This annex to the EASA TCDS IM.A.196 was created to publish selected special conditions / deviations / equivalent safety findings that are part of the applicable certification basis:

Certification Review Items

SPECIAL CONDITION	**A-1: Type Certification Basis**
APPLICABILITY:	B747-400F
REQUIREMENTS:	-
ADVISORY MATERIAL:	

B747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT	**: Type Certification Basis**	**IDENTIFICATION : A-1**
REQUIREMENTS:	**Draft JAR 21.101**	**STAGE : 5 PAGES: 1/6**
POLICY	**: JAA Information Leaflet No. 18**	**STATUS: Closed**
		DATE : 1 September 1993

Note: Until JAR 21 has been formally accepted by the AA, reference to JAR 21 shall be interpreted as reference to the equivalent national requirements.

PROBLEM:

The Boeing 747-400 Freighter aircraft is a derivative version of the basic 747-400 passenger/combi aircraft.
The basic 747-400 was jointly type certificated in June 1989 by the four national authorities of France, Germany, The Netherlands and the United Kingdom (called hereafter AA). Important design changes from the basic 747-400 are listed below for the 747-400 Freighter.
Note: the approved engine installations (viz. General Electric CF6-80C2B1F and Rolls Royce RB 211-524H) and the APU-installation remain unchanged.

- Strengthened wings
- 747-200 freighter fuselage
- Increased MZFW to 610K and MLW to 652K
- Increased C.G. range
- Increased cargo capability
- Improved loadability for brake release gross weights above 850K
- Strengthened main and nose landing gears
- No stretched upper deck
- Upperdeck compartment not designed to transport of passengers
- Crew rest installation
- Flight control changes
- Rerouted hydraulic powerlines
- Relocated electrical wiring
- Revised door configuration
- Revised equipment cooling system
- Automatic cabin depressurization to 25000 ft when class E cargo fire procedures are initiated
- Revised airconditioning and temperature controls
- Cargo fire protection system improved
- Flight deck avionics revised to accommodate Freighter features
- Potable water system revised
- Evacuation procedures
- Full cargo liner
- Sidewall and aft pressure bulkhead protection panels

Note: Ref. Boeing letter B-T02T-91-3239, dated 18 December, 1991 for complete description.

SPECIAL CONDITION	**A-2: Additional national design standards for type certification**
APPLICABILITY:	B747-400F
REQUIREMENTS:	-
ADVISORY MATERIAL:	

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : Additional National Design Standards for Type Certification	IDENTIFICATION: A-2
	STAGE : 3 PAGE 1/1
REQUIREMENTS: --	STATUS: Closed
	DATE : 27 July 1993

PROBLEM:

In addition to the Joint Certification Requirements (CRI A-1), National Requirements may exist to accept the design for type certification.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT: ADDITIONAL NATIONAL REQUIREMENTS FOR TYPE CERTIFICATION IN GERMANY	IDENTIFICATION NR: A-2-1
	STAGE : 3
REQUIREMENTS: National	PAGE : 1/1 (+ app.)
	STATUS: Closed
	DATE : 18 May 1993

~~STATEMENT:~~

~~Germany has issued the following requirements:~~

APPENDIX 3
GERMAN ADDITIONAL REQUIREMENTS FOR TC

Issue: 3
Date: 04.11.199?

Additional National Design and Administrative Requirements

FOR TYPE CERTIFICATION

in the Federal Republic of Germany

1. Additional design requirements

1.1 Barometric scales have to be calibrated in HPa.

Note: This additional requirement will be deleted, if it has been included into the JAA Joint Type Certification Basis as a "Harmonization Condition" on a mandatory or voluntary basis.

2. Additional administrative requirements

2.1 Noise Certification

A Noise Certification is required prior to the issuance of a Type Certificate. A JAA Team accepted report showing compliance with the environmental standards of the Joint Type Certification Basis must be submitted to the LBA for review of compliance with applicable German noise requirements and for issuance of a LBA Noise Certificate for Type Certification.

Note: The applicable noise requirements in the Federal Republic of Germany are at present the

"LSL-Lärmschutzforderungen für Luftfahrzeuge"
effective 1 January 1991.

The technical content of this issue is mainly identical with ICAO Annex 16, Volume 1, Amdt. 3.

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2.2 Engine/APU Certification

Engine and APU certification by the LBA is required in the Federal Republic of Germany prior to Type Certification of the airplane.

For certification of the engine a separate application is required.

