speed" is disturbing and ill justified:

Why an applicant should <u>use</u> that speed? An applicant has to <u>determine</u> a speed, but not to <u>use</u> it.
Operators use speeds recommended or prescribed by applicants.

But why an operator should use the minimum manoeuvring speed or is meant the minimum manoeuvring speed limit?
The minimum manoeuvring speed could be the stall speed at minimum weight. Why should operators fly at stall speed and/or at minimum weight?
Moreover, what is meant with minimum weight? Does that mean the minimum allowable mass or the minimum weightforce? At low G the minimum weightforce might be zero or near zero. Should crews perform a low-G manoeuvre? Weak terminology!

Above that the objective of the agency is confusing:
subject of the NPA is inappropriate rudder usage and exceptional loads on the vertical tail caused by pilot induced actions.
The load on the vertical tail is dependant from aerodynamic forces, caused by rudder and vertical fin.

	The lower the speed at a given air density, the lower the aerodynmamic force. This is the main message to note. Flying at minimum manoeuvring speed is neither necessary nor improving flight safety.
response	Noted. Please refer to the response to comment 50.

comment	*28* comment by: *Airbus-EIAIX-SRg* In general Airbus proposes to retain the one-pedal doublet manoeuver of the ARAC report (Position 2) to create a new CS25.353. Specifically Airbus proposes following changes (on different pages of NPA 2017-18): Page 5, para. 2.3 - How we want to achive it Airbus propose following change: Change -create a new CS25.353 yaw manoeuvre condition, consisting of a *two-pedal* doublet manoeuver…. By -create a new CS25.353 yaw manoeuvre condition, consisting of a one-pedal doublet manoeuver…. Rational for this proposal: This draft NPA is based on FCHWG "Rudder Pedal Sensitivity/Rudder Reversal Recommendation Report, dated Nov 7, 2013. This report presents multiple views regarding the need for additional part 25 standards to mitigate inappropriate rudder usage as consensus could not be obtained. Airbus understanding is that EASA retained the two-pedal doublet manoeuver of the ARAC report (Position 3) despite dissenting opinions raised in the frame of FCHWG. Since its participation to the FCHWG in 2013, Airbus position is to consider that, in addition to CS25.351 requirements, the addition of a design load requirement that would consist of a single full-stroke rudder control doublet maneuver (full displacement input, following by one reversal and return to neural) is a sufficient design standard to provide additional protection against rudder control reversals as: · Significant rudder control reversal events appear to be very rare, on the order of 10-8/FH. · Only one accident, AA587, has a unique pedal and control wheel activity, with erroneous training procedures. It should not serve as a design standard. · The conservative single full-stroke rudder control doublet covers all other known incidents of multiple rudder control reversals investigated. · For some types of aircraft, overly severe criteria, including multiple full-stroke doublets, would lead to structural strengthening, a weight penalty, and/or system changes that could be detrimental to normal operations.

· Enhanced training (as recommended by FCHWG) is the most effective countermeasure to inappropriate rudder control reversals.

Airbus disagrees with EASA that it is necessary to make regulatory change as well as to apply the new proposed rule as well as a Special Condition to ensure that aeroplanes are design tolerant to two rudder pedal doublets on new applicable large aeroplane certification project.

Airbus considers that applying a new rule to ensure that aeroplanes are design tolerant to one full-stroke rudder pedal doublet on new applicable large aeroplane certification project would provide a significant safety improvement. The associated costs (economic impact) in this case would be commensurate with the benefit in terms of safety.
In addition, in order to mitigate the safety risk associated to inappropriate rudder doublets, depending on aircraft design, different solutions may be envisaged: implementation of rudder control laws, and/or implementation of warnings associated to an enhanced training.

response Not accepted.

Please refer to Section 4.4.1. Safety impact of the NPA.

Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario;

EASA believes that it is necessary to protect against such scenarios.

Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

Please note that the implementation of rudder control laws is one potential solution to mitigate the safety risk. The FCHWG reviewed the possibility to implement a provision allowing the use of an alert in the rule, and concluded as follows:

Refer to the FCHWG final report dated 30 December 2013, page 16, end of Section 2:
'*The group discussed the possibility of including in the rule the allowance to use deterrent systems, including warning systems, to mitigate the severity of the loading condition defined in 25.353 or deter the pilot from making subsequent doublets. However, the rule cannot anticipate the various solutions that manufacturers might propose. Therefore, references to deterrent systems including warning systems were not included in the final proposal. Deterrent systems like warning systems could be used only as part an Equivalent Level of Safety request of a compliance demonstration to 25.353*.'

comment *41* comment by: *Gulfstream Aerospace*

1) It is noted in Section 2.1 that the NTSB recommended that CS 25 be modified to include "limits for rudder pedal sensitivity (A-10-119)", and in Section 4.1.1.1 that existing CS 25 regulations "do not address specific control system parameters such as inceptor travel, breakout force, or force gradient." The existing FAA issue papers related to Yaw Oscillations have specified that the applicant show by test or analysis that rudder control system design characteristics including pedal sensitivity, breakout forces, lateral accelerations as a function of pedal force, the ability to adequately modulate rudder control throughout the flight envelope, and displacement and harmony with other flight controls provide safe handling qualities throughout the flight envelope. This proposal does not address this aspect of the

	NTSB safety recommendation nor the current content of the FAA Issue Paper, despite identifying that the current regulations are inadequate to do so. Was this an oversight, or is this issue being addressed by other rulemaking?
response	Noted. The rudder pedal sensitivity aspect of the NTSB safety recommendation has been analysed by the FCHWG, with support from the FTHWG. We refer to the FCHWG report page 16, paragraph 2, which includes the following: '*The group determined that no standard can be developed to prevent unintended rudder usage. However, the group was able to develop a standard that accounts for inappropriate usage (a design load condition), described above. The referenced standards (a. thru e.) were considered.* *In responding to this question, the FCHWG also considered NTSB SR A-04-056, "Modify 14 CFR part 25 to include a certification standard that will ensure safe handling qualities in the yaw axis throughout the flight envelope, including limits for rudder pedal sensitivity." FCHWG investigated Airplane Response/Maneuverability (2b) and Control Sensitivity (2d), including engagement of the Flight Test Harmonization Working Group (FTHWG) and analysis of 9 different airplanes' responses to a contrived rudder pedal input aimed at determining a pass/fail criteria for rudder pedal control sensitivity. However, given the time/resources available, the group was unable to reach any conclusions regarding what kinds of sensitivity parameters pilots were sensitive to, especially with regards to what would make them less prone to making rudder pedal reversals. (Additional details are contained in Attachment H.) Hence, this recommendation contains no changes to Subpart B.* *Furthermore, after significant review of the existing Subpart D and F System requirements (2c), there was no logical place where system requirements, in isolation from the airplane, would aid reducing rudder reversals. Even when the airplane response to a rudder doublet (FTHWG, see above) was considered, the group was unable to reach any conclusions regarding systems parameters which would make pilots less prone to making rudder pedal reversals. Hence, this recommendation contains no changes to Subpart D or F.* *For this reason, the recommendation for changes to 14 CFR Part 25 contained herein is a change to Subpart C (Loads, 2a), largely because of the FCHWG's inability to determine reasonable and effective changes to the other subparts of 14 CFR Part 25*.' EASA agrees with these conclusions.

comment	*42* comment by: *Gulfstream Aerospace*
	Section 2.2 identifies an objective to "clarify that applicants should use the minimum (low weight) manoeuvring speed." In Section 3.1 Proposed Amendment 4, AMC 25.1507 only explains that pitch maneuvers to near stall angles of attack below the maneuvering speed may not prevent exceedance of the design load factor if low airplane weights are not considered when setting maneuvering speed. In addition, CS 25.335(c)(2) specifies that Va, the Design Maneuvering Speed, must be evaluated at the "design weight" and CS 25.1507 only requires that the maneuvering speed not exceed the design maneuvering speed. The proposed advisory material for AMC 25.1507 does not directly provide guidance that a low weight condition should be used to establish the maneuvering speed limitation, and thus it's not apparent that the stated objective is met.
response	Noted.

