EASA European Union Aviation Safety Agency	Consultation paper Deviation from CS 25.855 related to the design of cargo compartments installed on Large Aeroplanes	Doc. No.: Issue : 3 Date : 26 August 2021 Proposed ☐ Final ☒

SUBJECT	:	**Transportation of cargo in passenger compartments**
REQUIREMENTS incl. Amdt.	:	**CS 25.855 Amendment 26**
ASSOCIATED IM/MoC[1]	:	Yes☒ / No ☐
ADVISORY MATERIAL	:	**EASA CM-CS-003 "Installation of Cargo Seat Bags on Passenger Seats"** **EASA CM-S-002 "Frequent Removal of Interior Structures"** **EASA CM-CS-010 "Incomplete Passenger Cabin"** **SAE ARP 4049A "Cargo Restraint on Aircraft Passenger Seats – Main Passenger Cabin"**

INTRODUCTORY NOTE:

Deviations 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 has received applications proposing design changes that would allow the transportation of cargo instead of passengers, in the passenger cabin of (CS-25) Large Aeroplane beyond the use permitted by the operational rules of the already existing designated areas/volumes such as overhead bins, galleys or stowage compartments.

The proposed designs will change the passenger compartment to allow carriage of cargo in the passenger cabin, instead of passengers, in a cabin area that was not designed as a cargo compartment. The certification specifications in CS-25 address the design of cargo compartments (ref. CS 25.855 and CS 25.857).

The design of the passenger cabin does not meet any of the cargo compartment class definitions described in CS 25.857. The design specification of the stowage compartments available in the passenger cabin, the quantity and type of handheld fire extinguishers installed therein and the approved fire-fighting emergency procedures are driven by assumptions on the reasonable level of criticality of the fires that are likely to occur. In fact, cabin fires originate either from aircraft systems or from occupants personal belongings that are subject to intensive screening and control. Furthermore, it is assumed that passengers and crew members can detect cabin fires in a timely manner.

If the passenger cabin is used to transport cargo, the above assumptions are not valid anymore and there is an increased fire risk which needs to be addressed through the installation of the additional aircraft systems as required for the design of cargo compartments by CS 25.855 and CS 25.857 (e.g. smoke detection system, built-in fire suppression system, cargo liners, means to shut-off ventilation, smoke barrier).

To ensure an acceptable level of safety, in line with that required for the design of cargo compartments installed on large aeroplanes, a special condition had been proposed by EASA and published for consultation from 9th June to 7th July 2020.

EASA received 166 comments from 16 different commenters, including Aviation Authorities and key stakeholders. After a thorough review of the comments received, EASA concluded that the complexity associated to the performance of a fire risk assessment could create the conditions for applicants to underestimate the hazard associated to a cargo fire. The initially proposed certification approach could have been successful only through the introduction of very severe limitations to the type of cargo allowed in the cabin. EASA therefore decided to publish instead a deviation imposing a time limitation expressed in flight hours or terminal date, whichever occurs first, in order to mitigate to an acceptable level the risk of exposure to a catastrophic cargo fire event. As a matter of fact, if only manual fire-fighting capability is available, protection of the cabin occupants from smoke and toxic gases generated by the cargo fire event can be achieved only if the fire is detected in a timely manner and fully extinguished. These objectives can be achieved only assuming transportation of cargo that is associated to a very low fire risk.

The intent of this deviation is, in the context of the COVID-19 crisis and its commercial impact on the industry and on airline operators, to allow higher flexibility in the transportation of cargo in the cabin. This additional flexibility could be granted as long as the exposure to the risk of a catastrophic cargo fire is mitigated by operational limitations that are established on the basis of conservative assumptions related to:

a) the number of aeroplanes for which the passenger cabin will be converted to transport cargo through a design change;
b) the expected average number of flight hours per year for an affected aeroplane; and
c) the probability of having a cargo fire.

In addition, the assumptions on the rate of conversion of the fleet and on the average flight hours per affected aeroplane per year are established taking into account the expected temporary nature of this demanded kind of passenger aeroplane operation, which is expected to phase out as soon as the situation generated by the current COVID-19 emergency improves and normal fleet operation is restored.
EASA has established the proposed operating limitations in the previous issues of the present Deviation assuming that until 31st December 2021 maximum 2500 aeroplanes would be converted to transport cargo in the cabin. Considering the statistical evidence coming from international databases, the probability of having a cargo fire is assumed to be equal to 10-7 /FH.
As not all cargo fire events are catastrophic, it was therefore considered sufficiently conservative to allow each affected aeroplane to fly for a maximum of 2000 flight hours until 31st December 2021.
As of 30 June 2021, EASA had approved a very low number of design changes and also the number of converted aeroplanes was significantly lower than initially assumed. Consequently, EASA has determined that it is reasonable and sufficiently conservative to allow each affected aeroplane to fly until July 31st 2022. The operating limitation applicable to the number of flight hours remains unchanged. EASA intends to keep on monitoring the implementation of the design changes that will be approved based on the deviation in order to confirm the validity of the above-mentioned assumptions.

