

This annex to the EASA TCDS A.064 was created to publish selected Special Conditions, Equivalent Safety Findings that are part of the applicable certification basis and particular Interpretative Material:

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SPECIAL CONDITION	D-0306-000: Application of Heat Release and Smoke Density Requirements to Seat Materials
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	JAR 25.853(a-1) at Change 13; JAR 25.853(c) at Change 14; CS 25 25.853(d); Appendix F Part IV and V
ADVISORY MATERIAL:	AMC 25.853

1. Except as provided in paragraph 3 of these special conditions, compliance with CS25, Appendix F, parts IV and V, heat release and smoke emission, is required for seats that incorporate non- traditional, large, non-metallic panels that may either be a single component or multiple components in a concentrated area in their design.
2. The applicant may designate up to and including 0.139 m² (1.5 square feet) of non-traditional, non-metallic panel material per seat place that does not have to comply with special condition Number 1, above. A triple seat assembly may have a total of 0.418 m² (4.5 square feet) excluded on any portion of the assembly (e.g., outboard seat place 0.093 m² (1 square foot), middle 0.093 m² (1 square foot), and inboard 0.231 m² (2.5 square feet)).
3. Seats do not have to meet the test requirements of CS25, Appendix F, parts IV and V, when installed in compartments that are not otherwise required to meet these requirements. Examples include:
 - a. Airplanes with passenger capacities of 19 or less and
 - b. Airplanes exempted from smoke and heat release requirements.
4. Only airplanes associated with new seat certification programs applied for after the effective date of these special conditions will be affected by the requirements in these special conditions. This Special Condition is not applicable to:
 - a. the existing airplane fleet and follow-on deliveries of airplanes with previously certified interiors
 - b. For minor layout changes and major layout changes of already certified versions that:
 - does not affect seat design;
 - does not introduce changes to seat design that affect panels that could be defined as "non- traditional, large, non-metallic panels".

SPECIAL CONDITION	D-0322-001: Installation of suite type seating
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	JAR 25.785 (h)(2), JAR 25.813 (e)
ADVISORY MATERIAL:	FAA AC 25-17

1. Only single occupancy of the Mini-suite is allowed during taxi, take-off and landing
2. Mini-suite entrance can only provide access to the specific mini-suite
3. Mini-suites cannot provide an egress path for evacuation other than the path out of the mini-suite for its single occupant
4. Installation of the mini-suites must not introduce any additional obstructions or diversions to evacuating passengers, even from other parts of the cabin
5. The design of the doors and surrounding "furniture" above the cabin floor in the aisles must be such that each passenger's actions and demeanour can be readily observed by cabin crew members with stature as low as the 5th percentile female, when walking along the aisle.
6. The mini-suite doors must be open during taxi, take-off and landing
7. The hold open retention mechanism for mini-suite doors must hold the doors open under JAR 25.561(b) emergency landing conditions. If the mini-suite doors are part of the seat the door retention feature must not fail under conditions of JAR 25.562(b)(2).
8. There must be a secondary, backup hold open retention mechanism for the mini-suite doors that can be used to "lock" the doors in the open position if there is an electrical or mechanical failure of the primary retention mechanism. The secondary retention mechanism must hold the doors open under JAR 25.561(b) emergency landing conditions, or if the mini-suite doors are part of the seat the door retention feature must not fail under conditions of JAR 25.562(b)(2).
9. There must be a means by which cabin crew can readily check, that all mini-suite doors are in the fully open and in the latched condition.
10. There must be means by which cabin crew can prevent the seated mini-suite occupant from operating the doors. This means is envisaged to be used in particular to secure the TTOL phases of the flight.
11. Appropriate placards, or other equivalent means must be provided to ensure the mini-suite occupants know that the doors must be in the open position for taxi, take-off and landing.
12. Training and operating instruction materials regarding the proper configuration of the mini-suite doors for taxi, take-off and landing must be provided to the operator for incorporation into their cabin crew training programs and associated operational manuals.
13. The mini-suite must have an Emergency Passage Feature (EPF) to allow for evacuation of the mini-suite occupant in the event the door closes and becomes jammed during an emergency landing. This EPF may be through frangibility and /or a removable of emergency panel, or equivalent (such as dual sliding doors). The EPF must be easily broken /removed by the occupant of the mini-suite when the door becomes jammed. Trapping of any occupant is not acceptable and in no case shall the occupant using the EPF have to rely on another occupant to assist in passage. In addition a second path out

of the mini suite must be provided. All ways to exit the mini suite in case of emergency must be demonstrated to work for a 5th percentile female and a 95th percentile male.

14. The height of the mini suite walls and doors must be such that a 95th percentile male can fit between them and the airplanes interior furnishing.
15. No mechanism to latch the doors together in the closed position is allowed.
16. The mini-suite doors must be openable from the inside or outside with 25 pounds force or less regardless of power failure conditions.
17. If the mini-suite doors are electrically powered the doors must remained "locked" in the open position after power loss to the mini-suite.
18. Mini-suites installation must maintain the main, cross aisles and passage ways.
19. Mini-suite doors must not impede main aisle or cross aisle egress paths in the open ,closed or translating position.
20. The mini-suite doors must be open able even with a crowded aisle.
21. The number of individual passenger seat modules shall not exceed 25% of the max. seating capacity of the specific cabin zone according to the A319/A320/A321 Type Certification Layout.
22. For compliance to JAR 25.785(h)(2) the length of the main aisle adjacent to the seat modules must be visible, at least such that the main aisle part remaining unobservable does not exceed 50% of the total main aisle width at the end of this cabin section (entrance area of last seat module), and
23. In case the main aisle width cannot be observed to at least 50% at the end of the cabin section (entrance area of last seat module), it is equivalent to have at least 80% of the seat module entrance areas in direct view from designated direct view seats, under the same conditions adopted for the showing of compliance to the requirements of CRI E-4007 (A319) and CRI E-5003 (A318). An entrance area is considered visible, if a person standing in the main aisle, directly at the seat module entrance is observable. In line with the current assist space dimension a body depth of 12 inches is therefore assumed.

SPECIAL CONDITION	E10: High Altitude Airport Operations (up to 14,100 ft)
APPLICABILITY:	A319 / A320 / A321
REQUIREMENTS:	JAR 25.841(a), (b)(6), JAR 25.1447(c)(1) at Change 11
ADVISORY MATERIAL:	N/A

Landing and take-off modes.

- 1- The normal or high altitude modes for take-off and landing must be clearly indicated to the flight crew.

Pressurisation system.

- 2- In high altitude mode and for operation over 25,000 feet, the excessive warning altitude setting must be such that corrective actions can be taken in time to ensure that cabin pressure altitude cannot exceed 15,000 feet "in the event of any reasonably probable failure" of the pressurisation system.
- 3- Under all other conditions, § 25.841(a) & (b)(6) requirements apply. The pressurisation system must perform identically to that found on the standard airplane. In particular, the flight crew retains the capability to control the pressurisation system manually in the event of a system failure.

Oxygen system.