Please refer to the response to comment 50.

3. Proposed amendments and rationale in detail p. 6

comment *15* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 5, 2nd paragraph, 5ft subparagraph

Terminology ambiguity: „weight"
Weight is used as an ambiguous term here.

If mass times acceleration (M * a) is meant, "weight" should be replaced by "weightforce"
If mass (M) is meant, "weight" should be replaced by "mass".

Explanation:

Despite the fact that colloquially "weight" and "mass" are often used synonymously, it should be noted that from a flight physics perspective, weight and mass are different concepts.
A synonoumous usage is not in line with scientific standards.

EASA should not use a colloquial terminology in official documents.

response Noted.

The comment is technically correct. However, the term 'weight' has been used for a long time by the aviation stakeholders and is still used in various places in regulations (EASA, FAA, and others).

comment *29* comment by: *Airbus-EIAIX-SRg*

Page 6, para 3.1 - Draft certification specifications and acceptable means of compliance (Draft EASA decision)
Section: Description

Airbus propose following change:

Change
It is proposed to amend CS-25 as follows:
— create a new CS 25.353 yaw manoeuvre condition, consisting of a *two-pedal* doublet manoeuvre, which is based on the text of the EASA Special Condition (SC) on Rudder Control Reversal Load Conditions (refer to 4.1.1.3), itself prepared based on the FCHWG report (attachment B of the report, Version 2 – Two Doublet Condition);
— create a new AMC 25.353, which is based on the proposed new AMC that was published by EASA together with the SC mentioned above, itself based on the FCHWG report (attachment C of the report, Version 2 – *Two* Doublet Condition);

By

	It is proposed to amend CS-25 as follows: — create a new CS 25.353 yaw manoeuvre condition, consisting of a one-pedal doublet manoeuvre, which is based on the text of the EASA Special Condition (SC) on Rudder Control Reversal Load Conditions (refer to 4.1.1.3), itself prepared based on the FCHWG report (attachment B of the report, Version 1 – Single Doublet Condition); — create a new AMC 25.353, which is based on the proposed new AMC that was published by EASA together with the SC mentioned above, itself based on the FCHWG report (attachment C of the report, Version 1 – Single Doublet Condition); Rational for proposal: Airbus considers that applying a new rule to ensure that aeroplanes are design tolerant to one full-stroke rudder pedal doublet on new applicable large aeroplane certification project would provide a significant safety improvement. Airbus proposes to retain the Position 2 of FCHWG report and the attachment C of the report, Version 1 – Single Doublet Condition.
response	Not accepted. Please refer to Section 4.4.1. Safety impact of the NPA. Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario; EASA believes that it is necessary to protect against such scenarios. Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

comment	*39* comment by: *Prof. Dr.-Ing. Bernd Hamacher* **3.1 5th dashline:** "minimum (low weight) manoeuvring speed" is confusing here: - it is unknown to me, that a low weight manoeuvring speed (f.e. a low-G speed of 0.5 G) is determined and published in the AFM. What is published in the AFM is a speed at a mass below MTOM. That´s a fundamental difference, which should not mixed-up by sloppy terminology. - manoeuvring speed addresses two loads: (a) aerodynamic loads/forces and (b) acceleration loads/forces. The aceleleration loads are depending on mass, the aerodynamic loads **not**. As rudder loads, which are here in focus, are depending on aerodynamic loads and additional acceleration loads (swing-over), which are not depending on the total mass of the aeroplane, it is not convincing to refer here to an aeroplane mass (wrongly called weight) dependent speed. Please revise!

response | Noted.

Please refer to the response to comment 50.

comment | *43* | comment by: *Gulfstream Aerospace*

1) Section 3.1 Proposed Amendment 2 for AMC 25.353, paragraph 4.a.(3)(i) is a run-on sentence and its intent is unclear. Is the idea that dispatching via MMEL with a load limiting system unavailable would be permitted only if the flight envelope is restricted such that the specified rudder reversal maneuvers could be satisfied with the system inoperative without ultimate load exceedance? Or is the intent that some time limited dispatch would be permitted by assessment of the probability of a rudder reversal input?

response | Noted.

Time-limited dispatches with failures (under MMEL) may be allowed, but they will have to be reviewed and discussed on a case-by-case basis, as per the guidance given in paragraph 4.a.(3)(i) of AMC 25.353.

It is difficult to be more specific and therefore no modification to the text is proposed.

comment | *44* | comment by: *Gulfstream Aerospace*

1) Section 3.1 Proposed Amendment 2 for AMC 25.353, paragraph 4.a.(4) is confusing when compared to the 4.a.(3)(ii) paragraph. If the failure probability is greater than 1/1000, is this paragraph (4) saying the failure condition still need not be addressed (i.e., maneuver loads can be assessed with the system operating normally even if the undetected failure probability is 2/1000)?

response | Accepted.

Paragraph 4.a(3) applies to systems that are used to demonstrate compliance with the rudder pedal doublet load conditions specified in CS 25.353 (e.g. yaw damper, rudder travel limitation).

The intent of paragraph 4.a(4) is to specify that, assuming that the systems used to demonstrate compliance with CS 25.353 meet the criteria in 4.a(3)(i) and (ii), failure scenarios do not need to be addressed.

Therefore, paragraph 4.a(4) has been clarified.

If the 1/1000 criterion cannot be met, the applicant should probably consider reducing the exposure time.

comment | *45* | comment by: *Gulfstream Aerospace*

Section 3.1 Proposed Amendment 2 for AMC 25.353, paragraph 4.a.(4) states that failure scenarios do not need to be addressed in combination with the rudder control reversal load conditions. It is recommended that this proposed AMC 25.353 paragraph add a clarifying statement, “As such, consideration of rudder control reversal load conditions is not required when showing compliance with CS 25.302.

response | Partially accepted.

Paragraph 4.a(4) applies to any system failure, and specifies that failures do not need to be combined with a full rudder pedal doublet event due to the very low probability, assuming that the systems used to demonstrate compliance with CS 25.353 meet the criteria in 4.a(3)(i) and (ii). CS 25.302 do not apply. This paragraph has been clarified.

comment | *46* comment by: *Gulfstream Aerospace*

1) Section 3.1 Proposed Amendment 2 for AMC 25.353, paragraph 4.a.(4) states that full rudder pedal doublet events are a very low probability and Section 4.4.1 estimates the probability of rudder reversal that reaches or exceeds design limit loading to be approximately 10-8 per flight hour. Isn't this probability dependent on the rudder control system sensitivity of an airplane? The referenced NTSB report indicates that some rudder control system designs can be prone to pilot input reversals due to overly sensitive force vs displacement, limited pedal travel and high break-out force? Why was the pedal sensitivity issue of the NTSB recommendation not addressed in the proposed rulemaking?

response | Noted.

Please refer to the response to comment 41 regarding the rudder control system sensitivity aspects.

Please note that the figure of approximately 10^{-8} per flight hour is provided while assuming an equal probability across all types of large aeroplanes. Please refer to the FCHWG final report, page 7, paragraph Factor of safety.

comment | *47* comment by: *Gulfstream Aerospace*

1) Section 3.1 Proposed Amendment 2 for AMC 25.353, paragraph 4.b.(1): The proposed guidance states that pitch control should be applied to maintain airspeed. Guidance should also be provided for intended control inputs in the roll axis. For an airplane with a roll rate control law, lateral stability may be neutral and control surfaces would presumably be deflected to oppose the roll axis disturbance during the rudder reversal maneuvers. For a conventional airplane with lateral stability, large bank angle and roll rate behavior will occur during the specified rudder maneuvers unless lateral control inputs are assumed to be made to maintain wings-level.

response | Accepted.