For APU certification either a separate application is also required or the certification of the APU may be granted as part of the Type Certification of the aircraft; in that case, the certification of the APU is valid only for use in the certified aircraft type.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : Additional National Design Standards for Type Certification in France	IDENTIFICATION: A-2-2
	STAGE : 2 PAGE 1/2
REQUIREMENTS: National	STATUS: Closed
	DATE : 1 April 1993

PROBLEM:

France has issued the following requirements:

1. ENDURANCE DEMONSTRATION

The applicant is to carry out all the flight test considered necessary by the competent authorities to determine that there is reasonable assurance that the aircraft, its componenents and its equipment are reliable and function properly.

These flight tests must include:
a) for an aircaft incorporating turbine engines of a type not previously used in a type certificated aircraft, at least 300 hours of operation with a full complement of engines that conform to a type certificate.
b) for all other aircraft, at least 150 hours of operation.

2. EQUIPMENT PERFORMANCE

The equipment installed on the aircaft and certified with it must fulfill the performance standards required for equipment qualification (QAC or JTSO or TSO).

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : Additional National Design Standards for Type Certification in the United Kingdom

IDENTIFICATION: A-2-3

STAGE : 2 PAGE 1/1

REQUIREMENTS: National

STATUS: Closed

DATE : 27 July 1993

PROBLEM:

The United Kingdom has issued the following requirements:

None.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : Additional National Design Standards for Type Certification in Luxembourg

IDENTIFICATION: A-2-4

STAGE : 2 PAGE 1/1

REQUIREMENTS: National

STATUS: Closed

DATE : 1 April 1993

PROBLEM:

Luxembourg has issued the following requirements:

None.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : Additional National Design Standards for Type Certification in The Netherlands	IDENTIFICATION: A-2-5
	STAGE : 2 PAGE 1/1 (+ App.)
REQUIREMENTS: National	STATUS: Closed
	DATE : 1 April 1993

PROBLEM:

The Netherlands have issued the following requirements:

Annex 15 of the Dutch Airworthiness Requirements

Noise Requirements for Transport Category Aeroplanes
(Summary)

* ICAO Annex 16, Vol I, Ch. 2 or FAR 36, Stage 2.

  Applicability: 2 or 3 engined subsonic jet-aeroplanes with a maximum certified take-off mass more than 20,000 kg.

* ICAO Annex 16, Vol I, Ch. 2.

  Applicability: 4 engined subsonic jet-aeroplanes.

* ICAO Annex 16, Vol I, Ch. 3 or FAR 36, Stage 3.

  Applicability:

  - Jet-engined aeroplanes with a maximum certified take-off mass of 20,000 kg or less.
  - Propeller driven aeroplanes with a maximum certified take-off mass of more than 5700 kg.

SPECIAL CONDITION	**A-3: National environmental standards**
APPLICABILITY:	B747-400F
REQUIREMENTS:	-
ADVISORY MATERIAL:	

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : NATIONAL ENVIRONMENTAL STANDARDS	IDENTIFICATION: A-3
	STAGE : 3 PAGE 1/1 (+ App.)
REQUIREMENTS: --	STATUS: Closed
	DATE : 27 July 1993

PROBLEM:

In addition to the Joint Certification Requirements (CRI A-1), National Environmental Standards may exist to accept the design for type certification.

Appendix to CRI A-3

National Environmental Standards

Country	Noise	Emissions
Germany	See CRI A-2-1	--
France	ICAO Annex 16 Vol 1 Chapter 3	--
United Kingdom	See CRI A-5-3	See CRI A-5-3
Luxembourg	--	--
The Netherlands	See CRI A-2-5	--

SPECIAL CONDITION	**A-4: Additional national design standards for the issue of a certificate of airworthiness**
APPLICABILITY:	B747-400F
REQUIREMENTS:	-
ADVISORY MATERIAL:	

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR THE ISSUE OF A CERTIFICATE OF AIRWORTHINESS	IDENTIFICATION: A-4
	STAGE : 3 PAGE 1/1
REQUIREMENTS:	STATUS: Closed
	DATE : 27 July 1993

PROBLEM:

In addition to the Joint Certification Requirements (CRI A-1), National Requirements may exist in relation to the issue of a Certificate of Airworthiness.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR THE ISSUE OF A CERTIFICATE OF AIRWORTHINESS IN GERMANY	IDENTIFICATION: A-4-1
	STAGE : 3 PAGE 1/1 (+ app.)
REQUIREMENTS: National	STATUS: Closed
	DATE : 18 May 1993

PROBLEM:

Germany has issued the following requirements:

APPENDIX 5
GERMAN ADDITIONAL REQUIREMENTS FOR C OF A

Issue: 3
Date: 04.11.1992

Additional National Design and Administrative Requirements

FOR ISSUE OF CERTIFICATE OF AIRWORTHINESS

in the Federal Republic of Germany

1. Additional design requirements

1.1 The registration mark of the airplane must be in compliance with "Anlage 1" to § 14, Abs. 1 of the "Luftverkehrs-Zulassungs-Ordnung (LuftVZO)" prior to the issuance of any Certificate of Airworthiness.