In conclusion, if the cabin design cannot meet the specifications of a Class B, C, E or F cargo compartment, the following deviation from the requirements of CS 25.855 needs to be established to achieve the compliance with the essential requirements for airworthiness laid down in Annex II to Regulation (EU) 2018/1139 for transportation of cargo in the cabin.

Deviation from CS 25.855(a),(b),(c),(d),(h),(i) Amdt 26

Transportation of cargo in passenger compartments

I. APPLICABILITY

Large Aeroplanes certified for the transport of passengers and that are intended to be used for the transport of cargo in the cabin.

II. APPLICABLE ESSENTIAL REQUIREMENTS FOR AIRWORTHINESS OF REGULATION (EU) 2018/1139 (Annex II)

1.1. Structures and materials

1.1.1. The integrity of the structure must be ensured throughout, and sufficiently beyond, the operational envelope for the aircraft, including its propulsion system, and maintained for the operational life of the aircraft.

1.1.2. All parts of the aircraft, the failure of which could reduce the structural integrity, must comply with the following conditions without detrimental deformation or failure. This includes all items of significant mass and their means of restraint.

(a) All combinations of load reasonably expected to occur within and sufficiently beyond, the weights, centre of gravity range, operational envelope and life of the aircraft must be considered. This includes loads due to gusts, manoeuvres, pressurisation, movable surfaces, control and propulsion systems both in flight and on the ground.

(b) Consideration must be given to the loads and likely failures induced by emergency landings either on land or water.

(c) As appropriate to the type of operation, dynamic effects must be covered in the structural response to those loads, taking into account the size and configuration of the aircraft.

1.1.4. The production processes and materials used in the construction of the aircraft must result in known and reproducible structural properties. Any changes in material performance related to the operational environment must be accounted for.

1.1.5. It must be ensured, to the extent practicable, that the effects of cyclic loading, environmental degradation, accidental and discrete source damage do not reduce the structural integrity below an acceptable residual strength level. All necessary instructions for ensuring continued airworthiness in this regard must be promulgated.

1.3. Systems and equipment (other than non-installed equipment):
1.3.1. The aircraft must not have design features or details that experience has shown to be hazardous.

1.3.2. The aircraft, including those systems, and equipment required for the assessment of the type design, or by operating rules, must function as intended under any foreseeable operating conditions, throughout and sufficiently beyond, the operational envelope of the aircraft, taking due account of the system or equipment operating environment. Other systems or equipment not required for type-certification, or by operating rules, whether functioning properly or improperly, must not reduce safety and must not adversely affect the proper functioning of any other system or equipment. Systems and equipment must be operable without needing exceptional skill or strength.

1.3.3. The aircraft systems and equipment, considered separately and in relation to each other, must be designed such that any catastrophic failure condition does not result from a single failure not shown to be extremely improbable and an inverse relationship must exist between the probability of a failure condition and the severity of its effect on the aircraft and its occupants. With respect to the single failure criterion above, it is accepted that due allowance must be made for the size and broad configuration of the aircraft and that this may prevent this single failure criterion from being met for some parts and some systems on helicopters and small aeroplanes.

1.3.4. Information needed for the safe conduct of the flight and information concerning unsafe conditions must be provided to the crew or maintenance personnel, as appropriate, in a clear, consistent and unambiguous manner. Systems, equipment and controls, including signs and announcements must be designed and located to minimise errors which could contribute to the creation of hazards.

1.3.5. Design precautions must be taken to minimise the hazards to the aircraft and occupants from reasonably probable threats, including information security threats, both inside and external to the aircraft, including protecting against the possibility of a significant failure in, or disruption of, any non-installed equipment.

1.5. Continuing airworthiness

1.5.1. All necessary documents including instructions for continuing airworthiness must be established and made available to ensure that the airworthiness standard related to the aircraft type and any associated part is maintained throughout the operational life of the aircraft.

1.5.2. Means must be provided to allow inspection, adjustment, lubrication, removal or replacement of parts and non- installed equipment as necessary for continuing airworthiness.