New text has been added to AMC 25.353 paragraph 4.b, to clarify that these conditions should be investigated assuming rational or conservative roll control input (pilot or system induced).

CS25.353 Rudder control reversal load conditions p. 6-7

comment | *30* comment by: *Airbus-EIAIX-SRg*

Page 6, para. 3.1 Draft certification specifications and acceptable means of compliance (Draft EASA decision)

Section: Proposed amendments, 1 - CS 25.353. is created as follows

Airbus propose following change:

Change
CS 25.353 Rudder control reversal load conditions
(See AMC 25.353)
The aeroplane must be designed for loads, considered as ultimate, resulting from the yaw manoeuvre conditions specified in the following sub-paragraphs (a) *through (e)* from the highest airspeed for which it is possible to achieve maximum rudder deflection at zero sideslip or VMC, whichever is greater, to VC*/MC*. These conditions are to be considered with the landing gear retracted and speed brakes (or spoilers when used as speed brakes) retracted. Flaps (or flaperons or any other aerodynamic devices when used as flaps) and slats-extended configurations are also to be considered if they are used in en-route conditions. Unbalanced aerodynamic moments about the centre of gravity must be reacted in a rational or conservative manner considering the aeroplane inertia forces. In computing *the loads on the aeroplane*, the yawing velocity may be assumed to be zero.
(a) With the aeroplane in un-accelerated flight at zero yaw, it is assumed that the cockpit rudder control is displaced as specified in CS 25.351(a)
and (b), *with the exception that only 890 N (200 lbf) needs to be applied.*
(b) With the aeroplane yawed to the overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly displaced in the opposite direction *to achieve the resulting rudder deflection, as limited by the control system or control surface stops, and as limited by the pilot force of 890 N (200 lbf).*
(c) With the aeroplane yawed to the opposite overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly *displaced in the opposite direction to achieve the resulting rudder deflection, as limited by the control system or control surface stops, and as limited by the pilot force of 890 N (200 lbf).*
(d) With the aeroplane yawed to the subsequent overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly displaced in the opposite direction to achieve the resulting rudder deflection, as limited by the control system or control surface stops, and as limited by the pilot force of 890 N (200 lbf).
(e) With the aeroplane yawed to the opposite overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly returned to neutral.

By
CS 25.353 Rudder control reversal load conditions
(See AMC 25.353)
The airplane must be designed for loads, considered as ultimate, resulting from the yaw maneuver conditions specified in paragraphs (a) through (c) of this section from the highest airspeed for which it is possible to achieve maximum rudder deflection at zero sideslip or VMC , whichever is greater, to VC. These conditions are to be considered with the landing gear retracted and speed brakes (or spoilers when used as speed brakes) retracted. Flaps (or flaperons or any other aerodynamic devices when used as flaps) and slats extended configurations are also to be considered if they are used in en route conditions. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner considering the airplane inertia forces. In computing the tail loads the yawing velocity may be assumed to be zero. A pilot force of 200 pounds is assumed to be applied for all conditions.
(a) With the airplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is displaced as specified in Sec. 25.351(a)

	and (b).[deleted] (b) With the airplane yawed to the overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly displaced in the opposite direction. [deleted] (c) With the airplane yawed to the opposite overswing sideslip angle, it is assumed that the cockpit rudder control is suddenly returned to neutral. [sub-para (d) and (e) removed] Rational for the proposal: Airbus considers that applying a new rule to ensure that aeroplanes are design tolerant to one full-stroke rudder pedal doublet on new applicable large aeroplane certification project would provide a significant safety improvement. Airbus proposes to retain the Position 2 of FCHWG report and the attachment C of the report, Version 1 – Single Doublet Condition.
response	Not accepted. Please refer to Section 4.4.1. Safety impact of the NPA. Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario; EASA believes that it is necessary to protect against such scenarios. Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

AMC25.353 Rudder control reversal load conditions p. 7-9

comment	*5* comment by: *DGA Essais en vol* This sentence: "The aeroplane airspeed should be kept reasonably constant throughout the manoeuvre using pitch control" suggests that the manoeuvre may have to be demonstrated during real flight test. It is worded as an AMC describing a flight test technique and means to achieve a realistic demonstration. My initial understanding was that the requirement was only addressed by design and load computations, mainly because of risk management close to ultimate loads. If this is confirmed, then the sentence should be updated to avoid misunderstanding and to clarify the airspeed assumption ("reasonably constant" would have to be amended).
response	Noted. The proposed CS 25.353 specifies a new Subpart C manoeuvre load case. It should therefore be demonstrated via design and load computations, and not directly via flight test, due to the associated potential risk. The comment is understood, however no change to the proposed CS 25.353 and AMC 25.353 is deemed necessary.

comment	*23* comment by: *Transport Canada Civil Aviation Standards Branch*
	The following statement contained in AMC 25.353, Section 4.a.1 : 'However, any permanent deformation resulting from these ultimate conditions must not prevent continued safe flight and landing' should instead be in the first paragraph of the requirement, CS 25.363, and should appear there as : 'Any permanent deformation resulting from these ultimate conditions must not prevent continued safe flight and landing.' N.B. Such statements appear in other requirements in FAR/CS 25 which are specifically defined as ultimate conditions: e.g. 25.362.
response	Accepted. The proposed statement has been added to CS 25.353.

comment	*24* comment by: *Transport Canada Civil Aviation Standards Branch*
	In the same first paragraph of CS 25.353, reference is made to high lift devices in the enroute condition, viz. 'Flaps (or flaperons or any other aerodynamic devices when used as flaps) and slats-extended …if they are used in en-route conditions'. However, a previous sentence requires that the upper speed for the load conditions to be considered be Vc/Mc. This is inappropriate for high lift devices extended. It would be clear that the upper speeds are appropriately limited if the sentence were modified to read as follows: 'If flaps (or flaperons or any other aerodynamic devices when used as flaps) or slats are used in en-route conditions, these must be assessed to the highest airspeeds authorized for their use.' Alternately, it could be stated in the following fashion: 'Flaps (or flaperons or any other aerodynamic devices when used as flaps) and slats-extended are also to be considered <u>to the highest airspeeds authorized for their use</u> if they are used in en-route conditions'.
response	Not accepted. The comment is understood but it is not deemed necessary to change proposed CS 25.353 text, because the term 'en-route conditions' already implies the use of authorised airspeed.

comment	*25* comment by: *Transport Canada Civil Aviation Standards Branch*
	Section 4.b(4) begins '<u>As soon as</u> the maximum overswing yaw angle …'.

