Special Condition on Air Medical Services

Applicable to Large Aeroplane category

Issue 4

Introductory note:

The following Special Condition has been classified as an important Special Condition and as such shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of 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."

This proposed Special Condition was already consulted in August 2011 for Medical Evacuation configuration only. Consultation at Issue 4 adds elements for Ambulance Conversions and temporary Stretcher installations.

Statement of Issue

Large Aeroplanes are frequently used in a Medical Evacuation or Ambulance conversion configuration.
The primary purpose of the Medical Evacuation or Ambulance flights is the transport of patients whereas the primary purpose of flights where Airlines supplement their cabin with temporary stretcher installations is transporting mainly passengers.

However, all those configurations share several common design peculiarities not contained in JAR / CS-25 requirements. This Special Condition that was originally intended to address Medical Evacuation aircraft installations, is additionally offered by EASA to be used as guidance for the other types of installations such as Ambulance conversion or Temporary Stretcher installation configurations. For reasons of simplicity, the text will remain to address Medical Evacuation only, with limited[1] additional clarifications.

Despite the above, it is generally considered that permanent installations such as Ambulance conversions will feature design solutions allowing full compliance with the products certification basis.

Whether an installation is “permanent” will be assessed by EASA on a case by case basis depending on the particular situation. As general guidance, applicants can assume that spending the majority of operating time in a Medical Evacuation / Ambulance configuration would be considered “permanent”.

[1] Please contact EASA as / if required for more guidance on particular subjects

Some installations might have a considerable impact on ventilation (25.831) or rapid decompression (25.365). For the specific case of a Patient Transport Compartment, applicants are encouraged to contact EASA for additional information.

The conversion of the cabin of a large aeroplane from a standard airline layout into a configuration to be used in case of Medical Evacuation (Medevac) foresees the installation of certain number of stretchers to carry patients that could be incapacitated and/or non-ambulant. In some cases, a significant number of incapacitated patients could be carried on board.

The stretchers may directly be attached to the aeroplane seat tracks or be restrained to a support unit that is attached to the aeroplane structure. The stretchers and their support units are compliant with §25.561 but do not comply with §25.562. This should be considered during the selection of the installation position(s) to limit the risk to other passengers. Fitting stretchers close to bulky monuments will mitigate the need to consider §25.562. Additional seats for medical attendants are however expected be qualified like passenger seats unless their use for Taxi, Take-off and Landing is prohibited. In case the seat installations feature additional adapters, early coordination with EASA is recommended.

According to Appendix J of JAR/FAR/CS 25, the evacuation demonstration required to comply with §25.803, does not address evacuation of incapacitated patients transported on a stretcher. For all large aeroplanes, compliance with §25.803 is demonstrated by an evacuation demonstration or by analysis, based on evacuation demonstrations, in which stretcher installations have not been assessed. Therefore EASA expects the applicant to provide a concept of evacuation. This concept should include the number of able bodied persons involved in evacuation.

Based on past experience with the installations of medical evacuation configurations, EASA has identified the following areas that may not be in full compliance:
§25.785(j), i.e. do not provide to passengers/crew members a means to steady themselves in case of turbulence (firm handhold),
§25.785(h)(2), i.e. the existing cabin crew seats in the changed environment may be installed so that cabin crew may have no direct view of all cabin areas during TT&L.

§25.1447(c)(1) e.g. if stretchers are installed on top of another. In case of cabin decompression, oxygen masks may not be automatically presented to the patients on the stretchers and life preservers might not be within easy reach of stretcher occupants.

Installation of medical oxygen system provisions (e.g. pressure regulators) and or Lithium Batteries as part of the approved configuration require particular safety considerations, e.g. Fire Protection per §25.869.
Refer to the dedicated section supporting the Interpretative Material and Means of Compliance regarding Oxygen Fire Hazard in Gaseous Oxygen Systems.

Applicants are generally encouraged to clearly segregate between installation provisions and parts of the approved configuration. It is understood that equipment may be brought on board together with the patient(s) and considered as loose items.

Finally, stretchers sometimes incorporate mattresses, which may not be compliant with the overall §25.853 flammability requirement upgrade introduced by the cushion flammability test (oil burner) per CS 25 Appendix F Part II.[1]

As JAR/FAR/CS 25 does not contain requirements that specifically address medical evacuation configurations, Special Conditions are needed to establish a level of safety compatible with that intended by the applicable airworthiness code.

