

EASA CS 25 Practical Examples Related to Cabin Re-Configurations

Sofema Aviation Services (SAS) www.sassofia.com considers key elements related to cabin reconfiguration related to Large Aircraft.

- **LOPA** (The term "LOPA," which stands for "Layout of Passenger Accommodation," has been updated by EASA to "Aircraft Interior Control Document (AICD).") This change reflects a broader scope, encompassing various aspects of aircraft interior configurations beyond just passenger seating layouts.
- **CS 25.785: Seating Configuration, Restraints, and Access to Emergency Exits**
- **CS 25.853: Interior Flammability Requirements**
- **CS 25.812 Emergency Exit Access and Location:**
- **Galley Inserts Change - Affected Requirements:**
- **Upholstery Change**
- **Placard Changes**
- **General Compliance Demonstration Approaches for Interior Changes**

Introduction

Regulatory compliance for cabin reconfigurations compliant with CS 25 and Part 21J in large aircraft is driven by the critical need to maintain safety, reliability, and passenger well-being.

- Consider the following practical solutions for typical minor/major interior changes (LOPA changes, galley inserts change, upholstery change, emergency equipment changes, placard changes, etc...) practical examples on compliance demonstration for typical interiors changes under Part21J

LOPA (Layout of Passenger Accommodations) Changes

When considering Layout of Passenger Accommodations (LOPA) changes, specifically under the regulatory requirements of

- CS 25.785,
- CS 25.853,
- CS 25.562, and
- CS 25.812,

there are various challenges and best practices to ensure compliance

CS 25.785: Seating Configuration, Restraints, and Access to Emergency Exits

The Certification Specification (CS) 25.785 underlines requirements concerning the design and arrangement of passenger and crew seating, restraints, and access to emergency exits. Ensuring compliance with CS 25.785 involves addressing challenges in seating layout, safety, accessibility, and emergency procedures.

- Adjusting the seating layout often affects passenger access to emergency exits and can create obstructions in evacuation paths.
- This requires a careful analysis to ensure compliance without compromising passenger density or comfort.
- Consider scenario-based reviews to ensure all seating adjustments maintain adequate exit access and spacing.

CS 25.853: Interior Flammability Requirements

CS 25.853 covers the flammability standards for materials used in the cabin interiors of large commercial aircraft. The primary goal of this specification is to ensure that all materials used in the cabin (including seats, walls, flooring, and partitions) have flame-retardant properties to limit the spread of fire, protect occupants, and provide more time for safe evacuation.

- Materials used in the cabin must meet stringent flammability requirements to prevent the spread of fire.
- Changes to seating, partitions, or decorative finishes can inadvertently impact these safety standards.
- Utilize materials that have established flammability certifications for the new configurations.
 - A thorough review of all materials against the latest flammability standards before installation is essential to avoid retrofit issues and regulatory non-compliance

CS 25.562 requires dynamic testing of seats, which involves simulating specific emergency landing conditions with high deceleration forces. Seats must withstand two types of impact forces:

- **16g forward impact:** Tests the seat and restraint's ability to keep the occupant secured during a strong forward-facing impact.

- **14g downward impact:** Evaluates the seat's capacity to prevent the occupant from sliding out or experiencing excessive vertical loads in a vertical impact scenario.
 - Modifying the seat configuration, especially for added seats, affects crashworthiness. Each seat must withstand dynamic conditions, which is critical during any crash event.
 - Altering the configuration can lead to complex re-evaluations of structural strength and energy absorption requirements.
 - Conduct dynamic testing for new seating configurations. Also, review the latest engineering data on crash dynamics to ensure each seat complies with crashworthiness standards in its new placement.

CS 25.812 Emergency Exit Access and Location:

Emergency Lighting Requirements:

An independent emergency lighting system must be installed, covering exit marking, cabin illumination, exit area lighting, and floor proximity escape path marking.