	It would more precise if the sentence started ' At the instant when the maximum overswing yaw angle …" since these are analytical simulations/calculations rather than actual flight manoeuvres.
response	Not accepted. The comment is understood, but the proposed change is not deemed necessary, as the initial text is considered to be clear enough.

comment	*31* comment by: *Airbus-EIAIX-SRg* Page8 , para. 3.1 Draft certification specifications and acceptable means of compliance (Draft EASA decision) Section: Proposed amendments, 2 - AMC 25.353 is created as follows, #4. Application of the specification, b. CS 25.353 specifications (a) through (e) Airbus propose following change: Change (1) Specifications (a) *through (e)* of CS 25.353 are intended as a full displacement pedal input followed by three pedal reversals and return to neutral. *The aeroplane airspeed* should be kept reasonably constant throughout the manoeuvre using pitch control. *Refer to the illustration by Figure 1 below*. (2) With the aeroplane in un-accelerated flight at zero yaw, it is assumed that the cockpit rudder control is suddenly displaced to achieve the resulting rudder deflection, *as limited by the control system, control stops or pilot force of 890 N (200 lbf). In this context, 'suddenly' means as fast as possible within human and system limitations.* In the absence of a rational analysis, initial pedal displacement is achieved in no more than 0.2 seconds, and full rudder control reversal displacement is achieved in 0.4 seconds. Alternatively, the applicant may assume the rudder pedal is displaced instantaneously. (3) The resulting rudder displacement should take into account additional displacement caused by sideslip build-up, and the effects of flexibility should be considered when relevant. (4) As soon as the maximum overswing yaw angle is achieved, full opposite rudder pedal input is applied. The achieved rudder deflection may be limited by control laws, system architecture, or air loads, and may not be the same magnitude as the initial rudder deflection prior to the pedal reversal. For critically damped aeroplane response, the maximum overswing yaw angle may be assumed to occur when the sideslip angle is substantially stabilised. (5) *Two additional reversals are performed as defined in (4). After the second reversal, as soon as the aeroplane yaws to the opposite overswing yaw angle, the cockpit rudder control is suddenly returned to neutral*. By (1) Specifications (a) through (c) of CS 25.353 are intended as a full displacement pedal input followed by a pedal reversal and return to neutral. Speed should be kept reasonably constant throughout the maneuver using pitch control.[deleted] (2) With the airplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is suddenly displaced to achieve the resulting rudder deflection [deleted]. In this context, "suddenly" means as fast as possible within human and system limitations. In the absence of a rational analysis, initial pedal displacement is achieved in no more than 0.2 seconds, and full rudder control reversal displacement is achieved in 0.4 seconds.

	Alternatively, the applicant may assume the rudder pedal is displaced instantaneously. (3) The resulting rudder displacement should take into account additional displacement caused by sideslip build-up, and the effects of flexibility should be considered when relevant. (4) As soon as the maximum overswing yaw angle is achieved, full opposite rudder pedal input is applied. The achieved rudder deflection may be limited by control laws, system architecture, or air loads, and may not be the same magnitude as the initial rudder deflection prior to the pedal reversal. For critically damped aeroplane response, the maximum overswing yaw angle may be assumed to occur when the sideslip angle is substantially stabilized. (5) The airplane yaws to the opposite overswing yaw angle. As soon as this point is reached, the cockpit rudder control is suddenly returned to neutral. Rational for the proposal: Airbus considers that applying a new rule to ensure that aeroplanes are design tolerant to one full-stroke rudder pedal doublet on new applicable large aeroplane certification project would provide a significant safety improvement. Airbus proposes to retain the Position 2 of FCHWG report and the attachment C of the report, Version 1 – Single Doublet Condition.
response	Not accepted. Please refer to Section 4.4.1. Safety impact of the NPA. Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario; EASA believes that it is necessary to protect against such scenarios. Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

comment	*37* comment by: *Embraer S.A.* Embraer understands that the Normal Control Law does not necessarily imply the availability of a structural protection function. Any structural protection features implemented in the FBW aircraft should be subject to System-Structure Interaction assessment and their respective security factors applied based on the availability of the function. The use of the expression Normal Control Law is not comprehensive in relation to hydromechanical aircraft equipped with Yaw Damper. Proposed change: The original text: (3) System effects. System effects should be taken into account in the evaluation of this manoeuvre. For example, ~~fly-by-wire aeroplanes should be analysed assuming that the aeroplane is in the normal control law mode.~~ Any system function used to demonstrate compliance with these requirements should meet the following criteria:

	Should be changed to: (3) System effects. System effects should be taken into account in the evaluation of this manoeuvre. For example, aeroplanes with Primary Flight Control surfaces driven by fly-by-wire technology should be analysed without failures. Any system function used to demonstrate compliance with these requirements should meet the following criteria:
response	Not accepted. The comment refers to an example that originates from the FCHWG final report. The wording is considered to be clear enough.

comment	*55* comment by: *Bombardier* Section: 3.1.2.4b(2) Comment: The NPA uses multiple terminologies for the yaw inceptor. For example, in section 4b(2) at the bottom of page 8, it successively refers to "the cockpit rudder control", the "initial pedal displacement", the "rudder control reversal displacement" and the "rudder pedal". The use of the term "rudder control" in particular could be thought to refer to the rudder surface not the cockpit control. Proposal: Suggest using "rudder pedal" consistently and exclusively.
response	Partially accepted. The proposed CS 25.353 and AMC 25.353 text has been reviewed. It appears that the term 'cockpit rudder control' is used consistently throughout the text, except in one instance in paragraph 4.b(2) of AMC 25.353. This has been corrected.

CS25.1583 Operating limitations p. 9-10

comment	*16* comment by: *Prof. Dr.-Ing. Bernd Hamacher* page 10, last paragraph, last sentence Terminology ambiguity: „weight" Weight is used as an ambiguous term here. If mass times acceleration (M * a) is meant, "weight" should be replaced by "weightforce" If mass (M) is meant, "weight" should be replaced by "mass". Explanation: Despite the fact that colloquially "weight" and "mass" are often used synonymously, it should be noted that from a flight physics perspective, weight and mass are different concepts. A synonoumous usage is not in line with scientific standards. EASA should not use a colloquial terminology in official documents.

response

Noted.

The comment is technically correct. However, the term 'weight' has been used for a long time by the aviation stakeholders and is still used in various places in regulations (EASA, FAA, and others).

comment

18 comment by: *Prof. Dr.-Ing. Bernd Hamacher*

CS 25.1583(a)(3)(ii)

"structural failure at any speed"

This phrase is very misleading as it gives the impression that the risk of structural failures by rapid and large alternating control inputs is speed independant.

This message is wrong!

Instead, it must be clear that the aerodynamic loads on structures and attached surfaces **are a function of airspeed** (and air density/turbulences). The higher the airspeed, the higher in principle the loads and the higher the risk of possible structural failures. So the risk of structural failures is **not** speed independant.

The realization of this principle from flight mechanics, that aerodynamic loads are a function of airspeed and that the risk of structural failure increases as much as the loads approach the limits components are designed for, is fundamental to understand the nature of the risk.

In this context, the cited phrase from CS 25.1583 gives a fatal message.
The wording may lead to the impression that, for example, that a rudder check during taxi on the ground by applying of rudder reversal for check of proper movement could already result in structural failures. Although such a result can never fully excluded, it is unlikely that at such low airspeeds, the aerodynamic forces are high enough to cause damages by overloading. This must be clear and should not unsettle any pilot.

It is much more adequate to explain, that the limits are calculated for scenarios of **single** control inputs assuming that the components are new and not affected by any fatigue. Moreover it should be explained that combined control inputs will result in loads, which may significant higher than each single load at a given airspeed. The concept of ampflification of loads by combined effects is a comprehensible mental model for flight crews and easy to understand, although the exact calculation of these combined effects is sometimnes complex.

Additionally it should be considered that the resulting aerodynamic load is also influenced by horizontal gusts and turbulences on the tail. Pilots should have in mind that turbulent air affects the loads and my reduce load limits available for rudder application. This discussion is totally missing here.

response

Not accepted.