1.5.3. The instructions for continuing airworthiness must be in the form of a manual, or manuals, as appropriate for the quantity of data to be provided. The manuals must cover maintenance and

repair instructions, servicing information, trouble-shooting and inspection procedures, in a format that provides for a practical arrangement.

1.5.4. The instructions for continuing airworthiness must contain airworthiness limitations that set forth each mandatory replacement time, inspection interval and related inspection procedure.

2. AIRWORTHINESS ASPECTS OF PRODUCT OPERATION

2.1. The following must be shown to have been addressed to ensure safety for those on board or on the ground during the operation of the product:

(a) the kinds of operation for which the aircraft is approved must be established and limitations and information necessary for safe operation, including environmental limitations and performance, must be established;

(b) the aircraft must be safely controllable and manoeuvrable under all anticipated operating conditions including following the failure of one or, if appropriate, more propulsion systems, taking into account the size and configuration of the aircraft. Due account must be taken of pilot strength, flight deck environment, pilot workload and other human-factor considerations and of the phase of flight and its duration;

(c) it must be possible to make a smooth transition from one flight phase to another without requiring exceptional piloting skill, alertness, strength or workload under any probable operating condition;

(d) the aircraft must have such stability as to ensure that the demands made on the pilot are not excessive taking into account the phase of flight and its duration;

(e) procedures for normal operations, failure and emergency conditions must be established;

(f) warnings or other deterrents intended to prevent exceedance of the normal flight envelope, must be provided, as appropriate to the aircraft type;

(g) the characteristics of the aircraft and its systems must allow a safe return from extremes of the flight envelope that may be encountered.

2.2. The operating limitations and other information necessary for safe operation must be made available to the crew members.

2.3. Product operations must be protected from hazards resulting from adverse external and internal conditions, including environmental conditions.

(a) In particular, and as appropriate to the type of operation, no unsafe condition must occur from exposure to phenomena such as, but not limited to, adverse weather, lightning, bird strike, high frequency radiated fields, ozone, etc., reasonably expected to occur during product operation, taking into account the size and configuration of the aircraft;

(b) Cabin compartments, as appropriate to the type of operations, must provide passengers with suitable transport conditions and adequate protection from any expected hazard arising in flight operations or resulting in emergency situations, including fire, smoke, toxic gases and rapid decompression hazards, taking into account the size and configuration of the aircraft. Provisions must be made to give occupants every reasonable chance of avoiding serious injury

and quickly evacuating the aircraft and to protect them from the effect of the deceleration forces in the event of an emergency landing on land or water. Clear and unambiguous signs or announcements must be provided, as necessary, to instruct occupants in appropriate safe behaviour and the location and correct use of safety equipment. Required safety equipment must be readily accessible;

(c) Crew compartments, as appropriate to the type of operations, must be arranged in order to facilitate flight operations, including means providing situational awareness, and management of any expected situation and emergencies. The environment of crew compartments must not jeopardise the crew's ability to perform their tasks and its design must be such as to avoid interference during operation and misuse of the controls.

III. MITIGATING FACTORS

In lieu of CS 25.855(a),(b),(c),(d),(h),(i) the passenger cabin compartment of a Large Aeroplane, when used as cargo compartment, shall meet the mitigating factors of this deviation. Compliance with the mitigating factors ensures compliance with the applicable Essential Requirements of Annex II of Regulation (EU) 2018/1139.

1) Allowed cargo

a) The following limitation shall be included in the Airworthiness Limitations Section (ALS) and in the Aircraft Flight Manual (AFM):

The allowance to transport cargo in passenger compartment is limited to 2 000 FH following installation of the change or to July 31st 2022, whichever occurs first.

b) The Transportation of the following cargo in the cabin shall be prohibited:
   i) dangerous goods;
   ii) mail;
   iii) batteries, including batteries contained in, or packed with, equipment;
   iv) Cargo of a piercing, dense, rigid, or penetrating nature, or cargo with sharp edges or corners, such as rods, pipes, extrusions, or beams, that could become a projectile hazard during flight operations;
   v) live animals.

2) Fire Protection

a) All materials installed in the cabin shall at least comply with CS 25.853.
b) There shall be means by which the presence of a fire would be detected in a timely manner. The performance of additional fire and smoke detectors, if installed, shall be demonstrated.
c) There shall be means to extinguish a fire likely to occur in the areas where cargo is located, considering all approved operating configurations and conditions. A fire risk assessment shall be conducted by the applicant to determine the type and quantity of additional fire extinguishers necessary in the cabin. As a minimum, the following fire extinguishers shall be available in the cabin:
   i) Two Underwriters Laboratories (UL) 2A (2-1/2 gallon) rated water portable fire extinguishers;

ii) At least two fire extinguishers with a minimum UL 4A-80B:C rating or equivalent. Having four UL 2A-10B:C extinguishers is equivalent to two fire extinguishers with a minimum UL 4A-80B:C-rating.

d) The cargo installation in the cabin shall be designed such that there is visibility and adequate access to the cargo by the cabin occupants for fire detection and fire-fighting.

i) If cargo is loaded on seats, in each section of the cabin where cargo is transported:

(1) the cargo should not extend above the seatback height.