Emergency lights should be internally illuminated or use other means that do not depend on the main lighting system, enhancing visibility in low-light or emergency conditions

- **Accessibility:** Emergency exits must be easily accessible to passengers from their seating positions. There should be no obstacles blocking exit paths, and each exit must allow swift movement to accommodate rapid evacuation.
- **Placement:** Exits must be positioned along the cabin to ensure that passengers are no more than a specified distance from an exit. This placement helps distribute access points throughout the cabin for efficient egress.
 - Adjusting the LOPA can alter the pathways to emergency exits or affect the visibility of emergency lighting, both critical during evacuations.
 - Ensure all changes to the LOPA layout allow clear access to exits and that emergency lighting remains visible.
 - Run simulations of low-visibility evacuation scenarios to validate that lighting placement and brightness levels support safe egress

Practical Solution Review:

To demonstrate compliance with these affected requirements, a systematic approach is advised:

- **Validate Installation and Configuration**
- **Perform Functional Testing**
- **Evaluate Battery and Power Sources**
 - Verify placement of emergency lights at exits, aisles, floor paths, and exterior egress points.
 - Confirm the system is independent of the main power, with redundancies for power failures.
 - Check that lighting types (e.g., LED, fluorescent) meet intensity and visibility standards, including contrasting exit signage.
 - Verify exterior lighting at overwing and egress points for safe evacuation outside.
 - Test lights under simulated power failure and low visibility (e.g., smoke) to confirm operation.
 - Measure light intensity and verify it meets regulatory lux requirements (e.g., 0.3 lux for floor lighting).
 - Confirm exit signs remain visible in all conditions.
 - Test backup power sources for required duration (e.g., 10 minutes of lighting during power loss).
 - Perform maintenance checks on batteries for longevity and reliability.
 - Establish a battery replacement or recharging schedule.

Galley Inserts Change - Affected Requirements:

- **CS 25.853** (flammability),
- **CS 25.601** (aircraft integrity), and
- **CS 25.1309** (system safety and equipment reliability).

Practical Solution: When updating or adding new galley inserts (e.g., ovens, coffee makers), it's essential to evaluate electrical connections, weight, and flammability to ensure they meet the certification requirements.

- Ensure that the galley insert meets the necessary electrical and mechanical safety standards as outlined in CS 25.1365.
 - Compliance with overheat protection requirements for electrical appliances, motors, and transformers to prevent fire hazards(cs-25_amendment_28).
- Verify that all Electrical Wiring Interconnection Systems (EWIS) within the galley installation area are protected and positioned to prevent accidental damage from crew, passengers, or equipment movement.

- This aligns with CS 25.1721, which mandates safeguarding EWIS in high-activity areas like galleys to minimize potential contact with galley carts or other equipment
- Confirm that the insert includes built-in overheat protection, which interrupts the power supply in the event of overheating, thus reducing the risk of fire.
- The galley inserts, if involving heating elements, should have a dedicated ventilation system that is separate from cabin and cargo ventilation, as recommended in CS 25.1529 for continued airworthiness.
 - This ventilation system should include flame arresters to prevent flammable materials from entering cabin ventilation pathways
- Ensure that devices like water boilers and coffee makers are equipped with pressure relief mechanisms to handle over pressurization, addressing potential hazards caused by blockages or loss of water supply during operation
- Review spill containment provisions to mitigate the risk of slippery surfaces for passengers and crew, and ensure no structural damage from corrosion due to spilled fluids.

Upholstery Change

- **CS 25.853** (flammability),
- **CS 25.853(d)** (smoke emissions), and
- **CS 25.562** (seat crashworthiness).

Practical Solution: Upholstery updates require flammability testing and smoke emission verification for materials used in seat covers, wall panels, and carpets. Crashworthiness might be affected if padding characteristics are altered.