Please refer to the response to comment 20.

comment	*19* comment by: *Prof. Dr.-Ing. Bernd Hamacher*
	AMC 25.1581 (ii) (b) **"structural failure at any speed"** This phrase is very misleading as it gives the impression that the risk of structural failures by rapid and large alternating control inputs is speed independant. This message is wrong and dangerous! Instead, it must be clear that the aerodynamic loads on structures and attached surfaces are a function of airspeed. The higher the airspeed, the higher the loads in principle and the higher the risk of possible structural failures. So the risk of structural failures is **not** speed independant. The realization of this principle from flight mechanics, that aerodynamic loads are a function of airspeed and that the risk of structural failure increases as much as the loads approach the limits components are designed for, is fundamental to understand the nature of the risk. In this context, the cited phrase from CS 25.1581 gives a fatal message. The wording may lead to the impression that, for example, that the check for rudder functioning during taxi on the ground by applying of appropriate rudder reversal could already result in structural failures. Although such a result can never fully excluded, it is unlikely that at low airpeeds the aerodynamic forces are high enough to cause damages by overloading. This must be clear and should not unsettle any pilot or operator. It is much more adequate to explain, that the limits are calculated for scenarios of **single** control inputs assuming that the components are new and not affected by any fatigue. Moreover it should be explained that combined control inputs will result in loads, which may significant higher than each single load at a given airspeed. The concept of ampflification of loads by combined effects is a comprehensible mental model for flight crews and easy to understand, although the exact calculation of these combined effects is sometimes complex. Therefore the last part of the sentence should be better phrased **"structural failure at speeds even below manoeuvring speed limit."**
response	Not accepted. Please refer to the response to comment 20.

AMC25.1507 Manoeuvring speed	p. 10

comment	*6* comment by: *Prof. Dr.-Ing. Bernd Hamacher*
	page 10, last paragraph: This paragraph contains several terminology shortcomings:

	(static) lift coefficient The term "static lift coefficient" belongs to the domain of aerostatics, not to aerodynamics. A balloon has as static lift coefficient, an aeroplane not. Aeroplanes generate lift by movement through the air. This is why we call this domain aerodynamics. These domains should not be mixed up. It is known that some researchers - preferably in the US - use the term "static lift coefficient" in the context of wind tunnel experiments. Here this term is occationally used, to denote the state of a wind tunnel, until the air in the whole tunnel circuit has catched up to the disired target speed for experimentation. Consequently a static lift coefficient is not a real static lift coefficient, but a lift coefficient, where the first derivative of airspeed is **zero, not static.** As the NPA deals with determination of loads and operation limits of aeroplanes, not with wind tunnel experiments, these sloppy references should be avoided. Therefore "(static)" should be deleted. **Maximum lift coefficient (stall)** A stall is **not** defined by the maximum lift coefficient. So the addition "(stall)" in brackets is inappropriate and may misleading. An aeroplane enters a stall not necessarily at maximum lift coefficient. An aeroplane may enter a stall before or beyond peak lift coefficient. Although often misunderstood, this is not correct. The stall definition is different: According CS25.201 (d) an aeroplane is considered stalling, if: (1) A nose-down pitch that cannot be readily arrested; (2) Buffeting, of a magnitude and severity that is a strong and effective deterrent to further speed reduction; or (3) The pitch control reaches the aft stop and no further increase in pitch attitude occurs when the control is held full aft for a short time before recovery is initiated. So, "maximum lift coefficient" is not referred as a valid stall condition. Therefore the addition **"(stall)"** should be deleted.
response	Accepted.

Please refer to the response to comment 50.

comment *11* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 10, last prargraph:

The last sentence of the paragraph contains several poorly expressed concepts:

(1): “However this may be not always be the case”
This can be expressed much more precisely, f.e: "This happens only if V_A, selected by the applicant and the maneuvering speed according CS 25.107 equals V_{S1} * SQRT(n)

(2) The example “if the manoeuvring speed is not established based on the intersection of the (static) stall curve and the manoeuvre load factor” is poorly expressed. There is no reference to what the terms “intersection” or “load factor line” are referring to. Without a reference to the diagram, where the "intersection" and "curve" are originated from, the statement is unclear and meaningless. It is assumed that the example refers to the flight manoeuvering envelope according CS 25.333. If so, a reference to this envelope should be made, to allow readers tracing the meaning. An even better way to clarify this would be to introduce a unique designation into the envelope rather employing an laborious description.

Moreover the word “design” is missing before “manoeuvre load factor line” to distinguish between the design load factor and an actual load factor resulting from a manoeuvre. It is the design-manoeuvre-load-factor shown in the envelope and not the maoeuvring load factor.

(3) “If the lowest aeroplane weight permissible in flight is not considered”.
This sentence is ill determined:

(a): “lowest aeroplane weight permissible in flight” is not clearly defined. Is here meant the minimum weight *(mass ?)* as CS25.25 (b) and to which of the three cases, stated in CS 25.25 (b) are meant here?

(b) It seems that not **“weight”** is meant here; instead it is assumed that the **"speed at a minimum weight"** is meant here, as the v-n diagram is based on airspeed and load factor as main dimensions. Here the setup of the sentence is weak and should be corrected.

(c): as the negative design load factor for transport category aeroplanes must be at least -1, the "lowest aeroplane weight" by definition is a negative number. We doubt that this is meant here. Please clarify.

Finally it becomes not clear here what weight considerations have to do with aerodynamic loads on the vertical stabilizer and related problems in aeroelastics. The whole paragraph is reduced to pitch manoeuvres rather yaw-manoeuvres. The considerarion of pitch manoeuvres is relevant, but the subject of this NPA are effects by rudder application. This is unbalanced.

response Accepted.

Please refer to the response to comment 50.

comment | *12* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

As the subject of this NPA are inappropriate rudder usage and specifically rudder reversals, the relevance of this paragraph is unclear:

Rudder usage affects loads on the vertical tail around the yaw-axis. These loads are primarily dependent from loads caused by aerodynamic forces, hence speed and density of air! Weight and stall speed considerations are little relevant here. Therefore it is surprising that the new created AMC 25.507 is restricted to pitch-manoeuvers, not addressing yaw-manoeuvers.

It could be interesting to operators to learn in this context that the applicant selected an operating manoeuvring speed different to V_{S1} * SQRT(n) as the strength of the vertical stabilizer may be less to cope with the aerodynamic forces at V_{S1} * SQRT(n).

Therefore a revision of the paragraph in a more stringent way related to the subject of the NPA is recommended.

response | Accepted.

Please refer to the response to comment 50.

comment | *49* comment by: *The Boeing Company*

Non-Concur	***Substantive***	***Editorial***
		X

Page: 10
Paragraph: *5 (AMC 25.1507)*

<u>THE PROPOSED TEXT STATES</u>:

"AMC 25.1507 is created as follows:
AMC 25.1507
Manoeuvring speed
For pitch manoeuvres performed below the manoeuvring speed, exceedance of the design manoeuvre load factor may be prevented by the maximum (static) lift coefficient (stall). However, this may not always be the case, for example if the manoeuvring speed is not established based on the intersection of the (static) stall curve and the manoeuvre load factor line, or if the lowest aeroplane weight permissible in flight is not considered."

<u>REQUESTED CHANGE</u>:

As currently written, AMC 25.1507 simply provides a set of factual statements with no explicit, actionable description of the acceptable means of compliance to CS 25.1507. One is forced to look back at the discussion material in NPA 2017-18 (Section 3.1) to more clearly discern the intent of the AMC statements. Generally speaking, AMC material should be written as a stand-alone guide with clear and actionable discussions of the acceptable means of compliance.

No specific recommended changes are provided here, because the technical issues are discussed in the next comment.

JUSTIFICATION: The current wording of the AMC 25.1507 material does not provide a clear, actionable description of the acceptable means of compliance.

response Noted.

Please refer to the response to comment 50.

comment *50* comment by: *The Boeing Company*

Non-Concur ***X***	***Substantive***	***Editorial***
Page: 10 Paragraph: *5 (AMC 25.1507)*		

THE PROPOSED TEXT STATES:

"AMC 25.1507 is created as follows:
AMC 25.1507
Manoeuvring speed
For pitch manoeuvres performed below the manoeuvring speed, exceedance of the design manoeuvre load factor may be prevented by the maximum (static) lift coefficient (stall). However, this may not always be the case, for example if the manoeuvring speed is not established based on the intersection of the (static) stall curve and the manoeuvre load factor line, or if the lowest aeroplane weight permissible in flight is not considered."

