Decompression – Small Compartments

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Purpose

- Purpose:
  - To discuss the EASA Generic CRI on “Decompression – Small Compartments”
- Contents:
  - Background of the CRI
  - Discussion of the CRI
    - “Small” vs. “large” compartments
    - Opening sizes
    - Collapse/failure of boundary elements
  - Validation of decompression analysis tools

Background

- Text of CS/FAR 25.365(e)(2), as introduced by JAR-25 Change 14 and FAR 25 Amendment 71:

CS 25.365 Pressurised compartment loads

(e) Any structure, component or part, inside or outside a pressurised compartment, the failure of which could interfere with continued safe flight and landing, must be designed to withstand the effects of a sudden release of pressure through an opening in any compartment at any operating altitude resulting from each of the following conditions:

(1) The penetration of the compartment by a portion of an engine following an engine disintegration.

(3) The maximum opening caused by aeroplane or equipment failures not shown to be extremely improbable. (See AMC 25.365 (e).)

(2) Any opening in any pressurised compartment up to the size H_o in square feet; however, small compartments may be combined with an adjacent pressurised compartment and both considered as a single compartment for openings that cannot reasonably be expected to be confined to the small compartment. The size H_o must be computed by the following formula:

$$H_o = PA_s$$

where,

H_o = maximum opening in square feet, need not exceed 20 square feet.

$$P = \frac{A_s}{6240} + \cdot 024$$

A_s = maximum cross sectional area of the pressurised shell normal to the longitudinal axis, in square feet; and

Background

- Discussions with applicants seeking approval of (V)VIP conversions highlighted the need for a definition of “small” compartments
- Also, criteria for allowing collapse/failure of certain boundary elements (partitions, walls, ceilings,…) were lacking, in relation to CS/FAR 25.365(g):

> (g) Bulkheads, floors, and partitions in pressurised compartments for occupants must be designed to withstand conditions specified in sub-paragraph (e) of this paragraph. In addition, reasonable design precautions must be taken to minimise the probability of parts becoming detached and injuring occupants while in their seats.

Background

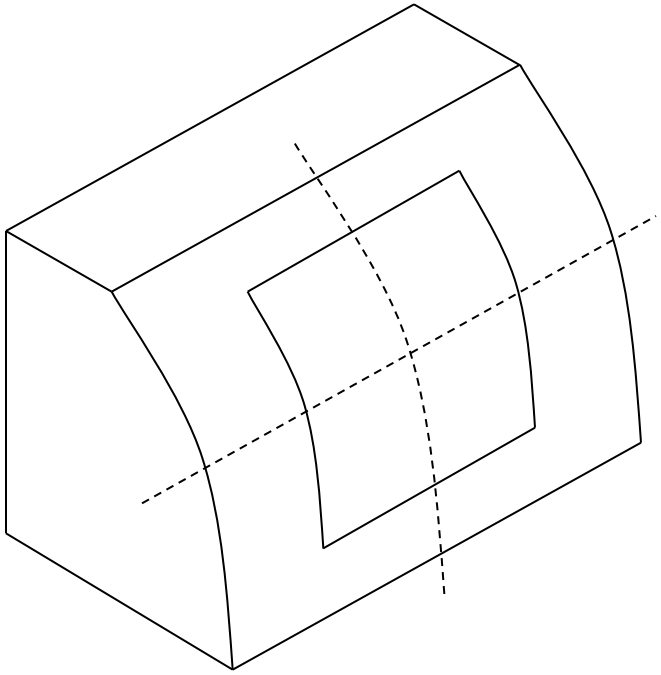
- The Generic CRI is addressing both issues identified on previous slide
- The CRI has been applied successfully to a number of (V)VIP conversions
  - Case by case review, sometimes discussions were difficult
- Further development of the CRI as needed
- Co-ordination with FAA on-going

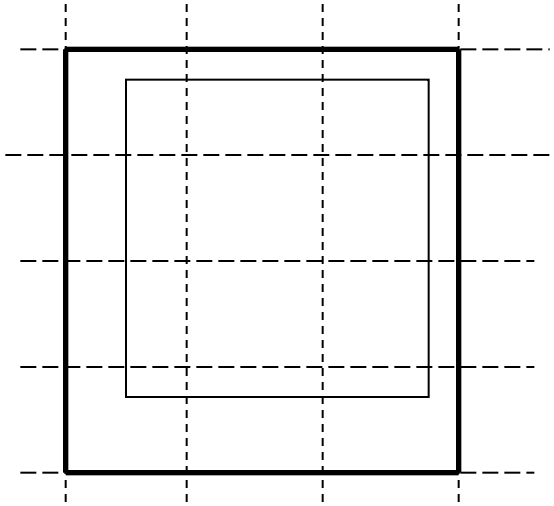
“Small” vs. “large” compartments

- To distinguish between “small” and “large” compartments, the following criterion is recommended in the CRI:
  - The opening size resulting from CS 25.365(e)(2) should be considered as a rectangle
  - So a 20 square feet opening size (the maximum in accordance with CS 25.365(e)(2)) would become a rectangle of approximately 4.5 by 4.5 feet, or 54 by 54 inches
  - Assuming a typical frame pitch of 20 inches, and assuming that the opening can be confined by the next frame on either side, this would mean that “small” compartments (for an aircraft where a 20 square feet opening size needs to be considered) would be those compartments that have a width of three frames or less

