

SUBJECT : **Enhanced Stall Protection**

REQUIREMENTS incl. Amdt. : **The following specifications of CS 25 amendment 18:**
CS 25.103 and CS 25.207(c), (e), (f)

ASSOCIATED IM/AMC¹ : Yes / No

ADVISORY MATERIAL :

INTRODUCTORY NOTE:

The following Equivalent Safety Finding has been classified as important and as such shall be subject to public consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

IDENTIFICATION OF ISSUE:

EASA receives an application for certification of a large aeroplane equipped with a protection system preventing significant exceedance of useful angles of attack. The design also includes a progression of aural, visual, and tactile cues and warnings during deceleration towards stall.

This protection system includes a high angle of attack (AoA) command and protection control law referred to as Enhanced Stall Protection (ESP). The ESP maximum AoA command is intended to enforce an end-point beyond stall warning coinciding with full aft longitudinal column input. The ESP maximum AoA command may be scheduled as a function of aeroplane configuration, aeroplane icing state, flight conditions and other relevant parameters. The ESP maximum AoA command cannot be readily overridden by the flight crew through inadvertent or habitual, reflexive action.

CS 25 Subpart B requires the determination of reference stall speeds and adequate stall warning margins.

The ESP maximum AoA command may be set at a value that is below the angle of attack associated with the maximum lift coefficient (CL_{MAX}) used in the determination of a 1g stall speed and subsequently used to define the reference stall speed (V_{SR}).

Therefore, literal compliance with CS 25.103 and CS 25.207(c), (e), (f) is not possible. However, compensating factors exist which can provide an equivalent level of safety.

The following Equivalent Safety Finding is proposed in appendix A.

¹ In case of SC, the associated Interpretative Material and/or Acceptable Means of Compliance may be published for awareness only and they are not subject to public consultation.

Appendix A**Equivalent Safety Finding to CS 25.103 and CS 25.207(c), (e), (f) at Amendment 18****Enhanced Stall Protection**

The following compensating factors must be demonstrated to provide an equivalent level of safety:

- Demonstration of reference stall speeds, in accordance with CS 25.103, with either the ESP disabled, or with the ESP enabled and the maximum AoA command set to a higher value than the normal production settings. For a production ESP maximum AoA command set below the AoA corresponding to CL_{MAX} during the CS 25.103 demonstration, it shall be shown that the integrated performance (e.g., lift to drag ratio, flight path) at the production ESP maximum AoA command will be at least equivalent compared to the integrated performance that would be attainable at the declared reference stall speed. **In addition, it must be shown that the ESP will neither adversely affect the aircraft control during expected levels of atmospheric disturbances, nor impede the application of recovery procedures in case of windshear.**
- **Demonstration of aeroplane handling qualities up to AoAs associated to reference stall speeds, determined as specified in the previous bullet point, must be evaluated at the most unfavourable (CG) position. During these demonstrations, the aeroplane must not exhibit unacceptable characteristics and it must always be possible to reduce AoA by conventional use of the controls.**
- Demonstration of stall warning margin, in accordance with CS 25.207, with either the ESP disabled, or with the ESP enabled and the maximum AoA command set to a higher value than for the normal production settings. This will ensure that at least the minimum required margin is demonstrated prior to reaching a stall identification cue required by CS 25.201(d) and that is not provided with the ESP enabled with production settings. **In case the applicant choses to show compliance with CS 25.207 (e) and (f) with the ESP enabled and the maximum AoA command shifted to a higher value than for the normal production settings, it shall be checked that the shifted maximum AoA command is such that the ESP does not have any adverse effect in the recovery manoeuvre.**

Reliability provisions

The probability of loss of the ESP shall be less than 10^{-5} per flight hour for all aircraft configurations.

Explanation of how design features or alternative means of compliance provide an equivalent level of safety to the level of safety intended by the regulation:

It is recognised that with the production ESP maximum AoA command settings the maximum angle of attack achievable may be below the angle of attack for CL_{MAX} determined during the demonstration of compliance with CS 25.103, and full-aft column may be achieved closer to the onset of stall warning than during the demonstration of compliance with CS 25.207. In these cases, the ESP provides additional stall protection, relative to a level demonstrated to be certifiable with respect to these requirements without compromising the integrated aircraft performance.

Equivalent Safety Finding
Enhanced Stall ProtectionDoc. No. : **ESF-B25.103-01**

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Proposed Final

Deadline for comments: 18 Dec 2020

The compensating factor(s) raise the level of safety to that required by CS 25.103, and CS 25.207(c),(e),(f) because they represent a critical demonstration of compliance with the intent of the certification specifications and therefore will establish at least an equivalent level of safety compared to permissible design implementations following literal compliance.