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EASA considers that it is reasonable to assume that such patients will have reduced mobility and/or are in a reduced state of consciousness. This will impact on their ability to evacuate the aircraft unaided. Although compliance with §25.803 in the normal case assumes all passengers are fully able to themselves evacuate the cabin such an assumption has questionable validity in the case of the subject design.

Designs incorporating temporarily a low number (typically no more than two) of stretchers into airliner cabins primarily used to transport passengers have been approved in the past on the assumption that able bodies persons will be requested to assist in the evacuation of the stretcher occupants and that in doing so the risk that they will endanger either themselves or other occupants is limited. The large number of stretchers in some of the medical evacuation layouts and the correspondingly relatively low number of seated occupants no longer supports this assumption. It can only be concluded that, in certain cases, evacuation of stretcher borne occupants will be significantly slower than that of other cabin occupants.

The fact that some stretcher occupants will not have

- automatic access to supplemental oxygen in the event of a cabin depressurisation,
- and/or will not have a life preserver within easy reach,
- and/or movement around the cabin will not be aided by the normally expected provision of firm handholds in all areas
- and/or the reduced cabin attendant “direct view” (ref. §25.785(h)(2))

are four additional examples where safety is compromised in comparison to the conventional passenger operations envisaged by JAR/FAR/CS25.

However, EASA appreciates that aeroplane cabins are configured for the medical evacuation of a considerable number of critically ill patients who depend on rapid repatriation. The number of flights made with such cabin configurations is assumed to be relatively limited.

After consideration of all the above, EASA agrees that practicable design solutions which would remove the above safety concerns are limited. Requiring literal compliance

[1] Refer to **Note** at the end of the Special Condition

may lead to reducing the maximum number of stretchers allowed on the aircraft. This reduction would presumably result in more flights with an increase of the probability of an emergency evacuation of the aeroplane.

The provision of automatically presented oxygen masks for stretcher occupants whilst not impossible would be difficult to achieve when more than one stretcher is installed on the same support module (i.e. the lower stretcher occupant cannot make use of the PSU located masks). Improved firm handhold provisions and cabin attendant direct view of the cabin during taxi, take-off and landing would similarly be possible but not easy, and bearing in mind the characteristics of the intended operations (i.e. supervision by medical personnel familiar with the cabin interior) this would likely provide small additional safety.

Having considered the benefit of evacuating injured or critically sick people from areas where, for many different reasons, their health and/or safety is at high risk, EASA is of the opinion that non-compliance with §25.803, §25.785(j), §25.785(h)(2), §25.1411(f), §25.1415(e) and §25.1447(c)(1), can be sufficiently compensated by showing compliance with the following Special Conditions :

a) In regards to seated occupants, each crew and passenger area must have emergency means to allow rapid evacuation in crash landings, with the landing gear extended as well as with the landing gear retracted, considering the possibility of the aeroplane being on fire. In regards to stretcher occupants, all practicable design precautions and operational procedures must be developed to facilitate evacuation without compromising the egress of cabin attendants and other passengers. Precautions may include features such as location relative to normal passenger seating and emergency exits, easy release of stretchers from their attachments to the a/c to enable patients to be stretcher borne to emergency exits, easily accessed patient restraint buckles to alternatively allow removal and direct carrying of patients, associated training/briefing procedures for attendants, etc. Proposed design precautions and procedures will be evaluated by the Agency for acceptability. An entry shall be made in an AFM supplement to define the procedure to be followed for the evacuation of the occupants of the stretchers.

b) In areas where closely spaced firm handholds cannot be easily provided as per §25.785(j), (e.g. along aisle portions where stretchers are installed) all practicable efforts must be taken to provide useable handholds to enable passengers to reach their designated seats. The proposed design will be evaluated by the Agency for acceptability. In all other areas where the cabin layout is similar to a standard airline layout (i.e. with seats installed on both sides of the aisle) firm handholds as normally expected for such seating areas must be provided.

c) To the extent practicable, without compromising proximity to a required floor level emergency exit, flight attendant seats must be located to face the cabin area for which the flight attendant is responsible.