- **Compliance Example:** When upgrading to a new type of fire-retardant fabric:
- Ensure materials meet flammability criteria for cabin interiors, such as flame spread, heat release, and smoke emission limits.
 - Conduct vertical burn tests to verify compliance with **CS 25.853** flammability standards.
 - Ensure seat padding and upholstery density comply with crash requirements under **CS 25.562**. If padding is altered significantly, impact testing may be necessary.
 - Select upholstery materials with EASA-approved certifications for fire resistance, durability, and toxicity (compliant with CS 25.853 for flammability standards).

- Conduct flammability tests on the upholstery material to verify compliance with CS 25.853, including heat release and smoke density tests.
- Review the impact of material changes on the seat's structure, including weight and balance considerations.
- Submit a Minor Modification or Major Change request to EASA, depending on the extent of the modification.
 - Ensure your Aircraft Interior Control Document (AICD) reflects this change.
- Conduct installation in compliance with CS 25.785 for passenger and crew accommodations, ensuring no alteration to seat strength or attachment points.

Emergency Equipment Change

- **CS 25.1309** (equipment reliability),
- **CS 25.1411** (emergency equipment location and accessibility), and
- **CS 25.1415** (ditching provisions for water landings, if applicable).
- **Practical Solution:** When modifying or adding emergency equipment, placement, accessibility, and operational readiness must be evaluated.
 - Equipment should be securely mounted, within easy reach, and visible to passengers and crew.

Process for Emergency Equipment Changes Compliant with CS-25

Define Scope of Equipment Change - Identify whether the change is a direct replacement (same equipment) or an upgrade (different model with new features).

- Example, replacing existing life vests with an updated model should be flagged as an "upgrade" if it introduces new usage instructions or design.
- Replacing old portable oxygen bottles with a new, lightweight model may require updated installation and user instructions, triggering specific compliance steps.

Safety Assessment and Compatibility Check

- Conduct a safety assessment to ensure the new equipment won't negatively impact other systems or introduce unforeseen hazards.

- Use risk management techniques, such as Failure Mode and Effects Analysis (FMEA) Comply with CS 25.1309.
- Verify Equipment Certification and Fire Safety
 - Ensure the emergency equipment meets EASA certification standards, specifically in terms of durability, toxicity, and fire resistance as per CS 25.853 (Compartment Interiors) and CS 25.851 (Fire Extinguishers).
 - Fire extinguishers in passenger cabins must pass toxicity and performance tests to ensure non-harmful exposure in confined spaces.
- Installation Planning and Documentation
 - Install equipment following OEM guidelines and confirm accessibility and security according to CS 25.1360 (Precautions Against Injury).
 - Example - If replacing emergency beacons, verify they are mounted per accessibility requirements without obstructing emergency egress paths, per CS 25.813, and secured to avoid accidental dislodgment during turbulence.
- Flammability and Functionality Testing
 - Conduct tests on emergency equipment to verify fire resistance and proper functionality under operational conditions, as required by CS 25.853 for flammability standards.
- Weight and Balance Analysis
 - Any equipment replacement that impacts weight or balance requires updated calculations. Maintain records of weight changes and ensure compliance with CS 25.29 (Empty Weight and Center of Gravity).

Placard Changes

- **Affected Requirements: CS 25.1541** (aircraft markings and placards) and **CS 25.1543** (placard visibility and durability).

Practical Solution: Any change to placards must ensure visibility, durability, and accuracy. Placards should provide clear, concise information for passengers and crew regarding equipment usage and safety.

The certification requirements are defined under **CS 25.1541** (Markings and Placards) and have specific conditions related to content, placement, and materials used for the placards.

- Markings or placards should be placed close to or on (as appropriate) the instrument or control with which they are associated. The terminology and units used should be consistent with those used in the Flight Manual. The units used for markings and placards should be those that are read on the relevant associated instrument.
- Publications which are considered to provide appropriate standards for the design substantiation and certification of symbolic placards may include, but are not limited to, 'General Aviation Manufacturers Association (GAMA) Publication No. 15 — Symbolic Messages', Initial Issue, 1 March 2014.
- EASA accepts the relevant parts of Federal Aviation Administration (FAA) AC 25-17A 'Transport Airplane Cabin Interiors Crashworthiness Handbook', of 24 May 2016, as an acceptable means of compliance with CS 25.1541.