- 4- In high altitude mode, in lieu of compliance with § 25.1447(c)(1) and considering the ACJ 25.1447(c)(1), passengers dispensing units must be automatically presented before the cabin pressure altitude exceeds 16,000 feet. At any time, the flight crew must retain the capability of deploying the masks, using the manual control in the cockpit.
- 5- Under all other conditions, the passenger oxygen system must perform identically to that found on the standard airplane. § 25.1447(c)(1) applies.

Procedures.

- 6- Appropriate procedures must be introduced in the Airplane Flight Manual.
- 7- The applicant must assess the consequences for the aeroplane and its occupants of the flight crew not applying the correct procedures (i.e. landing at high altitude airport in normal mode or at a normal altitude airport in high altitude modes).
- 8- Procedures must be such that the high altitude mode is set for the shortest time possible in order to have a minimum change in protections. Except when the aeroplane is landing at, or departing from, a high altitude airport, the cabin follows the normal profile.

EQUIVALENT SAFETY FINDING	E-18: Improved flammability standards for thermal / acoustic insulation materials - ESF to JAR 25.853(b) and 25.855(d)
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	JAR 25.853(b) at change 11 & 13; JAR 25.853(a) at change 14; JAR 25.855(d) at change 14; FAR 25.856(a) at amendment 111
ADVISORY MATERIAL:	N/A

Thermal / acoustic insulation materials accepted as compliant with FAR 25.856(a) will provide a level of safety at least as high as that provided by those accepted as compliant with JAR 25.853(b) at change 11 & 13, JAR 25.853(a) at change 14, and JAR 25.855(d) at change 14.

Since A318/A319/A320/A321 airplanes do not have amendment 111 in their certification basis, compliance with JAR 25.853 and JAR 25.855 is still required. However, once compliance with FAR 25.856(a) has been shown, it is not necessary to test in accordance with JAR 25.853(b) at change 11 and 13, JAR 25.853(a) at change 14, and JAR 25.855(d) at change 14, and these requirements can be substantiated based on equivalent safety.

SPECIAL CONDITION	E-2105: Type III Overwing Emergency Exit Access
APPLICABILITY:	A320
REQUIREMENTS:	JAR 25.813(c)(1), JAR 25.807(a)(3)
ADVISORY MATERIAL:	N/A

Statement of Issue I:

As a result of positioning the Type III sill height to meet the step down requirements of JAR 25.807(a)(3) and hence preclude the need for a supplementary step outside the aircraft, the passenger seat cushion immediately adjacent to the overwing exit encroaches into the outline of the exit in the fuselage.

JAR 25.813(c)(1) requires that the projected opening of the exit provided may not be obstructed and there must be no interference in opening the exit by seats, berths or other protrusions for the width of a passenger seat.

The actual opening in the fuselage is however larger than the minimum, i.e. 20" x 40" rather than 20" x 36".

The Airworthiness Authorities are prepared to accept compliance by Equivalent Safety based upon the following:

- Tests have shown that such an encroachment will not interfere with the effective opening of each overwing hatch.
- The actual opening in the side of the fuselage is larger than the minimum required.
- The seat cushion is readily compressible down to the level of the exit outline, assuming a force of 170 LB evenly distributed over 40 square inches (this criteria has been found to be an acceptable means of compliance on other aircraft types).

JAA Conclusion:

JAA accepts an Equivalent Safety finding to JAR 25.813(c) on the basis that:

- The A320 Type III exit is 4" oversize (20" x 40" for a minimum required of 20" x 36")
- The seat cushion does not encroach into the minimum required exit opening.
- The seat cushion is readily compressible.
- A minimum of 7" unobstructed access is provided to the Type III exit.
- Step down requirement of JAR 25.807 is met without providing any supplementary step outside.

In addition, it has been demonstrated by test that there is no interference in opening the exit.

Statement of Issue II:

The outboard seat adjacent to the emergency exit has been equipped with thinner seat cushion and the comfort is reduced. This could be improved by an increase of the outboard seat cushion height to 18.8" (instead of 16.8") in combination with a minimum 10" passageway leading to the exit.

Test has demonstrated that with a minimum access passageway to each Type III exit of 10", there is sufficient width of exit sill to allow compliance with JAR 25.807(a)(3), i.e. the 'step down' is from the sill rather than the compressed seat cushion.

JAA Conclusion:

An Equivalent Safety finding with JAR 25.813(c)(1) is granted on the basis that:

- There is no interference with exit operation (as demonstrated by test), provided the seat cushion height is limited to 18.8".
- Whilst the seat cushion does intrude into the 'exit opening provided', this is compensated by the provision of a larger than minimum Type III exit size, i.e. the seat cushion line is beneath the 20" x 36" minimum exit opening.

EQUIVALENT SAFETY FINDING	E-2107: Passenger Extension to 180
APPLICABILITY:	A320
REQUIREMENTS:	JAR 25.807
ADVISORY MATERIAL:	N/A

Statement of Issue:

An application was made on September 30, 1992 to JAA for certification of maximum number of passengers of 180.

Paragraph 25.807(c)(1) of JAR specifies for passenger seating configuration, the number and types of Emergency Exits for each side of the fuselage.

The maximum seating capacity allowable under JAR 25.807(c)(1) for A320 exit configuration is 179 (2 Type I and 2 Type III).

However, the exits size for front and rear doors on the A320 is such (32x73 inches) that they are oversized Type I and therefore can be considered as a non standard exit arrangement.

The same exit size is being used on a derivative of the A320, for which Latin Square Tests have been conducted in order to establish an appropriate rating for that kind of exits. These tests have shown that, when associated with the performance of the slide installed at these exits, a rating of 55 passengers is appropriate.

It should also be noted that the full scale emergency evacuation demonstration of the A320 with 179 passengers has demonstrated compliance with JAR 25.803(c) with sufficient margin to justify 180 passengers.

Under those conditions, a maximum capacity of 180 passengers is requested for the A320.

JAA Conclusion:

Based upon the demonstrated higher rating for the floor level exits and the adequate margins for 179 passengers shown in the 90 seconds demonstration, and used as a basis to show compliance to JAR 25.803(c), the JAA accept 180 passengers as the maximum capacity for the A320 on the basis of an Equivalent Safety Finding.

SPECIAL CONDITION	E-34: Seats with Inflatable Restraints
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	JAR 25.562(c)(5)
ADVISORY MATERIAL:	N/A

- 1) HIC Characteristic

The existing means of controlling Head Injury Criterion (HIC) result in an unquantified but nominally predictable progressive reduction of injury severity for impact conditions less than the maximum specified by the rule. Airbag technology however involves a step change in protection for impacts below and above that at which the airbag device deploys. This could result in the HIC being higher at an intermediate impact condition than that resulting from the maximum.

It is acceptable for the HIC to have such a non-linear or step change characteristic provided that the value does not exceed 1000 at any condition at which the inflatable lap belt does or does not deploy, up to the maximum severity pulse specified by the requirements. Tests must be performed to demonstrate this taking into account any necessary tolerances for deployment.
- 2) Intermediate Pulse Shape

The existing ideal triangular maximum severity pulse is defined in FAA AC 25.562.1. EASA considers that for the evaluation and testing of less severe pulses, a similar triangular pulse should be used with acceleration, rise time, and velocity change scaled accordingly.
- 3) Protection during Secondary Impacts

EASA acknowledges that the inflatable lap belt will not provide protection during secondary impacts after actuation. However, evidence must be provided that the post-deployment features of the installation shall not result in an unacceptable injury hazard. This must include consideration of the deflation characteristics in addition to physical effects. As a minimum, a qualitative assessment shall be provided.