d) The stowage provisions for life preservers described in §25.1415 must accommodate one life preserver for each occupant for which certification for ditching is requested. In the case of seated occupants, each life preserver must be within easy reach, whilst seated. For aeroplanes not certificated for ditching under §25.801 and not having approved life preservers for seated occupants, there must be an approved flotation means for each seated occupant. These means must be readily removable from the aeroplane. In the case of each stretcher occupants, regardless

of the fact that the aeroplane is certificated for ditching under §25.801, there must be a life preserver in a stowage location that enables an able bodied assistant to quickly locate it and hand it to the stretcher occupant. Operational procedures must be developed (e.g. pre-flight briefing to appropriate persons) to facilitate that such retrieval and distribution will occur.

e) If certification for operation above 7620 m (25 000 ft) is requested, there must be oxygen dispensing equipment meeting the following requirements (See AMC §25.1447(c)):

(1) There must be an oxygen dispensing unit compliant with §25.1443 (c) connected to oxygen supply terminals immediately available to each cabin occupant.

(2) If certification for operation above 9144 m (30 000 ft) is requested, the dispensing units providing the required oxygen flow must be automatically presented to the occupants of flight attendant and passenger seats and to occupants of the stretchers before the cabin pressure altitude exceeds 4572 m (15 000 ft) and the crew must be provided with a manual means to make the dispensing units immediately available in the event of failure of the automatic system. In case it is not practicable to have oxygen dispensing units automatically presented to all occupants of the stretchers, all efforts should be made to provide the safest alternative possible. In any case, dispensing units should be within easy reach of the occupants of the stretchers and should be such that they can be accessed and operated without assistance. Procedures must be developed to ensure assistance to the occupants of stretchers from cabin attendants as soon as it is reasonably practicable following a depressurisation of the cabin. The design of the dispensing units, any required pre-flight briefing, and/or cabin attendant training and assistance procedures must be substantiated and relevant information and limitations must be included in an AFM supplement.

(3) The total number of dispensing units and outlets must exceed the total number of seats and stretchers by at least 10%. The extra units must be as uniformly distributed throughout the cabin as practicable. (See AMC §25.1447(c)(1).)

f) As well as the entries discussed above, a supplement to the Aeroplane Flight Manual shall be developed containing a limitation stating that fare-paying passengers cannot be transported on the aeroplane.

For what concerns §25.562, the intention when the requirement was introduced was to provide an overall increased level of safety to passengers in a survivable accident. However stretchers for medical use were not considered when the requirements of §25.562 were defined. As a matter of fact, appropriate injury criteria for a non-ambulant person occupying a stretcher do not exist for the time being. For the above-mentioned reasons, JAA issued TGM/25/12 in order to exempt medical stretcher from §25.562. EASA considers the content of TGM/25/12 relevant to medical evacuation configurations. Therefore EASA maintains the interpretation that JAR/FAR/CS §25.562 is not applicable to stretchers.

This is further supported as per CS-25 Amendment 13. At time of this CS-25 amendment, EASA added the following text to CS 25.785(b):
[...] *However, berths intended only for the carriage of medical patients (e.g. stretchers) need not comply with the requirements of CS 25.562.*

It is understood that the stretchers must provide an adequate restraining means for the occupant, taking into consideration the applicable ground and flight loads in addition to the requirements of CS §25.561. Moreover, the stretcher design must take into account the protection of other passengers, e.g. it must foresee appropriate padding of exposed protuberances, etc.

EASA, considering the cushion function of the stretcher mattress, requires the stretcher mattress to comply also with CS §25.853(c), and therefore successfully pass flammability testing of Part II of Appendix F on JAR 25.[2]

It should be noted also that other dimensional requirements related to passageways, width of aisle, and exit size remain applicable without additional provisions for passage of stretcher or highly incapacitated occupant.

The design of the stretcher must comply with the following paragraphs of JAR/CS 25:

- JAR/CS 25.561 Emergency Landing Conditions
- JAR/CS 25.625 Fitting factors
- JAR/CS 25.785 Seats, berths, safety belts and harnesses
- JAR/CS 25.787 Stowage compartments
- JAR/CS 25.789 Retention of items of mass in passenger and crew compartments and galleys
- JAR/CS 25.791 Passenger information signs
- JAR/CS 25.807 Passenger Emergency Exits
- JAR/CS 25.812 Emergency Lighting
- JAR/CS 25.813 Emergency exit access
- JAR/CS 25.815 Width of aisle
- JAR/CS 25.853 Compartment interiors
- JAR/CS 25.1501 General
- JAR/CS 25.1529 Instructions for Continued Airworthiness
- JAR/CS 25.1541 Markings and placards

In addition:

1 All equipment intended to be certified as part of the installation (medical equipment, oxygen bottles, etc.) must be approved against the appropriate qualification standard.

