EASA	COMMENT RESPONSE DOCUMENT
	CS25.807(g) at Amdt 13 "Emergency Exits" **Applicable to Airbus A320** **ESF D-01 – Issue 1**

Note : Following the consultation of this Equivalent Safety Finding, and in accordance with some of the comments received, the initial Condition will be slightly amended.
Due to the minor aspects of the changes, the new issue of the Condition will not be subject to a new public consultation.

Commenter 1 : Boeing Commercial Airplanes

Comment # 1 – Statement of issue

The proposed text states:

"The applicant has requested an increase of the Maximum Passenger Seating Capacity (MPSC) of the A320 aircraft models from the current value of 180, by increasing the credit of seats permitted for the forward and aft floor levels exits."

Comment:
EASA should reconsider further processing of this ESF based on the marginal benefits of the applicant's proposal.

Justification:

a) While Boeing supports the use of improvements to emergency exits as a justification for increasing the passenger limit of an airplane, the improvements (i.e., the compensating factors) must be supported by test data. Extensive Boeing airplane evacuation testing has demonstrated that for end-of-cabin exits on a single-aisle airplane, there is no appreciable difference in the evacuation rate capability of a 30-inch wide (Type C sized) exit vs. a 32-inch wide (Type B sized) exit. Boeing has conducted eight Full Scale Evacuation Demonstrations (FSEDs) on single aisle airplanes that involved end-of-cabin exits that were at least 30 inches wide. The average evacuation rate observed at the eight end-of-cabin exits that were 30 inches wide had an evacuation rate that averaged

60.5 people per minute (PPM) and the average evacuation rate observed at the six end-of-cabin exits that were 33+ inches wide averaged 59.7 PPM. Therefore, the only compensating factor that has been proposed for this ESF is the use of a an escape slide with a usable sliding width of more than 80 inches in lieu of the existing single lane slide. However, since the exit can only be fed from one direction by a single lane of evacuees along the cabin's main aisle and through the single lane passageway leading to the exit, there is no appreciable benefit to having a wider escape slide (i.e., both the main aisle width and the proposed passageway width will limit the evacuee flow to single lane).

b) While the proposed dual lane slide at the end-of-cabin exits on a single aisle airplane may provide some marginal benefit when considering the very specific evacuation scenario outlined in Appendix J of CS 25 (e.g., only one exit of each exit pair is usable), it will provide no improved evacuation capability in most foreseeable airplane evacuation events. This includes all situations where both exits of the exit pair are usable since the maximum flow of evacuees along a single main aisle cannot support maximum evacuee flow to both exits, even when single lane slides are installed. Therefore, it would be inappropriate to provide additional passenger credit for an exit pair that does not provide improved evacuation capability in foreseeable evacuation situations.

EASA response:

This comments address two main points therefore for ease of understanding EASA has grouped the comment into two sub-paragraphs.

PARTIALLY AGREED

a) This comment is not agreed. The exits affected are "single flow" type exits at the end of a passenger cabin. Emergency exits performance is not driven by a single element e.g. exit dimension. The evacuation flow is controlled by slide performance and evacuee's hesitation at the sill combined with sufficient space provided to access the exit and at the door cut out. The test referred to in the justification of the commenter have been conducted with single lane slides (generally 24 inches wide without lateral boundaries). The rate of such an escape system is around 60PPM and to some extent limited by the beam strength of the slide and the appearance to the evacuees standing at the sill. The tests have been conducted with wider escape means showing a significant increase in passenger rate. These extra wide single lane escape devices (initially a slide raft) provided a beam strength and sliding surface space capable of more than 1.5 times the evacuation rate of a standard single lane slide.
The escape means are considered to be of a single lane type. In addition to the increase in width of the exit by 2 inches, above the minimum requirements for a Type I exit, the exit height is substantially increased (73 inches) over that of a Type I exit which requires a minimum height of 48 inches. This increase in height allows the majority of passengers to access the slide without bending over. This, along with the less intimidating appearance and the feasibility of staggered flow, has been demonstrated to appreciably decrease the hesitation times during the evacuation.