(2) There should be at least one longitudinal aisle meeting the minimum width dimensions specified in CS 25.815 for aeroplanes with a seating capacity of 10 or less passengers.

(3) For twin-aisle aeroplanes in which seats are not removed and are used to restrain cargo, there shall be an unloaded seat row that allows crossing from one aisle to the other and is approximately located at equal distance from the available cross-aisles required by CS 25.813.

ii) If cargo is loaded on the floor, the cargo items to be transported shall be distributed in cargo loading areas as follows:

(1) in each cargo loading area, the height of the cargo shall not exceed 127 cm (50 inches).

(2) The volume of each cargo loading area, whether on a pallet or directly tied to the floor shall not exceed 3.54m³ (125 ft³).

(3) Each cargo loading area shall be adjacent to at least one longitudinal aisle having a minimum width of 51 cm (20"). Each longitudinal aisle shall enable a crewmember to traverse it while walking upright.

(4) Lateral access that is at least 38 cm (15") wide shall be provided fore and aft of each cargo loading area.

e) Access provisions shall be unobstructed by cargo restraint means including the consideration of shifting of cargo items under the applicable ground and flight loads.

3) Cabin Occupants

a) The AFM shall:

i) Contain an operating limitation specifying the number of occupants whose duties are to detect and fight a fire, and relay information to the flight crew. At least two occupants whose duties are to detect and fight a fire and relay information to the flightcrew are required.

ii) Specify that, if cargo is transported in the cabin, only occupants allowed by mitigating factor 3) a) i) shall be transported in the cabin.

iii) Identify the seats that shall be occupied by the cabin occupants in the cabin during taxi, take-off and landing, and in emergency scenarios such as turbulence or decompression.

iv) Specify that the occupants allowed by 3) a) i) shall receive hand on training on:

(1) the operation of emergency exits (door opening, slide release);

(2) the usage of oxygen equipment (automatic and portable) and procedures to be followed in case of depressurization;

(3) the applicable fire/smoke detection procedures and the usage of the two-way communication system between the flight deck and the cabin;

(4) the usage of the handheld fire extinguishers required by mitigating factor 2) c) and the applicable fire-fighting procedures;

(5) first aid.

v) Require that cabin occupants shall be physically able to accomplish the applicable procedures.

vi) Require that a pre-flight safety briefing is delivered to the cabin occupants, highlighting the location of the available emergency equipment and which emergency exits will be used in an emergency evacuation.
vii) Require to carry portable oxygen equipment by any cabin occupant each time when leaving the seat for cabin walk through (see mitigating factor 7)b)).
viii) Require that a visual inspection of the cargo is conducted on a regular basis including prior to take-off and landing.
ix) Contain appropriate operating procedures for cabin and cockpit ventilation during fire-fighting, and after fire-fighting phase for smoke evacuation.
x) Identify the seats that may be occupied by additional occupants based on a fire risk assessment considering, at a minimum, the size of the aeroplane. The allowance to transport such additional occupants must be obtained by the NAA that is in charge to authorize the operation of the aeroplane.

b) Provisions shall be available to allow the flight crew members to notify the cabin occupants of emergencies (e.g. when to don the oxygen equipment, when returning to their seats is required).

4) Emergency escape routes

a) No cargo shall be installed between any seat that is designated to be occupied for take-off and landing by a cabin occupant and the nearest emergency exit on each side of the fuselage.
b) The required emergency exits shall be easily accessible and operable under any cargo loading condition.
c) The installation of cargo in the cabin shall not decrease the width of the aisle(s), cross aisles, passageways considering the shifting of cargo items under the applicable ground, flight and emergency landing loads.
d) The installation of cargo in the cabin shall not obscure any portion of the required emergency exit marking and floor proximity emergency escape marking considering the shifting of cargo items under the applicable ground, flight and emergency landing loads.