REQUESTED CHANGE:

Boeing proposes that the AMC 25.1507 material be removed.

A potential alternate approach to address EASA's concerns is described at the end of the "Justification" discussion below.

JUSTIFICATION:

Boeing is providing comments based on the interpretation that this AMC material requires the CS 25.1507 maneuver speed to be the speed at which the airplane is incapable of exceeding 2.5g with the flaps up at the minimum flight weight allowed.

The Boeing position is that this AMC material should be removed for the reasons outlined below:

1. The maneuver load factor limits are already provided to the flight crew per CS 25.1531. This includes the flaps-up 2.5g limit and the flaps-down 2g limit, along with the load factor variation from 2g at Maximum Landing Weight to 1.5g at Maximum Takeoff Weight when in landing flap configurations [reference CS 25.345(a) and (d)]. In addition,

the structural design requirements of CS 25.331(c)(1) cover for rapid application of full pitch control up to the structural design maneuver speed, VA.

2. Given the large range of gross weights over which large transport airplanes can fly, this new minimum flight weight maneuvering speed may be up to 100 knots lower than the VA speed. In typical operations at moderate to high gross weights, the minimum gross weight maneuvering speed would provide misleading information to the flight crew with respect to their allowable maneuvering.

3. The proposed AMC 25.1507 material addresses only the flaps-up 2.5g load factor limits, and does not consider implications related to the corresponding flaps-down 2g/1.5g load factor limits. This presents an inconsistency in the proposed AMC.

For these reasons, Boeing believes that documenting a maneuvering speed at which it is impossible to pull more than 2.5g at the lowest gross weights provides no added value to the flight crew and no improvement to airplane safety.

Boeing understands the desire to minimize the potential for inappropriate application of control inputs, but we feel that there are better ways to address this concern. If EASA wishes to pursue this further, Boeing suggests an approach that would simply add wording in the flight manuals, similar to that required in the proposed CS 25.1583(a)(3)(ii), informing the flight crew that, at lower gross weights, full and sustained application of the pitch control inputs may result in an exceedance of the maneuver load factor limits, even below VA. Note that this approach also avoids the inconsistency with respect to the various flaps-up and flaps-down maneuver load factor limits discussed above.

response Accepted.

Upon review of the comments received related to the proposed AMC 25.1507, it has been determined that the text of the AMC is not prescriptive enough in terms of defining what information should be included in the AFM. Instead of modifying the proposed text of the AMC, EASA undertook an attempt to modify CS 25.1583(a)(3). The underlying safety concern is that certain manoeuvres, even when performed below the manoeuvring speed mentioned in the AFM, are not addressed in the structural requirements of CS-25, and could therefore potentially lead to structural failures.

One of these manoeuvres would be a pitch-up manoeuvre performed at a low aeroplane weight, where the risk exists of exceeding the limit manoeuvring load factor. It was, however, pointed out to EASA that even though AFMs typically contain the manoeuvring speed at high aeroplane weight, commercial air transport pilots, through their training, are well aware of the fact that the manoeuvring speed is a function of aeroplane weight. In addition, pulling a high load factor creates an uncomfortable situation for the pilots and is a natural deterrent. Furthermore, exceeding the limit manoeuvring load factor does not necessarily result in a structural failure.

Another type of manoeuvre not covered by the structural requirements is the full and sustained application of cockpit control in one axis. It was pointed out, however, that this would result in unusual aeroplane attitudes, e.g. due to roll/yaw coupling, beyond what the pilot would naturally counteract.

In addition, nowadays many aeroplanes are equipped with envelope protection systems, which also help to mitigate these risks.

Overall, the change to CS 25.1583(a)(3)(i) and (ii) proposed in NPA 2017-18 adequately covers the most important types of manoeuvres that pilots should avoid. Although there could be other manoeuvres to be avoided as explained above, these are less likely to occur. In addition, any AFM text should be clear and concise, and should not burden the pilots with potentially conflicting information.

In conclusion, the proposed AMC 25.1507 is withdrawn.

4. Impact assessment p. 11-23

comment *9* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 14, 5th paragraph

Notation error VA

The correct notation of the design manoeuvring speed is V_A.
V_A belongs to the so called V-speeds, where "V" means speed associated with an index to specify what specific V-speed is meant. Therefore the index notation as a subscript is mandatory to avoid confusion.

The abbreviation **VA** may have a different meaning. In German, for example, VA means Voltampere and is the unit for the apparent power in an electrical circuit.

response Accepted.

This was a typo error.

comment *10* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

notation errors on pages:

14: 6th paragraph
15: 1st paragraph

Notation error:

The correct notation of the design manoeuvring speed is V_A.
V_A belongs to the so called V-speeds, where V means speed associated with an index to specify what V-speed is meant. Therefore the index notation as a subscript is mandatory here to avoid confusion.

	The abbreviation **VA** may have a different meaning. In German, for example, VA means Voltampere and is the unit for the apparent power in an electrical circuit.
response	Accepted. This was a typo error.

comment	*20* comment by: *Prof. Dr.-Ing. Bernd Hamacher*
	page 14, 4.1.2.1 Safety risk assessment, 2nd paragraph **"structural failure at any speed"** This phrase is very misleading as it gives the impression that the risk of structural failures by rapid and large alternating control inputs is speed independant. This message is wrong! Instead, it must be clear that the aerodynamic loads on structures and attached surfaces are a function of airspeed. The higher the airspeed, the higher the loads in principle and the higher the risk of possible structural failures. So the risk of structural failures is **not** speed independant. The realization of this principle from flight mechanics, that aerodynamic loads are a function of airspeed and that the risk of structural failure increases as much as the loads approach the limits components are designed for, is fundamental to understand the nature of the risk. In this context, the cited phrase from CS 25.1583 gives a fatal message. The wording may lead to the impression that, for example, that the check for rudder functioning during taxi on the ground by applying of appropriate rudder reversal could already result in structural failures. Although such a result can never fully excluded it is unlikely that at low airpeeds the aerodynamic forces are high enough to cause damages by overloading. This must be clear and should not unsettle any pilot. It is much more adequate to explain, that the limits are calculated for scenarios of **single** control inputs assuming that the components are new and not affected by any fatigue. Moreover it should be explained that combined control inputs will result in loads, which may significant higher than each single load at a given airspeed. The concept of ampflification of loads by combined effects is a comprehensible mental model for flight crews and easy to understand, although the exact calculation of these combined effects is sometimnes complex. Therefore the last part of the sentence should be better phrased **"structural failure at speeds even below manoeuvring speed limit."**
response	Not accepted. Aerodynamic loads are not only a function of the airspeed, but also (for example) of the altitude (Mach) and the aeroplane weight. They are also influenced by the aeroplane configuration (for example, flaps retracted or extended) and by control surface deflections. In addition, aeroplane total loads are composed of not only aerodynamic loads, but also

inertia loads, propulsion loads, etc. Therefore, a higher airspeed does not always lead to higher loads.

The flight manoeuvre load conditions contained in CS-25 are based on single (non-alternating) control inputs applied in one axis only. This is well-known throughout the aerospace industry and does not have to be explained again.

Rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw, and full control inputs in more than one axis at the same time, could result in higher loads than those defined by the single input / one axis load conditions, either below or above the manoeuvring speed. The proposed CS 25.1583(a)(3)(ii) addresses this in a better way than the alternative text proposed by the commenter.

comment 21 comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 15, last paragraph

"structural failure at any speed"

This phrase is very misleading as it gives the impression that the risk of structural failures by rapid and large alternating control inputs is speed independant.

This message is wrong!

Instead, it must be clear that the aerodynamic loads on structures and attached surfaces are a function of airspeed. The higher the airspeed, the higher the loads in principle and the higher the risk of possible structural failures. So the risk of structural failures is **not** speed independant.