b) The comment is partially agreed. The EASA agrees that the comment raises a valid point. Equivalent safety must be shown for foreseeable evacuation scenarios other than that defined in Appendix J. The comment is correct in stating that when both exits of an end of cabin pair are available, the overall evacuation flow rate is determined by the ability of the escapees to move along the longitudinal aisle. However, the A320 cabin layouts associated with the passengers increase have longitudinal aisle characteristics better than the minimum allowed by the CS-25 (i.e. the aisle width is larger than 20" and there are no or limited floor to ceiling monuments). The applicant will be required to demonstrate that the increased flow rate capability of such an aisle is proportionally better than that resulting from the "minimum" aisle such that the last person on ground is not experiencing any additional delay. This may result in an overall acceptable maximum passenger increase below that resulting from the additional credit allowed by the over-performing Type I exits themselves.

The "Design/Analysis Proposal" section of the ESF will be amended by adding the following wording:

- ***"additional testing and/or analysis to demonstrate that an equivalent level of safety is maintained in foreseeable evacuation scenarios."***

Comment # 2 – Justification (Paragraph 2)

The proposed text states:

"… In addition to the justifications proposed, and in order to demonstrate the safety equivalency acceptable, the following conditions and/or limitations have to be considered:

- ***The applicant should demonstrate through comparative testing with statistically significant results that the non-standard exit configuration provides a proportionate increase in evacuation performance over the Type C performance standard to justify the required increase of maximum number of passenger seats permitted for each of the floor level exit pair (i.e. 65 vs 55), achieved under a conservative approach. …"***

Comment:

The ESF needs to specify the test protocol and success criteria (test setup criteria, number of evacuation trials, number of test subjects, minimum acceptable level of evacuation improvement, etc.).

Justification:

a) This ESF is essentially laying the ground work for a new exit rating that provides a passenger credit between that of Type C and Type B exits. If approved, it is near certainty that other airframe manufacturers will propose similar ESFs. Therefore, it is critical that an industry-accepted protocol be followed that clearly demonstrates the improved evacuation capability of the proposed new exit Type. This is especially true since it is questionable that an improvement in the evacuation capability provided by simply adding a dual lane slide at an end-of-cabin oversized Type C exit on a single aisle airplane would warrant a 65 passenger rating.
Extensive airplane evacuation testing has demonstrated that an end-of-cabin Type C exit on a single aisle airplane can support an evacuation rate of approximately 60 people per minute (PPM). It has also been demonstrated that a Type B exit provides approximately a 40% improvement in the evacuation capability compared to a typical Type C exit. This 40% improvement in evacuation capability justifies the nearly 40% increase in the passenger credit provided for a Type B exit, as compared to a Type C exit (75 vs. 55). Therefore, in order to justify the nearly 20% increase in passenger credit (65 vs. 55), it should be demonstrated that the proposed exit configuration provides a corresponding 20% increase in evacuation capability. Accordingly, it should be shown that the proposed new exit type consistently supports an evacuation rate in the range of 72 PPM.
Furthermore, it is very questionable if an evacuation rate of 72 PPM could be achieved at an end of cabin exit on a single aisle airplane, regardless of the size of the escape slide, since 72 PPM is approaching the maximum rate evacuees can move along a crowded aisle (i.e., it is approaching the rate limit at which evacuees could reach the exit if there were no hesitation at the exit itself). Aerospace Industries Association (AIA) Report CPD-4 identifies that the emergency evacuation aisle-head flow rate was found to

range from 70 PPM to 75 PPM, with an average of 72 PPM. Evacuation testing conducted by Boeing supports that the maximum crowded aisle flow rate is within the range identified in the AIA report. In addition, there is a natural tendency for evacuees to hesitate prior to jumping into the slide. This is true regardless of the width of the slide. Thus, the evacuation rate at an end-of-cabin exit on a single aisle airplane will always be appreciably less than the rate evacuees can move along a crowded aisle.