2 The stretcher shall provide an adequate restraining means for the person, using such devices as a shoulder harness, the appropriate number of body-belts and/or end board, taking into consideration the aircraft flight loads and the loads under requirements of JAR 25.561 and keeping all loads on the occupant's body to a

[2] Refer to **Note** at the end of the Special Condition

minimum. Besides the protection of the occupant, all constructive features have to take into account the protection of other passengers, e.g. appropriate padding of exposed protuberances, etc.

3 EASA interpretation of 25.853 requirements for the stretcher mattress has been reviewed to be consistent with past decision related to flammability of individual cabin items. Considering its cushion function, the stretcher mattress must also comply with 25.853(b), and therefore successfully pass flammability testing of Part II of Appendix F on JAR 25.

Note :
Regarding the compliance with §25.853(c) in previous consultations EASA reiterated the policy to require CS §25.853(c), and therefore successfully pass flammability testing of Part II of Appendix F on JAR/FAR/CS 25 for stretcher mattresses. Since EASA was made aware that existing designs for stretcher mattresses vary widely in terms of compliance with this requirement, EASA agreed to an implementation timeframe of 18 months counted from the end of the Special Condition Issue 3 final publication date which was 8.August 2011.

Interpretative Material and Proposed Means of Compliance on Oxygen Fire Hazard in Gaseous Oxygen Systems

The systems considered could be centralised, decentralised or portable. Those systems could be installed in an occupied compartment or in a remote inaccessible area. For those systems, CS 25.869(c) and the associated AMC shall be considered in association with the following:

1. Installation

Oxygen systems must be installed so that escaping oxygen cannot cause a fire in normal operation or as a result of failure or malfunction of any surrounding systems.

As already mentioned in 25.869(c), oxygen equipment and lines must not be located in any designated fire zone and be protected from heat that may be generated in, or escape from, any designated fire zone. In addition:

1.1. External Ignition Sources

An analysis must be performed to identify all possible “external” ignition mechanism. It must be demonstrated that if an ignition source exist in the vicinity of the oxygen system installation, in normal operation or as a result of failure or malfunction of any systems, the risk is minimised and all design precautions have been taken.

1.2. Contamination

The compartments in which oxygen system components are installed shall provide adequate protection against potential contamination by liquids, lubricant (grease…), dust …etc.

1.3. Ventilation

The compartments in which oxygen system components are installed shall be ventilated in such a way that, should a leak occur or should oxygen be discharged directly into the compartment (not overboard) from protective device and pressure limiting device if so designed, the likelihood of ignition of the enriched oxygen environment would be minimized. The applicant shall substantiate a rate of airflow changes per minute in the compartment to insure an adequate ventilation. Analytically determined ventilation rates shall be validated by flight test results or equivalent.

CS 25.1453 (f) does provide additional requirement related to ventilation.

This paragraph does not apply to portable oxygen systems, such as system used to provide first aid oxygen to passengers or supplemental oxygen for cabin crew mobility, stowed usually in overhead bins of “dog houses”, provided it is confirmed that the shutoff means mounted on the oxygen container is always closed when the system is stowed and not used.

1.4. Routing

The installation of the system should be such that components and pipe lines are:

- adequately separated from electrical and fluid systems,

- routed so as to minimise joints and sharp bends,
- clear of moving controls and other mechanisms

CS 25.1453(b) does provide additional requirement related to Oxygen pressure sources and tubing installation that must be complied with.

2. Oxygen Hazards Analysis (OHA)

The applicant must demonstrate that the oxygen systems and its components are designed so that the occurrence of an uncontrolled oxygen fire at aircraft level is extremely improbable and does not result from a single failure.

To assess the consequences of system/component failures, an Oxygen Hazards Analysis (OHA) must be provided. This demonstration may be done in a qualitative or quantitative analysis. The conclusion of the OHA will be included in the Oxygen Systems System Safety Analysis (SSA).

The applicant shall provide an OHA with a detailed assessment of the potential ignition and combustion mechanism. The OHA shall consider the following:

2.1. Equipment failures

Detailed FMEA at component level shall be used as input for the OHA. Quality / production issues or human errors during assembly are not included in this OHA.