Furthermore, the case where a small impact is followed by a large impact must be addressed. In such a case if the minimum deceleration severity at which the airbag is set to deploy is unnecessarily low, the bag's protection may be lost by the time the second larger impact occurs. It must be substantiated that the trigger point for airbag deployment has been chosen to maximize the probability of the protection being available when needed.
- 4) Protection of Occupants other than 50th Percentile

The existing policy is to consider other percentile occupants on a judgmental basis only i.e. not using direct testing of inquiry criteria but evidence from head paths etc. to determine likely areas of impact.

The same philosophy may be used for inflatable lap belts in that test results for other size occupants need not be submitted. However, sufficient evidence must be provided that other size occupants are protected.

A range of stature from a two-year-old child to a ninety-five percentile male must be considered.

In addition the following situations must be taken into account:

 - The seat occupant is holding an infant, including the case where a supplemental loop infant restraint is used:
 - The seat occupant is a child in a child restraint device.
 - The seat occupant is a pregnant woman
- 5) Occupants Adopting the Brace Position

There is no requirement for protection to be assessed or measured for set occupants in any other position or configuration than seated alone upright, as specified in FAA AC 25.562-1A (dated 19 January 1996). However, it must be shown that the inflatable lap

belt does not, in itself, form a hazard to any occupant in a brace position during deployment.

- 6) It must be shown that the gas generator does not release hazardous quantities of gas or particulate matter into the cabin.
- 7) It must be ensured by design that the inflatable lap belt cannot be used in the incorrect orientation (twisted) such that improper deployment would result.
- 8) The probability of inadvertent deployment must be shown to be acceptably low. The seated occupant must not be seriously injured as a result of the inflatable label deployment, including when loosely attached. Inadvertent deployment must not cause a hazard to the aircraft or cause injury to anyone who may be positioned close to the inflatable lap belt (e.g. seated in an adjacent seat or standing adjacent to the seat). Cases where the inadvertently deploying inflatable lap belt is buckled or unbuckled around a seated occupant and where it is buckled or unbuckled in an empty seat must be considered.
- 9) It must be demonstrated that the inflatable lap belt when deployed does not impair access to the buckle, and does not hinder evacuation, including consideration of adjacent seat places and the aisle.
- 10) There must be a means for a crewmember to verify the integrity of the inflatable lap belt activation system prior to each flight, or the integrity of the inflatable lap belt activation system must be demonstrated to reliably operate between inspection intervals.
- 11) It must be shown that the inflatable lap belt is not susceptible to inadvertent deployment as a result of wear and tear, or inertial loads resulting from in-flight or ground manoeuvres likely to be experienced in service.
- 12) The equipment must meet the requirements of JAR 25.1316 with associated guidance material IM S-1006 for indirect effects of lightning. Electro static discharge must also be considered.
- 13) The equipment must meet the requirements for HIRF (SC S-10.2 and IM S-10.2) with an additional minimum RF test for the threat from passenger electronic devices of 15 Watts radiated power.
- 14) The inflatable lap belt mechanisms and controls must be protected from external contamination associated with that which could occur on or around passenger seating.
- 15) The inflatable lap belt installation must be protected from the effects of fire such that no hazard to occupants will result.
- 16) The inflatable lap belt must provide adequate protection for each occupant regardless of the number of occupants of the seat assembly or adjacent seats considering that unoccupied seats may have active inflatable lap belts, which may be buckled or unbuckled.
- 17) Each inflatable lap belt must function properly following any separation in the fuselage.
- 18) It is accepted that a material suitable for the inflatable bag that will meet the normally accepted flammability standard for a textile, i.e. the 12 second vertical test of JAR25 Appendix F, Part 1, Paragraph (b)(4), is not currently available. In recognition of the overall safety benefit of inflatable lap belts, and in lieu of this standard, it is acceptable for the material of the inflatable bags to have an average burn rate of no greater than 2.5 inches/minute when tested using the horizontal flammability test of JAR25 Appendix F, part I, paragraph (b)(5).

INTERPRETATIVE MATERIAL	E-3002: Reclassification of doors 2 & 3 to type III
APPLICABILITY:	A321
REQUIREMENTS:	JAR 25.807 (a) JAR 25.813
ADVISORY MATERIAL:	N/A

Statement of Issue:

On the basic A321 aircraft, the doors 2 and 3 are classified as non-standard floor level exits (see CRI E3001), equipped with assist means.

As a customer option, the applicant wishes to reclassify these exits to the requirements of a Type III to allow a revised seating arrangement around these exits.

The maximum seating capacity would be adjusted accordingly.

Each of the exists will be provided with:

- an unobstructed 12 inch passageway from the aisle to the exit,
- an assist space of appropriate dimensions,
- a cabin attendants seat,
- exit operating placards installed on each exit and on the back of passenger seats in front of the passageway,
- fixed seat backs and restricted recline and break-over for all seats bounding the passageways to the exits,
- outboard seat armrest will not encroach into the exit clear opening.

The exit design and operating mechanism, and the slide configuration would remain unchanged from the basic floor level exit arrangement.

On this basis, the applicant wishes to rate these Type III exits at 35 passengers, i.e.

Maximum capacity for either doors 2 and 3 changed to Type III	= 200 pax.
Maximum capacity with both doors 2 and 3 classified as Type III	= 180 pax.

JAA Position:

In view of the close proximity of passengers to the exit operating system, the arrangement must be designed to minimise the likelihood of inadvertent operation of disarm / arm lever.

The provision of a cabin attendant seat and an associated assist space in a position next to and to the right of the aisle is considered satisfactory as meeting the intent of JAR 25.785 and 25.813.

Since the modified exit arrangement involves a floor level exit with assist means, a cabin attend will be required at these exists to manage the assist means.

IM-E4:

The projected opening of the minimum required Type III exit may not be obstructed and the 12 inch unobstructed passageway leading from the aisle to the exit must be totally within the contour of the minimum required Type III exit.

EQUIVALENT SAFETY FINDING	E-4001: Exit configuration
APPLICABILITY:	A319
REQUIREMENTS:	JAR 25.807 (c) Change 13, OP90-1 JAR 25.809 Change 11
ADVISORY MATERIAL:	N/A

Statement of Issue

For an aeroplane equipped with two pairs of Type I exits and one pair of Type III exits, JAR 25.807(c) Change 13 allows a maximum passenger capacity of 139 passengers.

The exit configuration of the A319 consists of two pairs of non-standard floor level exits (oversized Type 1), and one pair of Type III overwing exits. For this configuration, Airbus Industrie has requested certification for a number of passengers of 145, using data from the A321.