b) Since the evacuation rate needed to justify the applicant's proposed passenger credit increase is approaching the rate limit at which evacuees are able to approach the exit, the test protocol needs to ensure that access limitations associated with the main aisle are adequately represented (i.e., it is not just a test of the exit and new assist means). This includes ensuring an adequate number of evacuees are included to get the crowded main aisle effect, and that carry-on baggage, blankets, pillows, and other similar articles be distributed in the aisle and passageways to create minor obstructions, which are the conditions specified in CS 25, Appendix J (Emergency Demonstration). Other Appendix J conditions that could influence the evacuation rate should also be included (e.g., emergency lighting, test subject age/gender mix).

c) To justify the proposed passenger credit increase, the test protocol should include a comparison between Type C and Type B exits. The average time to evacuate 65 passengers from the proposed exit configuration must be less than or equal to the time to evacuate 55 passengers from a Type C exit and to evacuate 75 passengers from a Type B exit. This is consistent with the test protocol that the JAA required of Boeing for the increased passenger rating for the 737NG Automatic Opening Exit (AOE). This test comparison method is described in JAA 737NG Special Condition Certification Review Item (CRI) D-14.

EASA response:

NOTED

a) The justification exercise for the ESF shall include a demonstration that the improvements proposed provide for a significant increase in evacuation performance compared with the base exit type (capable of a credit of 55). The exit cut out dimensions and the escape slide performance of the base exit type (capable of a credit of 55) shall be demonstrated prior comparison.

b) Test conditions have been agreed with the applicant in accordance with CS25 Appendix J

c) The intent of the ESF is to define the criteria needed to show equivalency. The specific test protocol is the responsibility of the applicant. The comparison was conducted with single lane exits only. Despite the dimensions of the cut outs, the exit is not considered a Type B.

Comment # 3 – Design Proposal

The proposed text states:

The equivalence justification below details the means and provisions (i.e., the compensating factors) the applicant intends to use to demonstrate that an equivalent level of safety, compared with the currently required exit performance, will be reached or exceeded for the desired increase in number of seats permitted for the floor level exits.

"Design proposal
-- The design features characterizing the new over-performing Type I exit are:
o a door size of 32"x73" (unobstructed opening)
o an escape slide
- ***with a usable sliding width of more than 80 inches***
- ***capable of dual use***
- ***strong enlarged sliding surface boundaries***
- ***good illumination of sliding surface***
- ***beam strength as per the values identified in ETSO C-69c"***

Comment:
Revise the proposed text as follows:
"Design proposal
− The design features characterizing the new over-performing Type I exit are:
- o a door size of 32"x73" (unobstructed opening)
- o an escape slide with a usable sliding width of more than 80 inches."
  - ~~with a usable sliding width of more than 80 inches~~
  - ~~capable of dual use~~
  - ~~strong enlarged sliding surface boundaries~~
  - ~~good illumination of sliding surface~~
  - ~~beam strength as per the values identified in ETSO C-69c~~

Justification:
a) There are only two compensating features being proposed: (1) the oversized exit and (2) the wider escape slides. The other identified "compensating features" are requirements regardless of whether or not this ESF is granted (e.g., sliding surface illumination, slide beam strength). Compliance with other applicable certification requirements (e.g., CS 25.812(h) and ETSO-C69c) should not be used as justification for an equivalent safety finding for CS 25.807.

b) The same is true for the discussion on substantiating compliance with CS 25.803(c). Compliance with this regulation is required whenever the exit arrangement is changed and particularly when an increase in the Maximum Passenger Seating Capacity (MPSC) is proposed beyond the limit currently specified in the Type Certificate Data Sheet (TCDS). Compliance with CS 25.803(c) is not a

compensating feature or justification for the proposed ESF.

c) The statement that the slide is capable of dual use can be interpreted to mean the slide is capable of supporting two lanes of evacuees or that the slide is designed to have dual function as an escape slide and as a life raft. Regardless of what is meant, it is not a compensating factor that supports an increased passenger rating for the exit and it should be deleted. Dual lane use is redundant to the first compensating factor that states the sliding lane is more than 80 inches wide, and the use of the slide as a life raft has no effect on the evacuation capability of the exit.