All single failures, and failure combinations not shown to be extremely improbable, shall be taken into account.

2.2. Operating Conditions

The worst case operating conditions shall be taken into consideration including failures determined from 2.1 not shown to be extremely improbable.

2.3. Component and materials

The analysis shall contain all component designation and the materials of construction including compounds and non-metallic material.

Most materials ignite at lower temperatures in an oxygen-enriched environment than in air, auto-ignition temperature shall be established assuming a 100% enriched oxygen environment. The materials used shall be evaluated to determine if they are flammable under the conditions specified in § 2.2.

2.4. Ignition mechanisms

The assessment shall address the identification of the possible internal ignition mechanisms. As a minimum, the following mechanisms shall be assessed:

- adiabatic compression (pneumatic impact), (See Note 1)
- frictional heating,
- mechanical impact,

- particle impact,
- mechanical stress or vibration,
- static discharge,
- electric arc,
- chemical reaction,
- resonance

Under the conditions specified in § 2.2, each ignition mechanism must be evaluated to determine if it exists in the component and the system considered.

Note 1: In calculating the temperature elevation due to oxygen compression, the transient peak pressures measured under §3.2 should be used, unless other values are duly demonstrated.

2.5. Kindling Chain

The ability of a fire to propagate and burn through a component, i.e., the kindling chain, shall be evaluated. The ignition and burning of a single component may produce sufficient heat, to ignite the surrounding materials leading to a burn-through of the component.

Therefore, if any of the ignition mechanisms assessed under 2.4 exists, an analysis should assess the kindling chain based on the ability of the materials of construction to contain a fire.

3. Design Considerations

3.1. High Pressure shutoff

As required by 25.1453(c), parts of the system subjected to high oxygen pressure must be kept to a minimum and must be remote from occupied compartments to the extent practicable.

High pressure shutoff valves should be designed to provide effective slow opening and closing, so as to avoid the possible risk of fire or explosion.

3.2. Pressure limiting devices (e.g. relief valves)

As required by 25.1453(e), the pressure limiting devices (e.g. relief valves), provided to protect parts of the system from excessive pressure, must be designed to prevent the pressures from exceeding the applicable maximum working pressure multiplied by 1•33 in the event of malfunction of the normal pressure controlling means (e.g. pressure reducing valve).

In addition, the performance of pressure limiting devices must tested on a complete system under the conditions specified in § 2.2 but limited to failures which are not

shown to be extremely improbable. For testing purposes, oxygen can be replaced by an inert gas (e.g. nitrogen), however relationship between pressure and temperature would not be simulated by the inert gas and must be separately analysed. Transient Pressure Level (TPL) shall be measured at various locations and each component of the oxygen system exposed to the TPL shall be demonstrated to sustain the pressure level.

CS 25.1453(d) does provide additional requirements related to oxygen pressure source (e.g. tanks or cylinders) protection against overpressure.

3.3. Isolation

When the system includes multiple bottles as oxygen sources, each source shall be protected from reverse flow or reverse pressure should a failure occur on one source. Such isolation can be achieved by installing check valves or equivalent means in an appropriate manner.

3.4. Non-metallic Hoses

Except for flexible lines from oxygen outlets to the dispensing units, or where shown to be otherwise suitable to the installation, non-metallic hoses should not be used for any oxygen line that is normally pressurised during flight.

If non-metallic hoses with anti-collapse springs are to be used due to installation constraints, metallic braid correctly grounded should be considered to prevent inadvertent electrical current to reach the spring which could cause the hose to melt or burn leading to an oxygen fed-fire.

In addition, non-metallic oxygen distribution lines must not be routed where they may be subjected to elevated temperatures, electrical arcing, and released flammable fluids that might result from normal operation or as a result of failure or malfunction of any systems.

3.5. Grounding

All the oxygen lines and hoses should be adequately grounded.

3.6. Joints

Joints should where possible, be assembled dry, but where compounds are used for sealing they should be approved for that purpose.

3.7. Charging Systems

Recharging systems, if installed, should be provided with means to prevent excessive rates of charging which could result in dangerously high temperatures within the system. The charging system should also provide protection from contamination.

Where in-situ charging facilities are provided, the compartments in which they are located should be accessible from outside the aircraft and as remote as possible from other service points and equipment. Placards should be provided, located adjacent to the servicing point, with adequate instructions covering the precautions to be observed when the system is being charged.