To consider the key aspects related to ensuring aviation placards are fully compliant with the regulatory requirements and may be installed on aircraft.

As a general comment - If a company other than the OEM manufactures an item, they must identify who they are.

- Also, to strictly adhere to the Manufacturer's design data, you would need to ensure that the information is at the latest revision and also have access to the certification data.

Here, we consider the authority of a Part 21 DOA to create a placard and annotate it with the OEM P/N. Is this acceptable for Form 1 certification, or must we go the EPA route, which means annotating with OEM P/N plus letters EPA?

The Responsibilities of the DOA - Regulation (EU) No 2021/699

(a) Each part or appliance which is eligible for installation in a type-certified product shall be marked permanently and legibly with:

- a name, trademark, or symbol identifying the manufacturer in a manner identified by the applicable design data;
- the part number, as defined in the applicable design data and
- the letters EPA for parts or appliances produced in accordance with approved design data not belonging to the type-certificate holder of the related product,

except for ETSO articles and for parts and appliances covered under point (b) of point 21.A.307.

(b) By way of derogation from point (a), if the Agency agrees that a part or appliance is too small or that it is otherwise impractical to mark it with any of the information required by point (a), the authorised release document accompanying the part or appliance or its container shall include the information that could not be marked on the part or appliance.

DOA Procedures related to Placards

The DOA should use its own numbering system as per its procedures, and yes, it must include the letters EPA (21.A.804(a)).

- If their procedures say they can put OEM part numbers on parts, then that would be OK (again, with the letters EPA included)

Concerning 145 Fabrication of Parts

If a 145 organisation makes a part of an OEM drawing, then they could legitimately put the OEM part number on it. (again, it should be identified with a suffix related to the 145) – (possible licensing issues)

- Such parts cannot be sold or provided with an EASA Form 1

EASA FAQ n.20095 - Why and how must Parts and Appliances be marked, when are the letters EPA required, and which exceptions are acceptable?

- To comply with EASA Part-21, Subpart D, 21.A.109, Subpart E, 21A.118A (b) and Subpart M, 21A.451(a) and (b), the respective Holders of a Minor Change Approval, an STC, or a Major Repair Design Approval are required to specify the required markings, including EPA letters as applicable, in their Design (read, 'Approved Data'), according to EASA Part-21, Subpart Q.
- Subpart Q, 21.A.804(a), and related GM require proper identification of each Part and Appliance that is designed or redesigned, including parts designed to be incorporated in repairs (21A.451), by 'permanent and legible marking' hereof. This is applicable for Design Organisations and Manufacturers.
- 21.A.804(a) 1 and 2 require marking Parts and Appliances with 'name, trademark, or symbol identifying the Manufacturer' and 'Part number', as defined in the applicable Design Data.
- According to the GM, the Design Approval Holder shall identify in all its Designs (TC, STC, ETSO, Repair, Change) approved after 28 December 2009 how the

Manufacturer has to mark subject Parts and Appliances in accordance with 21A.804(a) 1. This can be limited to identifying a marking field and the method without prescribing the actual text or symbols.

- 21.A.804(a) 3 requires additional marking with the letters 'EPA' of all parts produced (manufactured) following data 'not belonging to the TC holder of the related product'.

EPA Marking

- Each interchangeable or removable Part or Appliance manufactured in accordance with a design issued by the Design Organisation shall be permanently and legibly marked according to 21.A.804.

Note 1- The EPA marking was introduced in 2004; this was done to identify any 'not original' Part (which means any Part or Appliance not designed by the TC- or ETSO-Approval Holder) as a trigger for Maintenance Organisations and Accident or Incident investigators, in the light of Continuing Airworthiness.

Note 2: The intention was not to require adding the letters 'EPA' to mark repairs. In this context, EPA marking only applies to the newly designed and manufactured parts to be incorporated into the repair. Especially where repairs impact interchangeability, identifying incorporated new Parts is very important, and DO Procedures should address this item.