For the A319, the exits arrangement and sizes are as follows:

forward doors: 1L/1R 32" wide x 73" high (unchanged A320/A321 standard)
 overwing exits: 2L/2R 20" wide x 40" high (unchanged A320 standard Type III)
 aft doors: 3L/3R 32" wide x 73" high (unchanged A320/A321 standard)

The forward and aft doors satisfy the minimum dimensions and assist means inflation time criteria of the proposed Type C exit in NPRM 90-04 [i.e. 30" wide x 48" high, 10 seconds inflation time].

JAA Position

The requirement stated in JAR 25.807(c) at Change 13 as amended by Orange Paper 90-1 shall be satisfied.

With regards to the maximum passenger seating capacity of aircraft equipped with "oversized Type I doors", the following policy is to be followed for approval of maximum seating capacity of passengers:

The JAAC agreed in principle that an Equivalent Safety Finding procedure based

- either on a test programme (to be defined)
- or on NPRM 90-4

shall be used to approve maximum passenger seating capacity of aircraft using 'oversized' Type I exits provided that the test programme resulting from Cabin Safety study group is agreed by JAAC.

For the A319, an Equivalent Safety Finding to JAR 25.807(c)(1) Change 13 OP90-1 is granted by JAA provided that NPRM 90-4 provisions are met.

INTERPRETATIVE MATERIAL	G-1006: ETOPS
APPLICABILITY:	A320
REQUIREMENTS:	JAA Information Leaflet No. 20 (July 1995) re-issued as JAA ACJ 20X6 (GAI 20, May 2002)
ADVISORY MATERIAL:	N/A

Statement of Issue I:

The Airbus A320 models are certified '120 minutes ETOPS' against the CAA-UK 'CAP 513' and the FAA Advisory Circular 'AC 120-42A ETOPS' requirements,

For the A320 equipped with CFM or IAE engines, Airbus ELECT TO COMPLY with the JAA ETOPS requirements 'Information leaflet N°20' (IL 20) dated 1/7/1995 (revised) for ETOPS 180 minutes Type Design Approval.

The purpose of this CRI is to address this Elect To Comply.

... Discussion removed

Conclusion:

a) With regard to the A320 ETOPS certification basis:

The A320 JAA ETOPS Type Design Approval (eligibility and capability) will be re-assessed according to JAR Information Leaflet N° dated 1/7/1995.

However the following consideration should be taken into account:

The JAA have considered the fact that the third generator (CSM/G) is not capable to power the weather radar, landing lights, auto-pilot, auto-throttle, main fuel pumps and windshield anti-icing.

The availability of those services was not required by the A320 initial ETOPS certification basis (CAA CAP513).

The JAA agree to apply the grandfather clause as defined in the IL 20.

Therefore, for A320, the availability of the above-mentioned services is accepted when the CSM/G is used as third generator.

b) With regard to the A320 ETOPS MMEL (CFMI and IAE engines):

Dispatch with one engine driven generator is not allowed for ETOPS.

Dispatch for one return flight with the APU/APU GEN inoperative is allowed for 120 minutes ETOPS.

Dispatch for ETOPS 180 minutes flight is only permitted with all generators serviceable.

Statement of Issue II (September 2003):

A - The criteria at IL20 / AMJ 120-42 has been published in final ACJ format (without technical change) as ACJ 20X6 in GAI 20. The new reference will supersede all reference to IL20 / AMJ 120-42 in JAA material. The operational provisions of ACJ 20X6 are immediately applicable for the operational approval of concerned airlines. This material does not refer to the design provisions of original il20 but only to those of ACJ 20X6.

B - The CRI wording concerning dispatch with APU / APU GEN inoperative is not in line with JOEB wording.

The purpose of Issue 2 of this CRI is to address the change in the publication reference of JAA ETOPS criteria and the inconsistency of wording between this CRI and the MMEL and CMP document.

... Discussion removed

Conclusion:

A - Concerned manuals will be re-issued with reference to ACJ 20X6 at next normal revision date.

B - All references in this CRI to "Dispatch for one return flight" with APU/APU GEN inoperative shall be interpreted as "dispatch for 4 flights" with APU/APU GEN inoperative for 120 minutes ETOPS (all electrical generators must be serviceable for 180 minutes ETOPS dispatch).

SPECIAL CONDITION	H-01: Enhanced Airworthiness Programme for Aeroplane Systems - ICA on EWIS
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	PART 21A.16B(a)(3), 21A.3B(c)(1), CS 25.1529 + Appendix H
ADVISORY MATERIAL:	N/A

Add to: **Appendix H Instructions for Continued Airworthiness**

H25.5 Electrical Wiring Interconnection Systems Instructions for Continued Airworthiness

The applicant must prepare Instructions for Continued Airworthiness (ICA) applicable to Electrical Wiring Interconnection System (EWIS) as defined below that include the following:

Maintenance and inspection requirements for the EWIS developed with the use of an enhanced zonal analysis procedure (EZAP) that includes:

- a. Identification of each zone of the aeroplane.
- b. Identification of each zone that contains EWIS.
- c. Identification of each zone containing EWIS that also contains combustible materials.
- d. Identification of each zone in which EWIS is in close proximity to both primary and back-up hydraulic, mechanical, or electrical flight controls and lines.
- e. Identification of –
 - Tasks, and the intervals for performing those tasks, that will reduce the likelihood of ignition sources and accumulation of combustible material, and
 - Procedures, and the intervals for performing those procedures, that will effectively clean the EWIS components of combustible material if there is not an effective task to reduce the likelihood of combustible material accumulation.
- f. Instructions for protections and caution information that will minimize contamination and accidental damage to EWIS, as applicable, during the performance of maintenance, alteration, or repairs.

The ICA must be in the form of a document appropriate for the information to be provided, and they must be easily recognizable as EWIS ICA.

For the purpose of this Appendix H25.5, the following EWIS definition applies:

(a) Electrical wiring interconnection system (EWIS) means any wire, wiring device, or combination of these, including termination devices, installed in any area of the aeroplane for the purpose of transmitting electrical energy, including data and signals between two or more intended termination points. Except as provided for in subparagraph (c) of this paragraph, this includes:

- (1) Wires and cables.
- (2) Bus bars.
- (3) The termination point on electrical devices, including those on relays, interrupters, switches, contactors, terminal blocks, and circuit breakers and other circuit protection devices.
- (4) Connectors, including feed-through connectors.
- (5) Connector accessories.
- (6) Electrical grounding and bonding devices and their associated connections.
- (7) Electrical splices.

- (8) Materials used to provide additional protection for wires, including wire insulation, wire sleeving, and conduits that have electrical termination for the purpose of bonding.
- (9) Shields or braids.
- (10) Clamps and other devices used to route and support the wire bundle.
- (11) Cable tie devices.
- (12) Labels or other means of identification.
- (13) Pressure seals.

(b) The definition in subparagraph (a) of this paragraph covers EWIS components inside shelves, panels, racks, junction boxes, distribution panels, and back-planes of equipment racks, including, but not limited to, circuit board back-planes, wire integration units and external wiring of equipment.