5) Cargo loading, installation and retaining

a) The means to provide the carriage of cargo (cargo seat bags, pallets,..), the means to restrain the cargo (nets, straps,…) and all of the attachment points (to seats, to pallets, to seat tracks/beams - including any fittings used) shall be designed for the placarded maximum weight of contents and for the critical load distribution (centre of gravity location) at the appropriate maximum load factors corresponding to the specified flight and ground load conditions and to the emergency landing conditions of CS 25.561(b).
b) In addition, means shall be provided to prevent the cargo items from becoming a hazard by shifting under the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of CS 25.561(b).
c) Deflections and deformations of cargo items installations under the load conditions mentioned under 5) a) shall not result in additional forces being imposed on other items in the cabin (such as adjacent pallets, seats, sidewalls, ceiling panels and bulkheads) unless these additional forces are accounted for.
d) If the cargo installations do not provide a firm handhold there shall be a handgrip or rail along each aisle to enable persons to steady themselves while using the aisles in moderately rough air.
e) If cargo seat bags are installed:

i) As specified in CS 25.787(a), the cargo seat bags shall fully enclose the contents and the enclosure shall meet the load conditions mentioned under 5) a).
ii) Regardless of the extent to which they are filled with cargo, they shall be fully closed and secured to prevent anyone becoming trapped in an emergency case.
iii) Any related necessary limitations regarding loading and installation, instructions for continued airworthiness and instructions for use shall be established.

f) Ventilation inlets, exhausts and decompression protection panels shall not be obstructed, considering the shifting of cargo items under the applicable ground and flight loads.

6) Electrical systems

a) Electrical systems and equipment installed in cabin areas in which cargo is transported shall be deactivated, removed, protected, relocated, or manipulated in a way that they do not cause an additional fire risk.
b) Equipment powered by batteries and installed in cabin areas where cargo is transported shall be protected in such a way that they do not cause an additional fire risk.

7) Oxygen systems

a) Oxygen systems installed in the cabin areas in which cargo is transported shall be deactivated, removed, protected, relocated or manipulated in such a way that they do not cause an additional fire risk.
b) Readily accessible portable oxygen shall be provided to cabin occupants when accessing the cargo area, for example walking around the cabin for fire detection. The equipment shall meet CS 25.1439(b)(1)(2)(4) for smoke protection, and CS 25.1443(e) for hypoxia protection in case of decompression.
c) Occupants not in charge of performing the applicable fire protection procedures shall:
   i) in case a smoke barrier is installed:
      (1) use, in case of decompression, the aircraft built-in supplemental oxygen system if still operative, or
      (2) be provided with readily accessible portable oxygen meeting CS 25.1443(c) for hypoxia protection in case of decompression;
   ii) in case no smoke barrier is installed:
      (1) use, in case of decompression, the aircraft built-in supplemental oxygen system if still operative, and
      (2) be provided with readily accessible portable oxygen equipment meeting CS 25.1439(b)(1)(2)(4) for smoke protection. This equipment shall also meet CS 25.1443(c) for hypoxia protection in case of decompression, if the aircraft built-in supplemental Oxygen system is not operative.

Interpretative Material

The present Interpretative Material is published for awareness only and is not subject to public consultation.

1) Allowed cargo

Procedures should be developed to ensure that the pilot-in-command is provided with information needed to meet the limitations related to the type of cargo allowed in the cabin through the cargo manifest or other appropriate documentation.

2) Fire Protection

The adequacy of the approach used to address the mitigating factors related to fire protection should be justified by means of a fire risk assessment. The risk assessment should take into account:

- The control of the cargo before loading: the type and quantity of cargo loaded in the cabin should be identified in detail,
- The capability of the cargo load to self-ignite,
- The flammability of the cargo load,
- …

If cargo seat bags are used to transport cargo in the cabin, they should meet at least CS-25 Appendix F Part 1(a)(1)(iv) and (v). The appropriate flammability standard that the bags should meet needs to be derived from a fire risk assessment.
Smoke or fire detection could be achieved either by means of a detection system, or with cabin occupants adequately monitoring the cabin where cargo is transported. Any smoke or fire detection system that is installed to meet mitigating factor 2) b) is subject to CS 25.858.
If no smoke or fire detection system is installed, cabin occupants should inspect the cargo periodically during the entire duration of the flight. The interval between consecutive inspections conducted on the same cargo area should not exceed 15 minutes. Cabin occupants may use technical carry-on devices that ease the detection of heat, fire or smoke.
During normal operation, cabin ventilation should be minimised to cope with the number of cabin occupants in order to minimise the oxygen supply to a potential fire.
If the ECS system is configured with gasper outlets they should be in closed or off position at all phases of flight.
Regarding cockpit and cabin ventilation, it should be justified that the procedure contained in the AFM:

(a) Does not slow down the fire extinguishing process
(b) Does not reactivate the fire after being extinguished during the smoke evacuation phase

It is recommended to contact the aircraft TC holder to confirm that existing AFM procedures in case of smoke, fire and fumes are also valid for a cargo fire located in cabin.