Note 3: For parts referred to in 21.A.307(b), as amended with (EU)2021/699 (applicable from 18.05.2022), the EPA marking is not required, as stated in 21.A.804(a)(3).

Small Parts Marking

- The only accepted exception regarding Marking (including EPA) is defined in 21.A.804(b). This subparagraph offers the possibility of not physically marking the Part of the Appliance when it is too small or when marking hereof is otherwise impractical, but only after "Agency agreement."

>> This wording allows an Applicant/Holder of a Design and the Agency to further define in detail how this 'agreement' can be obtained and will be formalized. A DOA Team Leader (DOATL) should, however, ensure that the DOA Applicant/Holder reflects this approach in its DO Handbook or Procedures, requiring at least a justification of the reason for not marking physically and details of the alternative way chosen for the identification, per 21A.804(b), to know on the authorised release document accompanying the Part or Appliance, or on its container.

C of C or EASA Form 1?

- In the case of Placards which are manufactured by a Part 21G Organisation (holding the applicable scope of approval), the expected release will be on EASA Form 1

>> Placards shall comply with flammability and traceability requirements.

Note—A Certificate of Conformity only applies to Standard Parts with traceability to the source; therefore, such a release is unacceptable for Placards.

General Compliance Demonstration Approaches for Interior Changes

Documentation and Traceability:

- Maintain detailed documentation of each change, including design drawings, testing outcomes, and compliance reports, as mandated under **Part 21.A.5** for record-keeping. This ensures traceability and helps manage audits or regulatory reviews.

Testing and Analysis:

- For each affected requirement, conduct appropriate tests, such as flammability tests (per **CS 25.853**), load-bearing tests (per **CS 25.785**), or visibility checks for placards. Document each test with signed reports and retain these in an accessible format.

Communication with Authorities:

- Ensure proactive communication with EASA, especially for major changes. Provide regular updates, compliance documentation, and test results as specified under **Part 21.A.3A** for ongoing reporting and feedback.

Overview of Compliance Demonstration Approaches for Interior Changes

- EASA's CS-25 standards require that interior modifications meet specific safety and operational criteria, covering areas such as:
 - **Emergency Equipment Accessibility** (CS 25.801 - CS 25.820)
 - **Structural Strength and Stability** (CS 25.561, CS 25.785)
 - **Fire Safety and Material Flammability** (CS 25.853)
 - **Passenger Information and Signage** (CS 25.791 - CS 25.1557)
- **Documentation and Certification**
 - Interior changes require documentation that includes updated maintenance procedures, material certifications, safety testing results, and

compliance records. This documentation supports EASA's review and audit processes.

Common Challenges and Practical Solutions for Interior Change Compliance

- **Material Flammability and Fire Safety Compliance (CS 25.853)**
 - Achieving compliance with strict flammability requirements for materials used in cabin interiors (e.g., seats, panels, carpets) can be challenging, as different materials may require unique testing.
- **Emergency Accessibility and Equipment Placement (CS 25.811 - CS 25.820)**
 - Modifications can sometimes interfere with emergency equipment accessibility or egress paths, potentially compromising evacuation safety.
 - Conduct ergonomic evaluations to ensure that safety equipment can be quickly and easily accessed by passengers and crew.
- **Structural Strength and Stability of Interior Components (CS 25.561, CS 25.785)**
 - Perform 16g and 9g impact tests on modified seats, cabinets, and other structural components to confirm they can endure extreme forces.
 - Analyze changes in interior weight distribution to ensure they do not impact the aircraft's center of gravity or balance.
 - When modifying cabin layout, ensure all components are securely mounted and documented, in addition to update the Aircraft Interior Control Document (AICD)

Next Steps

Sofema Aviation Services (SAS) www.sassaofia.com and Sofema Online (www.sofemaonline.com) provide Classroom Webinar and Online training for CS25 – please see the websites or email team@sassaofia.com