(c) Except for the equipment indicated in subparagraph (b) of this paragraph, EWIS components inside the following equipment, and the external connectors that are part of that equipment, are excluded from the definition in subparagraph (a) of this paragraph:

- (1) Electrical equipment or avionics that is qualified to environmental conditions and testing procedures when those conditions and procedures are -
 - (i) Appropriate for the intended function and operating environment, and
 - (ii) Acceptable to the Agency.
- (2) Portable electrical devices that are not part of the type design of the aeroplane. This includes personal entertainment devices and laptop computers.
- (3) Fibre optics.

- END -

SPECIAL CONDITION	P-27: Flammability Reduction System
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	JAR 25.1309, FAR 25.981(c)
ADVISORY MATERIAL:	N/A

1. Special Condition

1.1 General

The following special conditions are part of the type design certification basis for Airbus A318/A319/A320/A321 with a centre tank(s) equipped with a Flammability Reduction System (FRS).

Compliance with these special conditions does not relieve the applicant from compliance with the existing certification requirements.

These special conditions define additional requirements for the design and installation of a FRS that will inert fuel tanks with NEA in order to reduce the fleet average flammability exposure to 3% or less of the operational time for the aeroplane under evaluation. This 3% value is based upon the results of unheated wing tank Monte Carlo flammability analysis that gives results typically around this value. In order to address the high-risk phases of flight (i.e., warm/hot day pre-flight ground operations and climb where flammable conditions are more likely to occur), when the FRS is functional, it will be required to reduce the flammability exposure in each of these phases of operation to 3% or less of the operational time in those phases.

Irrespective of the addition of FRS, ignition source minimisation must still be applied to the tanks. Therefore the applicant is required to summarise modifications required for ignition source minimisation to be applied to the centre tank in compliance with INT/POL/25/12 (CS 25.1309).

The applicant may propose that MMEL relief is provided for aircraft operation with the FRS unavailable. Appropriate justification in accordance with normal policies and procedures including mitigating factors must be provided.

1.2 Definitions

- (a) *Bulk Average Fuel Temperature.* The average fuel temperature within the fuel tank, or different sections of the tank if the tank is subdivided by baffles or compartments.
- (b) *Flammability Exposure Evaluation Time (FEET).* For the purpose of these special conditions, the time from the start of preparing the aeroplane for flight, through the flight and landing, until all payload is unloaded and all passengers and crew have disembarked. In the Monte Carlo programme, the flight time is randomly selected from the Mission Range Distribution (Appendix 2, Table 3), the pre-flight times are provided as a function of the flight time, and the post-flight time is a constant 30 minutes.
- (c) *Flammable.* With respect to a fluid or gas, flammable means susceptible to igniting readily or to exploding. A non-flammable ullage is one where the gas mixture is too lean or too rich to burn and/or is inert per the definition below.
- (d) *Flash Point.* The flash point of a flammable fluid is the lowest temperature at which the application of a flame to a heated sample causes the vapour to ignite

momentarily, or "flash". A test for jet fuel is defined in the *ASTM* specification, *D56*, "Standard Test Method for Flash Point by Tag Close Cup Tester".

- (e) *Hazardous Atmosphere*. An atmosphere that may expose any person(s) to the risk of death, incapacitation, impairment of ability to self-rescue (escape unaided from a space), injury, or acute illness.
- (f) *Inert*. For the purpose of these special conditions, the tank is considered inert when the bulk average oxygen concentration within each compartment of the tank is 12% or less at sea level up to 10,000 feet, then linearly increasing from 12% at 10,000 feet to 14.5% at 40,000 feet, and extrapolated linearly above that altitude (based on FAA test data).
- (g) *Inerting*. A process where a non-combustible gas is introduced into the ullage of a fuel tank to displace sufficient oxygen so that the ullage becomes inert.
- (h) *Monte Carlo Analysis*. An analytical tool that provides a means to assess the degree of fleet average and warm day flammability exposure time for a fuel tank. See Appendices 1 and 2 of these special conditions for specific guidelines on conducting a Monte Carlo analysis.
- (i) *Transport Effects*. Transport effects are the effects on fuel vapour concentration caused by low fuel conditions (mass loading), fuel condensation, and vapourisation.
- (j) *Ullage, or Ullage Space*. The volume within the tank not occupied by liquid fuel at the time interval under evaluation.

1.3 System Performance and Reliability

It must be demonstrated that the FRS reduces tank flammability to levels defined in these special conditions. This should be shown by complying with performance and reliability requirements as follows:

- (a) The applicant must submit a combined fleet performance and reliability analysis (Monte Carlo analysis as described in Appendices 1 and 2) that must:
 - (1) Demonstrate that the overall fleet average flammability exposure of each fuel tank with a FRS installed is equal to or less than 3% of the FEET; and
 - (2) Demonstrate that neither the performance (when the FRS is operational) nor reliability (including all periods when the FRS is inoperative) contributions to the overall fleet average flammability exposure of a tank with a FRS installed are more than 1.8 percent (this will establish appropriate maintenance inspection procedures and intervals as required in paragraph 1.4 of these special conditions).
- (b) The applicant must submit a Monte Carlo analysis that demonstrates that the FRS, when functional, reduces the overall fleet average flammability exposure of each fuel tank with a FRS installed for warm day ground and climb phases to a level equal to or less than 3% of the FEET in each of these phases for the following conditions:
 - (1) The analysis must use the subset of 80°F (26.7°C) and warmer days from the Monte Carlo analyses done for overall performance, and
 - (2) The flammability exposure must be calculated by comparing the time during ground and climb phases for which the tank was flammable and not inert with the total time for the ground and climb phases.

- (c) The applicant must provide data from ground testing and flight testing that:
 - (1) validate the inputs to the Monte Carlo analysis needed to meet paragraphs 1.3(a), (b) and (c)(2) of these special conditions; and
 - (2) substantiate that the NEA distribution is effective at inerting all portions of the tank where the inerting system is needed to show compliance with these paragraphs.
- (d) The applicant must validate that the FRS meets the requirements of paragraphs (a), (b), and (c)(2) of this section with any combination of interfacing systems (e.g. electrical power system) approved for the aeroplane that may affect FRS reliability and performance.
- (e) Sufficient accessibility for maintenance personnel, or the flightcrew, must be provided to FRS status indications that are necessary to meet the reliability requirements of paragraph 1.3(a) of these special conditions.
- (f) The access doors and panels to the fuel tanks (including any tanks that communicate with an inerted tank via a vent system), and to any other enclosed areas that could contain NEA under normal or failure conditions, must be permanently stenciled, marked, or placarded as appropriate to warn maintenance crews of the possible presence of a potentially hazardous atmosphere. The proposal for markings does not alter the existing requirements that must be addressed when entering aeroplane fuel tanks.
- (g) Oxygen-enriched air produced by the FRS must not create a hazard during normal operating conditions.
- (h) Any FRS failures, or failures that could affect the FRS, with potential catastrophic consequences shall not result from a single failure or a combination of failures not shown to be extremely improbable.
 - (i) It must be shown that the fuel tank pressures will remain within limits during normal operating conditions and failure conditions.
 - (ii) Identify critical features of the fuel tank system to prevent an auxiliary fuel tank installation from increasing the flammability exposure of main tanks above that permitted under paragraphs 1.3(a)(1), (2) and (b) of these special conditions and to prevent degradation of the performance and reliability of the FRS.