The number, the type and location of fire extinguishers required to be installed in the cabin should be determined considering CS 25.851(a),AMC 25.851(a), AMC 25.851(a)(1), AMC 25.851(a)(2) and AMC 25.851(c), which include a reference to FAA AC 20-42D. In particular, fire extinguishers:

- should be of an approved type,
- should contain an extinguishing agent that is appropriate for the kinds and classes of fires likely to occur, and
- should have a capacity that is adequate for any fire likely to occur in the compartment, considering the volume of the cargo, compartment and the ventilation rate.
- Should be adequately located to be in immediate reach for the cabin occupants in charge of the fire-fighting.

The fire-fighting equipment should be installed at appropriate locations within the cabin so that is readily accessible to the cabin occupants and should include as a minimum:

(c) A smoke hood (ETSO C116 or equivalent)
(d) Fire protecting gloves
(e) A crow bar or a crash axe
(f) A flashlight

The equipment listed above needs to be installed only if it's not already approved as part of the aircraft pre-mod configuration.

3) Cabin occupants

Cabin occupants should not share seat rows with installed cargo seat bags.
During taxi, take-off and landing, there should be separation between the areas reserved to cabin occupants and those loaded with cargo.
Whenever possible, cabin occupants should be seated near floor level emergency exit.
The term "near" should be understood as specified in FAA AC 25.785-1B.
Exit areas shall be free of any cargo. If cargo is secured on seats, it should not be installed in seat rows fore and aft or leading to required emergency exits.
The present deviation allows the presence in the cabin of cabin occupants involved in the applicable fire protection procedures. Other occupants may be authorised to be in the cabin based on considerations of specific operational needs, if they belong to one of the following categories:

a. Any person determined by the operator for the particular flight, to be necessary for:
   i. the safety of flight
   ii. the loading or unloading of cargo
b. A person travelling to or from an assignment by the operator involving a function related to the operation of the aircraft to or from the assignment.
c. Other categories of personnel authorized by the competent aviation authority of the country of registration of the aeroplane.

According to mitigating factor 3)a) cabin occupants must receive hands on training on the use of handheld fire extinguishers required by mitigating factor 2.c), even if they are selected among professional crew members. This is due to the fact that the size and weight of the required extinguishers significantly exceed the size and weight of the extinguishers that are typically installed in the cabin of large aeroplanes used for commercial air transport of passengers.

The use of crew rest compartments is allowed only if the available evacuation paths do not lead to cabin areas in which cargo is transported.

Aural and/or visual means readily detectable from any accessible location in the passenger cabin (e.g. the public address system) should be available to allow the flight crew to warn any cabin occupant about the need to don the oxygen equipment and /or to return to their seats.

4) Emergency escape routes

The mitigating factors related to emergency escape routes apply to both emergency landing and ditching.

The installation of cargo should not compromise compliance with the requirements of CS 25.812 and 25.815, considering the evacuation paths available to each cabin occupant. It should be evaluated if the floor proximity emergency escape path marking is required to guide occupants to an emergency exit. For example, cabin occupants may be located in an area which makes it necessary to move through the aisle(s) to reach any emergency exit, or the flight crew may need to move through the cabin to reach any emergency exit. The demonstration of compliance with CS 25.812 should be conducted simulating the presence and maximum envelope of the cargo. The time to charge the non-electrical floor path marking stripes should be defined for a cabin fitted with cargo.

5) Cargo loading, installation and retaining

Structural Integrity

Appropriate special factors (CS 25.619) such as fitting factors (CS 25.625) and wear & tear factors (CS 25.561) should be applied. Refer to CM-S-002 “Frequent Removal of Interior Structures” for more guidance on the application of the wear & tear factor.
Structural loading limits and allowables (of the seats, cargo seat bags, pallets, nets, straps, seat tracks/beams…) provided by the OEM should be adhered to, as well as any airframe limitations (weight and balance, floor loading capacity and running loads - per fuselage frame and in total). Minimum distance between adjacent load introduction points may be prescribed, e.g. for seat tracks/beams. For bulkheads that have a placard indicating maximum capacity, the cargo items stowed aft of these bulkheads should not exceed the maximum capacity indicated in the placard.
Items for which (E)TSOs exist, such as pallets and nets, should be (E)TSO approved or shown to meet the minimum performance standards of the applicable (E)TSOs.