“Small” vs. “large” compartments

Opening size taken as rectangle

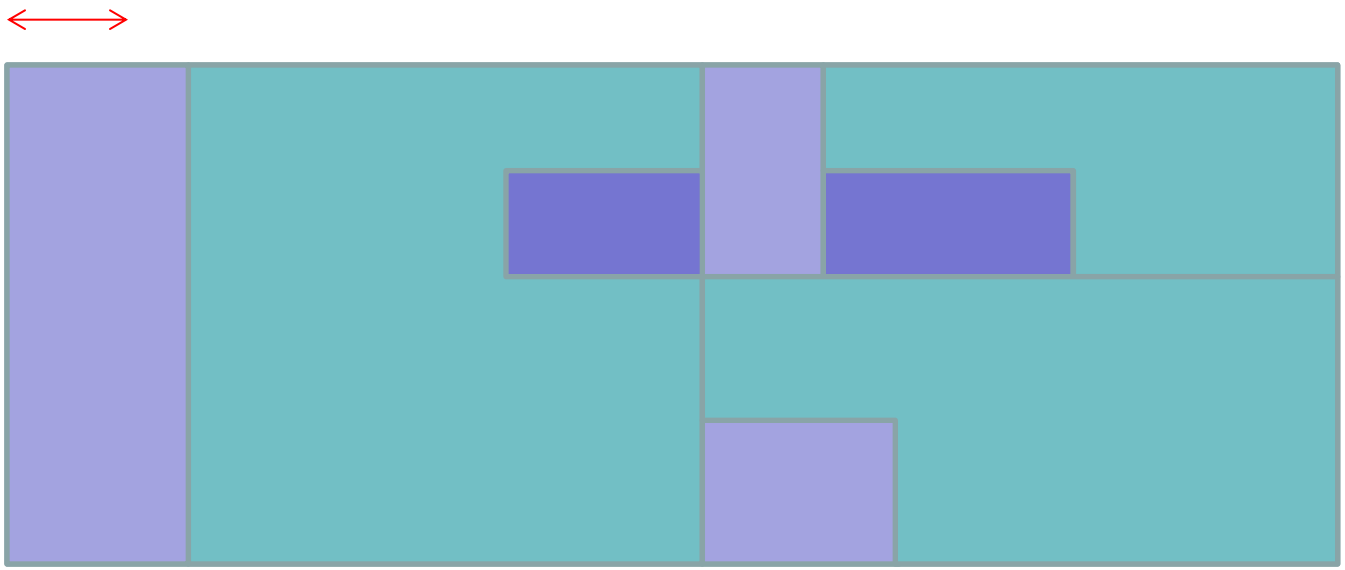




Opening size expanded (bold lines)

to next frames and stringers

Compartments vs. volumes



“large” compartment

“small” compartment

volume within compartment

frame pitch (ref.)

Opening sizes

- For “large” compartments two (2) scenarios:
  - Within compartment: as defined by CS 25.365(e)(1)(2)(3)
  - Outside compartment: idem dito
- For “small” compartments (considered in combination with large compartment) three (3) scenarios:
  - Within combined compartment:
    - As defined by CS 25.365(e)(2)
  - Within small compartment:
    - As defined by CS 25.365(e)(1)(3)
  - Outside small compartment:
    - As defined by CS 25.365(e)(1)(2)(3)
- For CS 25.365(e)(3), skin bay opening should be considered

Collapse/failure of boundary elements

- For reasons of continued safe flight and landing, and for occupant protection, every reasonable and practicable design effort should be taken to design partitions, walls, etc. to withstand the pressure differentials resulting from CS 25.365(e)
- This includes strengthening of structural elements (such as bulkheads, partitions and ceiling panels), providing additional venting, or relocation of interior walls (partitions)
- In some (very limited) cases, only under certain conditions, collapse/failure of such elements may be allowed

Collapse/failure of boundary elements

- These conditions are:
  - Strengthening, additional venting, etc. is shown not to be practicable
  - Continued safe flight and landing is preserved
    - E.g. no collapse of floors
  - Compartment is not provisioned with safety belts and not likely to be occupied by the same person for a significant period of time
    - Such as lavatories & corridors, but not crew rest, bedrooms, etc.
  - Minimize probability of debris becoming detached and injuring occupants
    - E.g. use of lanyards

Collapse/failure of boundary elements

- These conditions are: (continued)
  - No collapse/failure when considering an opening size equal to a skin bay
  - Clear identification of these cases and explicit agreement from EASA

Collapse/failure of boundary elements

- For most compartments showing of compliance is (relatively) clear
- For “small” (standard airline size) lavatories investigations are on-going
  - CRI requires consideration of skin bay size opening in these lavatories, without collapse of boundary elements
  - In the past compliance to this requirement has not been consistently required or shown by TC Holders
  - Not to penalize (V)VIP installers, if OEM lavatories are (re)installed, consideration of a skin bay size opening in the lavatory is currently not required

Validation of decompression analysis tools

- As per 21A.113(b), the STC Holder may show compliance through use of its own resources, or through an arrangement with the TC Holder
  - Arrangement with TC Holder:
  - Requires good understanding of tools and methods applied (often proprietary), or:
  - Confirmation that tools and methods are same as previously accepted by EASA
  - Own resources: validation of the decompression analysis tool is necessary
  - Comparison with “known” previously accepted cases
  - Test data to establish opening times and pressures of vent panels

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Thank you for your attention!

Any questions….?

Your safety is our mission.

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