1.4 Maintenance

The FRS shall be subject to analysis using conventional processes and methodology to ensure that the minimum scheduled maintenance tasks required for securing the continuing airworthiness of the system and installation are identified and published as part of the CS 25.1529 compliance. Maintenance tasks arising from either the Monte Carlo analysis or a CS 25.1309 safety assessment shall be dealt with in accordance with the principles laid down in FAA AC 25.19. The applicant shall prepare a validation programme for the associated continuing airworthiness maintenance tasks, fault finding procedures, and maintenance procedures.

1.5 In-Service Monitoring

Following introduction to service the applicant must introduce an event monitoring programme, accruing data from a reasonably representative sample of global operations,

to ensure that the implications of component failures affecting the FRS are adequately assessed on an on-going basis. The applicant must:

- (a) Provide a report to the primary certification authority (PCA) on a quarterly basis for the first five years of service introduction. After that period the requirement for continued reporting will be reviewed by the PCA.
- (b) Provide a report to the validating authorities on a quarterly basis for a period of at least two years following introduction to service.
- (c) Develop service instructions or revise the applicable aeroplane manuals, in accordance with a schedule agreed by the PCA, to correct any failures of the FRS that occur in service that could increase the fleet average or warm day flammability exposure of the tank to more than the exposure requirements of paragraphs 1.3(a) and 1.3(b) of these special conditions.

APPENDIX 1 to Special Condition P-27

1. Monte Carlo Analysis

- (a) A Monte Carlo analysis must be conducted for the fuel tank under evaluation to determine fleet average and warm day flammability exposure for the aeroplane under evaluation. The analysis must include the parameters defined in Appendices 1 and 2 of these special conditions. The aeroplane specific parameters and assumptions used in the Monte Carlo analysis must include:
- (1) FRS Performance – as defined by system performance.
 - (2) Cruise Altitude – as defined by aeroplane performance.
 - (3) Cruise Ambient Temperature – as defined in Appendix 2 of these special conditions.
 - (4) Overnight Temperature Drop – as defined in Appendix 2 of these special conditions.
 - (5) Fuel Flash Point and Upper and Lower Flammability Limits – as defined in Appendix 2 of these special conditions.
 - (6) Fuel Burn – as defined by aeroplane performance.
 - (7) Fuel Quantity – as defined by aeroplane performance.
 - (8) Fuel Transfer – as defined by aeroplane performance.
 - (9) Fuelling Duration – as defined by aeroplane performance.
 - (10) Ground Temperature – as defined in Appendix 2 of these special conditions.
 - (11) Mach Number – as defined by aeroplane performance.
 - (12) Mission Distribution – the applicant must use the mission distribution defined in Appendix 2 of these special conditions or may request EASA approval of alternative data.
 - (13) Oxygen Evolution – as defined by aeroplane performance or as defined in Appendix 2 of these special conditions.
 - (14) Maximum Aeroplane Range – as defined by aeroplane performance.
 - (15) Tank Thermal Characteristics – as defined by aeroplane performance.
 - (16) Descent Profile Distribution – the applicant must use either a fixed 2500 feet per minute descent rate or may request EASA approval of alternative data.
- (b) The assumptions for the analysis must include:
- (1) FRS performance throughout the flammability exposure evaluation time;
 - (2) Vent losses due to crosswind effects and aeroplane performance;

- (3) Periods when the system is operating properly but fails to inert the tank;

Note: Localized concentrations above the inert level as a result of fresh air that is drawn into the fuel tank through vents during descent would not be considered as flammable.

- (4) Expected system reliability;
- (5) The MMEL/MEL dispatch inoperative period assumed in the reliability analysis, (60 flight hours must be used for a 10-day MMEL dispatch limit unless an alternative period has been approved by the PCA), including action to be taken when dispatching with the FRS inoperative (Note: The actual MMEL dispatch inoperative period data must be included in the engineering reporting requirement of paragraph 1.5 of these special conditions);
- (6) Possible periods of system inoperability due to latent or known failures, including aeroplane system shut-downs and failures that could cause the FRS to shut down or become inoperative; and
- (7) Effects of failures of the FRS that could increase the flammability of the fuel tank.
- (8) Ancillary tanks where significant vapour transfer takes place, such as surge tanks, must be considered flammable if any primary fuel tank connected to the tank contains flammable vapors. In addition, these ancillary tanks are considered inert if all primary tanks are inert.
- (c) The Monte Carlo analysis, including a description of any variation assumed in the parameters (as identified under paragraph (a) of this appendix) that affect fleet average or warm day flammability exposure, and substantiating data must be submitted to EASA for approval.

APPENDIX 2 to Special Condition P-27

1. Monte Carlo Model

- (a) The FAA has developed a Monte Carlo model that can be used to develop a specific analysis model for the Boeing 747 to calculate fleet average and warm day flammability exposure for a fuel tank. The program requires the user to enter the aeroplane performance data specific to the aeroplane model being evaluated, such as maximum range, cruise mach number, typical step climb altitudes, tank thermal characteristics specified as exponential heating/cooling time constants, and equilibrium temperatures for various fuel tank conditions. The general methodology for conducting a Monte Carlo model is described in AC 25.981-2.
- (b) The FAA model, or one with modifications approved by the FAA, must be used as the means of compliance with these special conditions. Contact EASA Certification Directorate to obtain the correct version of the model to use. The following procedures, input variables, and data tables must be used in the analysis if the applicant develops a unique model to determine fleet average flammability exposure for a specific aeroplane type.

2. Monte Carlo Variables and Data Tables

- (a) Fleet average flammability exposure is the percent of the mission time the fuel tank ullage is flammable for a fleet of an aeroplane type operating over the range of actual or expected missions and in a world-wide range of environmental conditions and fuel properties. Variables used to calculate fleet average flammability exposure must include atmosphere, mission length (as defined in paragraph 1.2 Definitions, as FLEET), fuel flash point, thermal characteristics of the fuel tank, overnight temperature drop, and oxygen evolution from the fuel into the ullage. Transport effects are not to be allowed as parameters in the analysis.
- (b) For the purposes of these special conditions, a fuel tank is considered flammable when the ullage is not inert and the fuel vapour concentration is within the flammable range for the fuel type being used. The fuel vapour concentration of the ullage in a fuel tank must be determined based on the bulk average fuel temperature within the tank. This vapour concentration must be assumed to exist throughout all bays of the tank. For those aeroplanes with fuel tanks having different flammability exposure within different compartments of the tank, where mixing of the vapour or NEA does not occur, the Monte Carlo analysis must be conducted for the compartment of the tank with the highest flammability. The compartment with the highest flammability exposure for each flight phase must be used in the analysis to establish the fleet average flammability exposure. For example, the centre wing fuel tank in some designs extends into the wing and has compartments of the tank that are cooled by outside air, and other compartments of the tank that are insulated from outside air. Therefore, the fuel temperature and flammability is significantly different between these compartments of the fuel tank.
- (c) Atmosphere
 - (1) In order to predict flammability exposure during a given flight, the variation of ground ambient temperatures, cruise ambient temperatures, and a method to compute the transition from ground to cruise and back again must be used. The variation of the ground and cruise ambient temperatures and the flash point of the fuel are defined by a Gaussian curve, given by the 50 percent value and a ± 1 standard deviation value.