The installation of pallets on seat tracks/beams requires further attention. Special attachment means are typically needed as the existing seat track/beam arrangement is usually not compatible with the dimensions of the pallets, and pallets require specific locks/latches and pick-up points for tie-down. In addition, a passenger compartment floor is typically more flexible than a cargo compartment floor, so a careful design of the pallet installation is to be considered. Large pallets attached on multiple seat track locations should not alter significantly the aircraft floor stiffness and should not introduce unintended alternate load paths in the floor structure.
Loads should be appropriately introduced (only adequate strong points should be used) and adequate strength should be provided in the direction of the acting loads.
For items made of fabrics (such as nets, straps and cargo seat bags) environmental degradation (CS 25.603) should be accounted for (e.g. through the application of a special factor or establishment of a life limit).
Any pre-tension loads in attachment means such as straps, nets, floor fittings, etc. should be accounted for.
Cargo placed under seats should not exceed 9 kg (20 lbs) and should be properly restrained, including in the aft direction.
Mitigating factor 5)d) foresees the possibility that cargo installations may be used as firm handhold. In order to be considered as a means for the occupants to steady themselves while using the aisles in moderately rough air, the cargo installations must be assessed and determined to have equivalent performance as design features that in a passenger cabin are considered compliant with CS 25.785(j).

Pressure Loads / Decompression

In relation to pressure loads / decompression, the following considerations apply:

a. All cargo packaging should be able to equalize or sustain the (delta) pressure occurring during flight.
b. Features that allow for reduction of decompression loads should be maintained, i.e. pallets or cargo should not obstruct the operation of decompression vents or air flow.
c. If a significant amount of cabin volume is taken by cargo and the remaining cabin air volume is correspondingly reduced, this will lead to an increase in decompression loads on the floor structure in upward direction in case of a blow-out occurring above the floor. Depending on the OEM analysis assumptions, this case may exceed the available floor strength and needs to be checked. If a significant amount of cabin volume is taken by cargo beyond what would be taken up by passengers and baggage, the remaining cabin air volume is correspondingly reduced which will lead to an increase in internal pressure rise in the event of a water landing and prevent proper operation of the evacuation doors. Depending on the OEM analysis assumptions, this case needs to be checked.

Weight & Balance / Maintenance Program / Instructions for Continued Airworthiness

Any instructions and limitations regarding the loading and installation of cargo in the passenger cabin as well as instructions for continued airworthiness should be provided. Some examples of this would include:

a. Cargo loading in a storage location that is not addressed in the airplane Weight & Balance Manual (WBM) would require a change to the WBM;
b. Instructions on how to correctly sequence the loading and unloading of cargo in order to maintain proper airplane center of gravity while on the ground;
c. Instructions on how to load cargo (i.e. distribute cargo items, with consideration of the vertical and horizontal centre of gravity locations) in seat bags or on pallets;
d. Instructions on how to properly restrain cargo items with the use of seat bags, straps, nets and pallets and identification of the appropriate tie-down points;
e. Instructions on how to maintain/store or repair items made out of fabrics (e.g. nets, straps and seat bags) that are subject to wear and tear as well as environmental degradation;
f. The transportation of cargo (especially if palletized) through passenger doors may pose an increased risk of additional damage being inflicted to the doors and the airframe door surround area. Additional inspections to detect such damages may be needed. Likewise, the cabin floor may be subject (unless suitably protected, e.g. with additional foil) to an increased risk of additional damage compared to normal operation (with passengers).
g. Applicants should verify if the assumptions that support the aircraft maintenance program (including the Airworthiness Limitations) remain valid due to the change in operations (e.g. change from passenger to cargo operation may invalidate the TC Holder's assumption on average payload factors, mission/flight durations used to establish the fatigue spectrum), or changes in aircraft weight and balance.
h. Transportation of certain types of cargo (e.g. cargo that may release fluids) may increase the risk of contamination and consequent environmental damage to the aircraft structure and systems. This may pose a hazard that could compromise continued safe flight and landing of the aircraft and should therefore be addressed through dedicated inspections and maintenance tasks.

The effectiveness of the cargo loading instructions should be evaluated in a demonstration performed on an aeroplane or in a mock-up representative of the passenger cabin. As minimum, a demonstration needs to be conducted every time new loading instructions (i.e. not previously reviewed and accepted by EASA) are proposed.

The scope of the demonstration should also include the evaluation of the following items:

- Access to cargo areas and other stowage facilities (overhead bins, stowage compartments) for fire-fighting.
- Dimensions of longitudinal aisles and transversal corridors.
- Trip hazard generated by the cargo installation.
- Firm handhold availability.
- Capability to retrieve the emergency equipment required for fire-fighting.