The realization of this principle from flight mechanics, that aerodynamic loads are a function of airspeed and that the risk of structural failure increases as much as the loads approach the limits components are designed for, is fundamental to understand the nature of the risk.

In this context, the cited phrase from CS 25.1583 gives a fatal message.
The wording may lead to the impression that, for example, that the check for rudder functioning during taxi on the ground by applying of appropriate rudder reversal could already result in structural failures. Although such a result can never fully excluded it is unlikely that at low airpeeds the aerodynamic forces are high enough to cause damages by overloading. This must be clear and should not unsettle any pilot.

It is much more adequate to explain, that the limits are calculated for scenarios of **single** control inputs assuming that the components are new and not affected by any fatigue. Moreover it should be explained that combined control inputs will result in loads, which may significant higher than each single load at a given airspeed. The concept of ampflification of loads by combined effects is a comprehensible mental model for flight crews and easy to understand, although the exact calculation of these combined effects is sometimnes complex.

Therefore the last part of the sentence should be better phrased **"structural failure at speeds even below manoeuvring speed limit."**

response Not accepted.

Please refer to the response to comment 20.

comment *22* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

page 14, 6th paragraph

consistency

This is probably a typing error.
It is unlikely that the agency will remove a consistency by this NPA, but an inconsistency.
Please correct.

response Accepted.

This was a typo error.

comment *26* comment by: *Prof. Dr.-Ing. Bernd Hamacher*

Chapter 4.1.2 Manoeuvring speed limitation, page 14

Although it is agreed there is a need to clarify the difference between manoeuvring speed as a design speed and manoeuvring speed as an operating limitation the proposed terminology for this is not convincing.

It is proposed to term the design speed according CS 25.335 (c) (1) "Design manoeuvring speed, V_A" and the operating limitation according CS 25.1507 "Manoeuvring speed".

From a linguistic point of view, this distinction is misleading as this designates that "Manoeuvring speed" is the broader term and "Design manoeuvring speed, V_A" is a **subterm** of "Manoeuvring speed".

Similarly, if you talk about aeroplanes and you distinguish between "large aeroplanes" and "aeroplanes" you indicate with such a terminology, that you will differentiate between different levels of specification. "Large aeroplanes" are part of "aeroplanes" and nothing different. If you want to differentiate on the same level of specification, you may term between "large aeroplanes" and "small aeroplanes". But if you term "large aeroplanes" and "aeroplanes" you indicate that "large aeroplanes" are a subgroup of the more general term "aeroplanes". The attribute makes the difference! Therefore the attribute "Design" in terminology indicates that this is a **more specific** manoeuvring speed. But this is not meant here.

This declaration is reinforced by the addendum "V_A". This abbreviation indicates that this term is more specific than a term without an assigned abbreviation. (In this context it is also confusing, that the manoeuvring speed, defined in CS 25.1507 is the only airspeed limitation in this chapter "operating limitations" without a V-speed designator. This already shows a formal lack of consistency.)

From the rules of terminology design, hence three options for a proper and consistent terminology are available:

	"Manoeuvring speed, as a design speed according CS 25.335 (c) (1)" vs. "Manoeuvring speed, as an operating limitation according CS 25.1507" or: "Manoeuvring speed, according CS 25.335 (c) (1)" vs. "Manoeuvring speed, according CS 25.1507" or: Manoeuvring speed, V_A, according CS 25.335 (c) (1)" vs. "Manoeuvring speed, *[with a new assigned V-designator]*, according CS 25.1507" It is recommended to select one of these three options to revise the terminology in a clear and consistent way. The proposed terminology is not consistent with terminology linguistic rules and may lead to confusion and misunderstandings. The potential of misunderstanding is a safety issue and should be minimized – irrespective of tradition. Terminology must be clear and unmistakeably. This is a requirement. See CS 25.14545.
response	Not accepted. The two speeds are clearly defined and specified in different subparts of CS-25 (i.e. Subparts C and G).

comment	*32* comment by: *Airbus-EIAIX-SRg* Page 14, para. 4.1.1.3 EASA's actions on this issue, EASA Special Condition Section 2 Airbus propose following change: Change During the public consultation, EASA received only a few comments. Boeing proposed a text improvement, but did not oppose to the proposed rule. Embraer and *Boeing* recommended to use a single doublet condition, instead of the double doublet condition. In the end, EASA retained the same position like in the FCHWG. By During the public consultation, EASA received only a few comments. Boeing proposed a text improvement, but did not oppose to the proposed rule. Embraer and Airbus recommended to use a single doublet condition, instead of the double doublet condition. In the end, EASA retained the same position like in the FCHWG. Rational for this change: Typo error. Airbus recommended to use a single doublet condition (ref CRD SC C-xx Consultation Iss 1).

response	Accepted. This was a typo error. The correct reference is indeed 'Airbus'.
comment	*33* comment by: *Airbus-EIAIX-SRg* Page 17, para. 4.4.1 Safety impact Section #5 Airbus propose following change: Change: The single pedal doublet manoeuvre proposal (Option 1) would not protect against the American Airline accident scenario, but would protect both against a single full stroke rudder control doublet, as well as multiple rudder control doublets of reduced amplitude. *It would rely on pilot training to prevent such pedal reversals, which is not fully reliable given the fact that the reasons for such pilot behaviour are not fully understood and controlled*. By: The single pedal doublet manoeuvre proposal (Option 1) would not protect against the American Airline accident scenario, but would protect both against a single full stroke rudder control doublet, as well as multiple rudder control doublets of reduced amplitude. However, based on available service history data it appears that significant rudder reversal events are very rare, on the order of 10-8/FH. While single rudder control doublets cannot be coRationalmpletely ruled out inRational fot the the future, through adequate crew training and awareness, multiple large rudder control doublets would be even rarer. Rational for the proposal: Extract for ARAC report. Safety impact of single pedal doublet manoeuvre proposal (Option 1) should reflect ARAC discussions.
response	Noted. The low probability of a rudder reversal case that reaches or exceeds the design limit loading has been taken into account in the EASA decision not to mandate retroactive design changes.
comment	*34* comment by: *Airbus-EIAIX-SRg* Page 21 & 22, para. 4.5.1 Comparison of options Sections #4 - #6 Airbus propose following change: Remove section 4 - 6 ~~The FCHWG overall assessment of the economic impact (of the proposed single doublet or two doublet design load conditions) is as follows:~~ ~~In general, Attachment E shows that advanced flight control architectures (FBW) are able to meet the proposed criteria, whereas some hydro-mechanical and manual control architectures cannot. In some cases, OEMs assumed the yaw damper was not operational for their loads analysis of the single doublet and the two doublet conditions. (See line 17 of the~~

	~~table.) However, the yaw damper probably would be considered operational according to the final versions of the proposed rule and advisory material. If the yaw damper were 'unswampable' and assumed to be operational in those cases, the loads (and the costs) would likely decrease. The use of an unswampable yaw damper (YD) may be able to reduce the load levels for the single doublet to a 'low' or 'no' economic impact. However, it might not adequately reduce the large loads of the two-doublet condition to a 'low' economic impact. It would depend on the YD authority to reduce pilot commanded side slip angles to safe limits and the cost to redesign these items. Also the use of a high authority YD would need to consider the ramifications of failures and reliability.~~ ~~Furthermore, as noted previously in Section 4.4.1, there is a risk that future designs may include load alleviation features (e.g. speed protection systems, or other load alleviation features) and may therefore become less resilient to pedal reversals; certification requirements should therefore be created to prevent this risk, and only option 0 and 2 achieve this objective.~~ ~~Concerning aeroplanes with manual FCSs, it must be noted that the pedal force which would be specified in the new specifications (single and two doublet options) would be reduced from the levels in CS 25.351 to 890 N (200 lbf), recognising that it would be difficult for a pilot to maintain a high level of force (1335 N (300 lbf) up to VC) while performing rapid alternating inputs. This reduction in pedal force would reduce the loads for aeroplanes with manual control systems.~~ Rational for the proposal: A NPA should not prescribe design solutions.
response	Not accepted. The NPA does not prescribe a design solution. The commented paragraph reflects on the FCHWG impact assessment.

comment	*35* comment by: *Airbus-EIAIX-SRg* Page 22, para. 4.5.1 Comparison of options Last section Airbus propose following change: Change Finally, as explained in position 3 provided in the FCHWG, an FAA issue paper has been applied on recent certification projects and compliance has been demonstrated *with few technical or cost issues*. EASA has issued an SC requiring a two doublet load case; this SC has been applied since February 2016 to all new type certification projects, *and on a case-by-case basis to projects involving significant changes*. By Finally, as explained in position 3 provided in the FCHWG, an FAA issue paper has been applied on recent certification projects and compliance has been demonstrated [deleted]. EASA has issued an SC requiring a two doublet load case; this SC has been applied since February 2016 to all new type certification projects [deleted].