EASA response:

PARTIALLY AGREED

a) The key issues are the door cut-out and the width of the escape means, but also the sub items are considered important. The sliding surface width itself is not a guarantee for an improved rate when the slide cannot be entered in an easy way (i.e. off-set slide installation with respect to exit's opening). Side by side sliding cannot be achieved. Side boundaries as part of the design decrease the evacuee's hesitation and provide for improved illumination of the sliding surface (due to the location of the light source and light's reflection on the boundaries/sliding surface). The beam strength is important to maintain a high rate (also part of the latest ETSO C-69c). Per the certification basis of the A320, the beam strength does not need to meet the requirements of ETSO C-69c. However, although qualified to TSO C-69a, the slides fulfil the beam strength requirements of ETSO C-69c. This is considered a compensating feature in support of an ELOS.

b) The comment to CS 25.803(c) is not applicable in this context.
Dual use does not mean dual lane but the use of multiple persons at the same time. Also the toe end width is supporting the high performance as well as the rate recovery capability in case of slow down or temporary blockage.
The "Design/Analysis Proposal" section of the ESF will be amended by replacing the text "capable of dual use" by "capable of staggered use".

Comment # 4 – Statement of Issue (Paragraph 4)

The proposed text states:

"The change is classified as Major Significant and in the frame of this change, the affected requirement according to the Change Product Rule assessment (CPR) is CS 25.807(g) at Amdt 13."

Comment:

Revise the proposed text as follows:

"The change is classified as Major Significant and in the frame of this change, the affected requirements according to the Change Product Rule assessment (CPR) ~~is CS 25.807(g)~~ should include at a minimum CS 25.801, 25.803, 25.807, 25.809, 25.810, 25.812, and 25.813 at Amdt 13."

Justification:

a) Introducing a new exit arrangement and proposing an increase in the MPSC beyond that currently specified in the TCDS or allowed per the CS 25 regulations is a significant airplane-level change that cannot be adequately addressed by considering individual exit pairs in isolation. While CS 25.807(g) is the regulation that is specifically addressed in this proposed ESF, the proposed change will affect the overall evacuation characteristics of the airplane, including an increased number of passengers in the individual cabin zones, which will increase the evacuee flow at all of the emergency exits. Therefore, having all exits capable of at least being shown compliant with the current regulation should be a prerequisite for increasing the airplane's MPSC beyond that allowed per the regulations.

b) In addition, the proposed ESF repeatedly refers to the proposed new exit configuration as an "over-performing Type I emergency exit." This is not appropriate since this new exit type should be based on the highest exit rating to which the exit could otherwise be shown compliant. It would not be appropriate to change the exit arrangement and increase the MPSC without requiring the baseline exits to at least comply with the current affected regulations. The baseline requirements for the affected exit pairs should be those of a Type C exit and, if this ESF were to be granted, the new exit type should be referred to as "over-performing Type C exit." When the passenger limits of the Boeing 737NG models were established, it was necessary for Boeing to demonstrate that the airplane had improved evacuation capability and that all exits on the airplane provided improved evacuation capability relative to what was required by the then-current JAA regulations for the specific exit type. This same safety standard should apply in this case.

EASA response:

NOT AGREED

a) The sentence in the "Statement of Issue" section is not intended to identify the complete set of requirements to be complied with, but only to highlight one of the requirements for which the applicant has requested the ESF. In order to avoid any misunderstanding the sentence "The change is classified as Major Significant and in the frame of this change, the affected requirement according to the Change Product Rule assessment (CPR) is CS 25.807(g) at Amdt 13" will be changed in "The change is classified as Major Significant and in the frame of this change, one of the affected requirements according to the Change Product Rule assessment (CPR) is CS 25.807(g) at Amdt 13.". The identification of the full set of requirements and the respective amendment level is provided in the CPR analysis.

b) The certification basis of the aircraft model includes the I-III-III-I exit configuration as per JAR 25.807(c)(1). Type I would therefore be the largest exit type. As the term "oversize Type I" has been used previously (without an increase in performance) the term "over-performing Type I" was selected. Referring to the exit as an 'over-performing type C' would not change the ESF. The B737 NG overwing exits were physically changed and an increased evacuation performance was demonstrated for the evacuation from the cabin to the wing referring partially to 25.807 only. Floor level exits were raised in rate without physical changes.
The overall evacuation performance for the exit arrangement will be demonstrated by the applicant.