6) Electrical Systems

All systems and equipment (e.g. those powered by batteries) that could be involved in a cargo fire should be identified, and adequately deactivated, removed, relocated or protected or relocated. It should also be prevented that a cargo fire may originate from the failure of a system or equipment that is part of the aircraft design. The evaluation should address also batteries that:

a. are part of the design of fixed ELTs, airbag systems and escape slides,
b. may be located in inaccessible areas adjacent to the cabin.

The deactivation, removal, relocation or protection of electrical (and oxygen) systems is required in all cases in which a cargo fire could involve or start from one of those systems. The determination is based on proximity, as well as on the presence of protective barriers, between the transported cargo and the systems. The requirement applies to systems that are not essential for the operation of the aeroplane in the configuration which allows transportation of cargo in the cabin. For example, electrically powered emergency exit marking must not be relocated if considered necessary for the safe evacuation of the cabin occupants. Relocation of electrical /oxygen systems in emergency exit areas delimited by monuments such as galleys, lavatories, bulkheads, stowage compartments, is considered as an acceptable solution provided that the new installation meets all applicable installation requirements (e.g. special conditions of lithium batteries).

If an equipment that contains a battery (e.g. ELTs, flashlight, etc.) needs to be relocated, the impact on safety and training of cabin occupants should be considered.

Wires shall be removed, or kept installed unpowered, capped and stowed, being not accessible. Potential damage that could be created by the loading/unloading of cargo should be avoided.

If portable wireless equipment is used as a means to detect a cargo fire, then EMI and/or T-PED tolerance should be evaluated in all phases of flight in which their use is foreseen.

7) Oxygen Systems

The portable oxygen equipment required by mitigating factors 7) b), c)i)(2), and c)ii)(2), provided for hypoxia protection, should be immediately available:

- the mask is always connected to the bottle;
- oxygen can be delivered with no action being required except turning the system on and donning the mask;
- easy and unobstructed access is ensured by design.

For example, a smoke hood would not meet the above.
The portable oxygen equipment requested by mitigating factor 7) b) could be for example:

- A full-face mask assembly meeting at least ETSO C89a, and C78a; or
- a mask covering the nose and mouth assembly, meeting ETSO C89a and C78a, and some goggles protecting adequately the eyes (in the context of this deviation, no positive pressure to the goggle is requested); or
- any other equivalent equipment.

Hypoxia protection should be demonstrated up to the maximum aircraft altitude, or at least up to 40kft.

The performance standard met by the oxygen bottle should be in line with CM-ECS-001 (Minimum qualification standards for oxygen cylinders used on board aircraft).

The portable oxygen equipment required by mitigating factor 7)b) should supply oxygen for a duration sufficient to permit the occupant either to return to her/his seat and switch to his supplemental oxygen system if needed, or to reach her/his fire-fighting equipment.
If the portable oxygen equipment is the primary means to protect from hypoxia the occupants when seated, it should be ensured that the oxygen supply has time duration compatible with the routes to be flown.

The portable oxygen equipment required by mitigating factor 7)c)ii)2) should provide smoke protection during at least 15 minutes.

If a TSO C89a mask assembly is used to provide smoke protection, the mode selector should be set on 100% oxygen, to protect from smoke entering the mask.

The portable oxygen equipment required by mitigating factor 7)c)ii)(2) for smoke protection could be for example a traditional PBE (smoke hood) if the aircraft built-in supplemental oxygen system is still operative.

Portable oxygen equipment should be removed where cargo is installed.

For centralized passenger gaseous oxygen system, the applicant should get confirmation from the aircraft manufacturer that no oxygen is present in the passenger oxygen lines under normal operation. If confirmed, the opening of the PSU oxygen door should be forbidden by using for example the test knob button. In case the aircraft manufacturer cannot confirm that no oxygen is present in the passenger oxygen lines under normal operation, or the fire-fighting procedure includes cabin depressurisation, the oxygen source should be deactivated.

For decentralized oxygen systems, gaseous or chemical, the applicant should either remove the passenger oxygen system, or assess the maximum temperature to which the PSUs could be subject in case of fire developing in the cabin. This assessment should conservatively consider the maximum time to detect the fire associated with the longest time to extinguish the fire, and the shortest distance between the cargo and ceiling. If this temperature is below the one for which the system is qualified, the opening of the PSU oxygen door should be forbidden by using for example the test knob button. If this temperature is above the one for which the system is qualified, the system should be removed or adequately protected from excessive temperatures. In no case, the protection means should adversely impact the capability of the cabin occupants or detection equipment/system, to detect the fire in due time. The protection means should also not obscure any portion of the required emergency exit marking and floor proximity emergency escape marking.