(2) The ground and cruise temperatures are linked by a set of assumptions on the atmosphere. The temperature varies with altitude following the International Standard Atmosphere (ISA) rate of change from the ground temperature until the cruise temperature for the flight is reached. Above this altitude, the ambient temperature is fixed at the cruise ambient temperature. This results in a variation in the upper atmosphere (tropopause) temperature. For cold days, an inversion is applied up to 10,000 feet, and then the ISA rate of change is used. The warm day subset (see paragraph 1.3 (b) (1) of these special conditions) for ground and climb uses a range of temperatures above 80°F (26.7°C) and is included in the Monte Carlo model.

(3) The analysis must include a minimum number of flights, and for each flight a separate random number must be generated for each of the three parameters (i.e. ground ambient temperature, cruise ambient temperature, and fuel flash point) using the Gaussian distribution defined in Table 1. The applicant can verify the output values from the Gaussian distribution using Table 2.

(d) Fuel Properties.

(1) Flash point variation. The variation of the flash point of the fuel is defined by a Gaussian curve, given by the 50 percent value and a ± 1-standard deviation value.

(2) Upper and Lower Flammability Limits. The flammability envelope of the fuel that must be used for the flammability exposure analysis is a function of the flash point of the fuel selected by the Monte Carlo for a given flight. The flammability envelope for the fuel is defined by the upper flammability limit (UFL) and lower flammability limit (LFL) as follows:

(i) LFL at sea level = flash point temperature of the fuel at sea level minus 10 degrees F. LFL decreases from sea level value with increasing altitude at a rate of 1 degree F per 808 ft.

(ii) UFL at sea level = flash point temperature of the fuel at sea level plus 63.5 degrees F. UFL decreases from the sea level value with increasing altitude at a rate of 1 degree F per 512 ft.

Note: Table 1 includes the Gaussian distribution for fuel flash point. Table 2 also includes information to verify output values for fuel properties. Table 2 is based on typical use of Jet A type fuel, with limited TS-1 type fuel use.

Table 1. Gaussian Distribution for Ground Ambient, Cruise Ambient, and Flash Point

Parameter	Temperature in Deg F		Flash Point (FP)
	Ground Amb.	Cruise Amb.	
Mean Temp	59.95	-70	120
neg 1 std dev	20.14	8	8
pos 1 std dev	17.28	8	8

Table 2. Verification of Table 1

% Probability of Temps & Flash Point Being Below the Listed Values	Ground Amb.	Cruise Amb.	Flash Point	Ground Amb.	Cruise Amb.	Flash Point (FP)
	Deg F	Deg F	Deg F	Deg C	Deg C	Deg C
1	13.1	-88.6	101.4	-10.5	-67.0	38.5
5	26.8	-83.2	106.8	-2.9	-64.0	41.6
10	34.1	-80.3	109.7	1.2	-62.4	43.2
15	39.1	-78.3	111.7	3.9	-61.3	44.3
20	43.0	-76.7	113.3	6.1	-60.4	45.1
25	46.4	-75.4	114.6	8.0	-59.7	45.9
30	49.4	-74.2	115.8	9.7	-59.0	46.6
35	52.2	-73.1	116.9	11.2	-58.4	47.2
40	54.8	-72.0	118.0	12.7	-57.8	47.8
45	57.4	-71.0	119.0	14.1	-57.2	48.3
50	59.9	-70.0	120.0	15.5	-56.7	48.9
55	62.1	-69.0	121.0	16.7	-56.1	49.4
60	64.3	-68.0	122.0	18.0	-55.5	50.0
65	66.6	-66.9	123.1	19.2	-55.0	50.6
70	69.0	-65.8	124.2	20.6	-54.3	51.2
75	71.6	-64.6	125.4	22.0	-53.7	51.9
80	74.5	-63.3	126.7	23.6	-52.9	52.6
85	77.9	-61.7	128.3	25.5	-52.1	53.5
90	82.1	-59.7	130.3	27.8	-51.0	54.6
95	88.4	-56.8	133.2	31.3	-49.4	56.2
99	100.1	-51.4	138.6	37.9	-46.3	59.2

(e) Flight Mission Distribution

- (1) The mission length for each flight is determined from an equation that takes the maximum mission length for the aeroplane and randomly selects multiple flight lengths based on typical airline use.
- (2) The mission length selected for a given flight is used by the Monte Carlo model to select a 30-, 60-, or 90- minute time on the ground prior to takeoff, and the type of flight profile to be followed. Table 3 must be used to define the mission distribution. A linear interpolation between the values in the table must be assumed.

Table 3. Mission Range Distribution

Aeroplane Maximum Range - Nautical Miles (NM)

Flight Length (NM)		1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
From	To	Distribution of missions Lengths(%)									
0	200	11.7	7.5	6.2	5.5	4.7	4.0	3.4	3.0	2.6	2.3
200	400	27.3	19.9	17.0	15.2	13.2	11.4	9.7	8.5	7.5	6.7
400	600	46.3	40.0	35.7	32.6	28.5	24.9	21.2	18.7	16.4	14.8
600	800	10.3	11.6	11.0	10.2	9.1	8.0	6.9	6.1	5.4	4.8
800	1000	4.4	8.5	8.6	8.2	7.4	6.6	5.7	5.0	4.5	4.0
1000	1200	0.0	4.8	5.3	5.3	4.8	4.3	3.8	3.3	3.0	2.7
1200	1400	0.0	3.6	4.4	4.5	4.2	3.8	3.3	3.0	2.7	2.4
1400	1600	0.0	2.2	3.3	3.5	3.3	3.1	2.7	2.4	2.2	2.0
1600	1800	0.0	1.2	2.3	2.6	2.5	2.4	2.1	1.9	1.7	1.6
1800	2000	0.0	0.7	2.2	2.6	2.6	2.5	2.2	2.0	1.8	1.7
2000	2200	0.0	0.0	1.6	2.1	2.2	2.1	1.9	1.7	1.6	1.4
2200	2400	0.0	0.0	1.1	1.6	1.7	1.7	1.6	1.4	1.3	1.2
2400	2600	0.0	0.0	0.7	1.2	1.4	1.4	1.3	1.2	1.1	1.0
2600	2800	0.0	0.0	0.4	0.9	1.0	1.1	1.0	0.9	0.9	0.8
2800	3000	0.0	0.0	0.2	0.6	0.7	0.8	0.7	0.7	0.6	0.6
3000	3200	0.0	0.0	0.0	0.6	0.8	0.8	0.8	0.8	0.7	0.7
3200	3400	0.0	0.0	0.0	0.7	1.1	1.2	1.2	1.1	1.1	1.0
3400	3600	0.0	0.0	0.0	0.7	1.3	1.6	1.6	1.5	1.5	1.4
3600	3800	0.0	0.0	0.0	0.9	2.2	2.7	2.8	2.7	2.6	2.5
3800	4000	0.0	0.0	0.0	0.5	2.0	2.6	2.8	2.8	2.7	2.6
4000	4200	0.0	0.0	0.0	0.0	2.1	3.0	3.2	3.3	3.2	3.1
4200	4400	0.0	0.0	0.0	0.0	1.4	2.2	2.5	2.6	2.6	2.5
4400	4600	0.0	0.0	0.0	0.0	1.0	2.0	2.3	2.5	2.5	2.4
4600	4800	0.0	0.0	0.0	0.0	0.6	1.5	1.8	2.0	2.0	2.0
4800	5000	0.0	0.0	0.0	0.0	0.2	1.0	1.4	1.5	1.6	1.5
5000	5200	0.0	0.0	0.0	0.0	0.0	0.8	1.1	1.3	1.3	1.3
5200	5400	0.0	0.0	0.0	0.0	0.0	0.8	1.2	1.5	1.6	1.6
5400	5600	0.0	0.0	0.0	0.0	0.0	0.9	1.7	2.1	2.2	2.3
5600	5800	0.0	0.0	0.0	0.0	0.0	0.6	1.6	2.2	2.4	2.5
5800	6000	0.0	0.0	0.0	0.0	0.0	0.2	1.8	2.4	2.8	2.9
6000	6200	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.6	3.1	3.3
6200	6400	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.4	2.9	3.1
6400	6600	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8	2.2	2.5
6600	6800	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.2	1.6	1.9
6800	7000	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	1.1	1.3
7000	7200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.8
7200	7400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.7
7400	7600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.6
7600	7800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.7
7800	8000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.8
8000	8200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.8
8200	8400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0
8400	8600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.3
8600	8800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1
8800	9000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8
9000	9200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
9200	9400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
9400	9600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9600	9800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
9800	10000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