Comment # 5 – Justification proposal

The proposed text states:

"-- For the purpose of demonstrating the individual and overall increased evacuation performance the applicant will conduct:

- ***additional testing and analysis to demonstrate that the requirements of CS25.803(c), including the safety margins described in the associated guidance material, will still be met at aircraft level under the new mandatory configuration for an increased MPSC, through the following means: …"***

Comment:
All discussion related to compliance with CS 25.803(c) as justification for this ESF should be removed.

Justification:
When a new exit arrangement is being proposed, the requirement for an applicant to show compliance with CS 25.803(c) has always been required by the regulatory agencies and, therefore, it should not be considered a supporting justification for this proposal.

EASA response:

NOT AGREED

- ***The application was made for an increase of the MPSC and not for an individual increase of exits' credit. Therefore the requirements at exits' and at aircraft's level need to be addressed.***

Comment # 6 – Justification proposal (Bullet #2)

The proposed text states:

"Should an increase of the dimensions of the emergency exit access area (i.e., passageway, access space, etc.) above the minimum values be needed to demonstrate the desired evacuation performance, such new dimensions will constitute a limitation of the design of the new over-performing Type I emergency exit."

Comment:
The ESF should specify that the minimum passageway at the "over-performing Type I exit" be no less than 36 inches, which has been established by the industry as the minimum dimension that supports dual-lane evacuee flow through a 32-inch wide doorway and onto the

wider escape slide.

Justification:
With the proposed passageway being only 20 inches in width, only single-lane evacuee flow will result and there will be no benefit of having a wider escape slide and no possibility of an increased level of safety commensurate with increasing the exit pair's rating to 65 passengers. As stated by the FAA in the preamble to Amendment 25-88, *"The evacuees could not be expected to maintain two uniform parallel lines in a narrow passageway [less than 36 inches wide] if doing so would necessitate keeping their shoulders twisted for the entire length of the passageway. The use of a narrower passageway would, therefore, disrupt the orderly flow of parallel lines of evacuees to the exit and result in greatly reduced flow through it.*" This could lead to the cabin crew trying to encourage dual lane flow to take advantage of the dual lane slide. However, if the passageway is not configured to accommodate dual lane flow (i.e., less than 36 inches wide), this could lead to an unintended consequence of competitive evacuee behaviour that could significantly impede the evacuation, especially in a time-critical evacuation. Without dual lane flow leading to the exit, there is little benefit to a dual lane escape slide, since each evacuee will have a natural hesitation prior to jumping into the escape slide.

EASA response:

NOT AGREED

- ***It was not intended to create/accept a dual passenger flow at the exit access as the slide is single lane type only. When providing a minimum 20 inches access or one depending on the applicants' proposal resulting in a significant increase in evacuation flow compared to that through of an oversize type I or type C there is no need to require a minimum of 36 inches.***

Comment # 7 – Justification proposal (Bullet #4)

The proposed text states:

"The maximum passenger seat credit for the remaining emergency exits (i.e., over-wing exits) will be determined by the outcomes of the CPR analysis applicable to the proposed design."

Comment:
Revise the proposed text to read as follows:
"The maximum passenger seat credit for the remaining emergency exits (i.e., over-wing exits) will be determined by ~~the outcomes of the CPR analysis applicable to the proposed design~~ CS 25.807 at Amendment 13."

Justification:
This proposed change would increase the A320 MPSC beyond that allowed by the current regulations and it will change the evacuation characteristics of the airplane. Therefore, the airplane should be shown compliant with the current regulations that pertain to emergency

evacuation or be addressed by appropriate ESF(s) and/or exemption(s). It is not appropriate to consider increasing the passenger limit beyond that allowed by the current regulations without having all of the exits comply with the current requirements.
EASA response: ***NOT AGREED*** ***In order to maintain consistency with previous applications for an increase in MPSC and to grant equal treatment to all applicants, the credit allocated to the emergency exits not affected by the change is not determined a priori with the application of the latest requirements, but it is a consequence of the analysis of the specific design change presented by the applicant, using the provisions of Part 21.101 and associated advisory material.***