	Rational for the proposal: For recent Airbus certification project, compliance to FAA issue paper was not based on loads computation of two full stroke rudder doublets. Airbus still insists that EASA SC should not be applicable to other projects than new aircraft design. Application even on a case-by-case basis to significant changes determined through Changed Product Rule (CPR) Part 21.A.101 may lead to administrative burden (reversion dossier) or very high economic impact. As stated in NPA 2017-18 part 4.1, EASA has discarded the option to apply the new regulation on existing aircraft; it should also discard the option to apply the new regulation to significant changes of existing aircraft. For significant changes of existing aircraft, as EASA recognizes that the safety risk is under control and at an acceptable level on existing aeroplane, only an evaluation of the impact of the significant changes on the safety risk level should be required to the applicants.
response	First part of the comment: not accepted. The FAA issue paper is not specific on the number of rudder pedal doublets but requests to adequately protect the aeroplane from the adverse effects of potential inadvertent or inappropriate control inputs, including pilot-commanded pedal reversals (doublets). Second part of the comment: noted. EASA has discarded the option to propose a retroactive rule. For changes to existing large aeroplanes, the suitability to include the new rule in the certification basis is determined on a case-by-case basis, in application of Part-21 (e.g. 21.A.16, 21.A.101).

comment	*52* comment by: *Dassault-Aviation* Dassault-Aviation Paragraph 4.3 page 16 Three proposed options Comment: Dassault is in favor of option 1, i.e. a single rudder pedal doublet maneuver, in the normal state of the FCS, considered as an ultimate load (with no additional load factor). This position is consistent with Dassault-Aviation position during ARAC FCHWG on the topic (cf. ARAC FCHWG "Rudder Pedal Sensitivity/ Rudder Reversal" recommandation report dated 11/07/2013).
response	Not accepted. Please refer to Section 4.4.1. Safety impact of the NPA. Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario; EASA believes that it is necessary to protect against such scenarios.

Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

comment *53* comment by: *Dassault-Aviation*

Dassault-Aviation

Paragraph 4.5.2 page 23 quantified justifications inputs

Two aircraft models, one wih hydromech FCS, one with electrical FCS

	Option	**1**	**0 & 2**	**1**	**0 & 2**
Assumptions	Decade of Certification?	'10+		'00-'09	
	If a derivative model, what is the decade of the *original* Certification?	'90-'99		original TC	
	Would the design meet proposed one/two doublet criteria without any modifications?	Yes	No	Yes	Yes
	If unable to meet proposed criteria, what percentage does the one/two doublet condition loads exceed the design ultimate loads (VT tail side of body bending moment)?	1%	10%	---	---
	Is the design maneuver-load critical (i.e., not gust-critical) under current FARs?	No	No	No	No
	Type of Flight Control System architecture?	Hyr-Mech	Hyr-Mech	FBW	FBW
	Was Yaw Damper function assumed operational in these loads calculations?	No	No	Yes	Yes
	Is the Yaw Damper unswampable?	No	No	Yes	Yes
	Assumed design solution for complying with doublet(s) criteria: (Note: other solutions may be possible, but were not fully vetted for this evaluation.)		Structural		
Non-Recurring Costs to the Manufacturer		1 - Negl.	3 - Low	1 - Negl.	1 - Negl.

Recurring Costs to the Manufacturer		1 - Negl.	5 - Med	0 - None	0 - None
Increase in Fuel Burn/Emissions?		1 - Negl.	3 - Low	0 - None	0 - None
	GRAND TOTAL	**3.0**	**11.0**	**1.0**	**1.0**
	AVERAGE	**1.0**	**3.7**	**0.3**	**0.3**

response

Noted.

The input provided are consistent with the data included in the FCHWG final report. Therefore, there is no need to adjust the regulatory impact assessment.

comment *57* comment by: *Bombardier*

Section: 4.1.1.2

Comment: The industry position on FCHWG was for a single doublet. The analysis of just one doublet is sufficient to provide adequate safety and is commensurate with the likelihood of occurrence of the phenomenon. EASA is proposing a double doublet.

Proposal: Use of double doublet should be justified as it is inconsistent with the FCHWG recommendation.

response

Not accepted.

Please refer to Section 4.4.1. Safety impact of the NPA.

Multiple rudder reversal pedal inputs have already occurred in service, and a single doublet would not protect against the American Airlines accident scenario;

EASA believes that it is necessary to protect against such scenarios.

Recognising that the ARAC FCHWG discussions led to dissenting opinions, EASA retained position 3 supported by ALPA, ANAC, EASA, FAA, and Transport Canada, which has been reflected in a Special Condition and in this proposed amendment of CS-25.

comment *58* comment by: *Bombardier*

Section: 4.4.1

Comment:The argument in 4.4.1 that because more aircraft would fail the two doublet manoeuvre, it is "better" is spurious. By this reasoning, a three or four doublet manoeuvre would be even more preferable as it would cause even more aircraft to fail.

Proposal:The design manoeuvre should be selected based upon a rational assessment of what is necessary to provide design margin, not on what maximizes failure.

response	Noted. The purpose of the paragraph in the NPA was to show that applying a single doublet would have limited safety benefits, as most of the 14 aeroplanes studied already comply.

comment	*59* comment by: *Bombardier* <u>Section:</u>4.5.1 <u>Comment:</u>The statement "Although the proposed specifications of option 0 and option 2 (two doublet pedal input) entail a higher cost impact than option 1 for manual and hydromechanical FCSs (for fly-by-wire the impact is almost the same and close to 0), compliance can be ensured without significant strengthening of the vertical tail or significant changes to system design" is not borne out by the data presented in the table I, 4.4.4. This shows that 4 aircraft (4 of 8 non-FBW aircraft) have a "high" NRC or RC to the OEM. This implies a significant impact to the design. The EASA position does not seem to be influenced by the impact on non-FBW aircraft. <u>Proposal:</u>Validate that the impact on non-FBW aircraft has been fully considered in the assessment.
response	Noted. The applicant is responsible for proposing a design solution that complies with the rule. Nevertheless, EASA believes that the incorporation of electronic control systems is not the only possible solution. Structural strengthening and/or an improved yaw damper system could also be used to show compliance.

comment	*60* comment by: *Bombardier* <u>Section:</u> Overall <u>Comment:</u> This proposal would require a flight demonstration with ultimate loads as the limiting criteria. While ultimate load is a reasonable design criteria, exposing the aircraft to these ultimate load during flight test would be unacceptable from a flight safety perspective. <u>Proposal:</u> Validate requirements with ground structural load test instead.
response	Noted. The requirement specifies a new Subpart C manoeuvre load case. It is intended to be demonstrated via design and load computations, and not directly via flight test, due to the associated potential risk. The comment is understood, however it is not deemed necessary to change the proposed text.