(f) Fuel Tank Thermal Characteristics

- (1) The applicant must account for the thermal conditions of the fuel tank both on the ground and in flight. The Monte Carlo model, available on the website listed above, defines the ground condition using an equilibrium delta temperature (relative to the ambient temperature) that the tank will reach given a long enough time, with any heat inputs from aeroplane sources. Values are also input to define two exponential time constants (one for a near empty tank and one for a near full tank) for the ground condition. These time constants define the time for the fuel in the fuel tank to heat or cool in response to heat input. The fuel is assumed to heat or cool according to a normal exponential transition, governed by the temperature difference between the current temperature and the equilibrium temperature, given by ambient temperature plus delta temperature. Input values for this data can be obtained from validated thermal models of the tank based on ground and flight test data. The inputs for the in-flight condition are similar but are used for in-flight analysis.
- (2) Fuel management techniques are unique to each manufacturer's design and variations in fuel quantity within the tank for given points in the flight, including fuel transfer for any purpose, must be accounted for in the model. The model uses a "tank full" time, specified in minutes, that defines the time before touchdown when the fuel tank is still full. For a centre wing tank used first, this number would be the maximum flight time, and the tank would start to empty at takeoff. For a main tank used last, the tank will remain full for a shorter time before touch down, and would be "empty" at touch down (i.e., tank empty at 0 minutes before touch down). For a main tank with reserves, the term empty means at reserve level rather than totally empty. The thermal data for tank empty would also be for reserve level.
- (3) The model also uses a "tank empty" time to define the time when the tank is emptying, and the program uses a linear interpolation between the exponential time constants for full and empty during the time the tank is emptying. For a tank that is only used for long-range flights, the tank would be full only on longer range flights and would be empty a long time before touch down. For short flights, it would be empty for the whole flight. For a main tank that carried reserve fuel, it would be full for a long time and would only be down to empty at touch down. In this case, empty would really be at reserve level, and the thermal constants at empty should be those for the reserve level.
- (4) The applicant must propose means to validate thermal time constants and equilibrium temperatures to be used in the analysis. The applicant may propose using a more detailed thermal definition, such as changing time constants as a function of fuel quantity, provided the details and substantiation information are acceptable and the Monte Carlo model programme changes are validated.

(g) Overnight Temperature Drop

- (1) An overnight temperature drop must be considered in the Monte Carlo analysis as it may affect the oxygen concentration level in the fuel tank. The overnight temperature drop for these special conditions will be defined using:
 - A temperature at the beginning of the overnight period based on the landing temperature that is a random value based on a Gaussian distribution; and
 - An overnight temperature drop that is a random value based on a Gaussian distribution.

- (2) For any flight that will end with an overnight ground period (one flight per day out of an average of "x" flights per day, depending on use of the particular aeroplane model being evaluated), the landing outside air temperature (OAT) is to be chosen as a random value from the following Gaussian curve:

Table 4. Landing OAT

Parameter	Landing Temperature °F
Mean Temp	58.68
neg 1 std dev	20.55
pos 1 std dev	13.21

- (3) The outside ambient air temperature (OAT) drop for that night is to be chosen as a random value from the following Gaussian curve:

Table 5. OAT Drop

Parameter	OAT Drop Temperature °F
Mean Temp	12.0
1 std dev	6.0

- (h) Oxygen Evolution

The oxygen evolution rate must be considered in the Monte Carlo analysis if it can affect the flammability of the fuel tank or compartment. Fuel contains dissolved gases, and in the case of oxygen and nitrogen absorbed from the air, the oxygen level in the fuel can exceed 30 percent, instead of the normal 21 percent oxygen in air. Some of these gases will be released from the fuel during the reduction of ambient pressure experienced in the climb and cruise phases of flight. The applicant must consider the effects of air evolution from the fuel on the level of oxygen in the tank ullage during ground and flight operations and address these effects on the overall performance of the FRS. The applicant must provide the air evolution rate for the fuel tank under evaluation, along with substantiation data.

- (i) Number of Simulated Flights Required in Analysis

In order for the Monte Carlo analysis to be valid for showing compliance with the fleet average and warm day flammability exposure requirements of these special conditions, the applicant must run the analysis for an appropriate number of flights to ensure that the fleet average and warm day flammability exposure for the fuel tank under evaluation meets the flammability limits defined in Table 6.

Table 6. Flammability Limit

Number of Flights in Monte Carlo Analysis	Maximum Acceptable Fuel Tank Flammability (%)
1,000	2.73
5,000	2.88
10,000	2.91
100,000	2.98
1,000,000	3.00

SPECIAL CONDITION	S76-1: Protection from the effect of HIRF
APPLICABILITY:	A318 / A319 / A320 / A321
REQUIREMENTS:	JAR 25.1309 (a) and (b), JAR 25.1431 (a)
ADVISORY MATERIAL:	N/A

The JAA Interim Policy INT/POL/25/2 dated Feb 10, 1992 gives a definition of:

- the Certification HIRF environment
- the Normal HIRF environment.

Add to JAR 25.1431 new paragraph (d):

The aeroplane systems and associated components, considered separately and in relation to other systems, must be designed and installed so that:

- (d) (1) Each system that performs a critical or essential function is not adversely affected when the aeroplane is exposed to the Normal HIRF Environment.
- (d) (2) All critical functions must not be adversely affected when the aeroplane is exposed to the Certification HIRF Environment.
- (d) (3) After the aeroplane is exposed to the Certification HIRF environment, each affected system that performs a critical function recovers normal operation without requiring any crew action, unless this conflicts with other operational or functional requirements of that system.