2. Additional administrative requirements

2.1 Noise Certificate

A Noise Certification is required prior to the issuance of a C of A. A JAA Team accepted report showing compliance with the applied environmental standards must be submitted to the LBA for review of compliance with German noise requirements, effective at the day of application for a C of A.

Note: The applicable noise requirements in the Federal Republic of Germany are at present the

"LSL-Lärmschutzforderungen für Luftfahrzeuge" effective 1 January 1991.

The technical content of this issue is mainly identical with ICAO Annex 16, Volume 1, Amdt. 3.

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2.2 Avionic Equipment

Radio communication and navigation equipment (only transmitting/receiving equipment) which is considered as part of the Type Definition requires separate LBA certification prior to the issuance of the C of A for export for any aeroplane to be delivered to the FR of Germany.

Note: Due to Federal Regulations radio communication and navigation equipment requires also a separate approval by the "Bundesamt für Zulassungen in der Telekommunikation (BZT)" in the FR of Germany.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT	: ADDITIONAL NATIONAL DESIGN STANDARDS FOR THE ISSUE OF A CERTIFICATE OF AIRWORTHINESS IN FRANCE	IDENTIFICATION: A-4-2
		STAGE : 2 PAGE 1/1
REQUIREMENTS:	National	STATUS: Closed
		DATE : 1 April 1993

PROBLEM:

France has issued the following requirements:

None.

The National Co-ordinator
of France
was signed at stage 1

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR THE ISSUE OF A CERTIFICATE OF AIRWORTHINESS IN THE UNITED KINGDOM	IDENTIFICATION: A-4-3
	STAGE : 2 PAGE 1/1 (+ App.)
REQUIREMENTS: National	STATUS: Closed
	DATE : 27 July 1993

PROBLEM:

The United Kingdom has issued the following requirements:

Additional National Design Requirements for C of A Page

NOTE: 1) Certain items in this list are marked with an * to denote that they should be ! in mind during the design stage.

2) As a matter of principle, any relevant Airworthiness Notices must be complied ⱦ but, in addition to those listed under Type Certification standards, particular attention should be paid to the following.

Requirement	Date	Issue	Title	Remarks
Flight Manual (UK)			Flight Manual/Validation Note 9	Identifies additional performance information needed to comply with UK legislation.
B(Paper 737	9.05.80		Continued and Discontinued Approach	Interpretative Material f JAR-AWO. To be supersede by a JAR-AWO NPA.
BCAR Sect A; A2-3	24.01.91		Route Proving	Pending JAR 21 Material, Certification Committee Paper 36.3 will be used as interpretive material.
BCAR Sect A/B; 3-2*		Latest	Manuals	
BCAR Sect R4-2, 6.3*		Latest	Interphone Switches	
Spec 1	24.08.79	5	Safety Belts	Apart from buckle release angle, covered by FAA TSO
Spec 3*	10.07.53	2	Tests for Seats with Safety Belts attached	
4	1.02.62	2	Safety Harnesses	Covered by FAA TSO C114 fc small aircraft but no TSO equivalent for large aircraft. Will be coverec by JAR TSO when available.
Spec 5	23.11.79	2	Inflatable Life Jackets	
Spec 17	18.09.86	1	Aeroplane Wheels and Wheel Brake Assemblies	Will be superseded by JAR TSO when this is available
AN 45	1.11.83	1	Software Management	Reference should also be made to EUROCAE ED12A and RTCA DO178A.
AN 45A	1.07.86	1	Software Management and Certification Guide-lines	Reference should also be made to EUROCAE ED12A a RTCA DO178A.

Additional National Design Requirements for C of A Page 2

NOTE: 1) Certain items in this list are marked with an * to denote that they should be borne in mind during the design stage.

2) As a matter of principle, any relevant Airworthiness Notices must be complied with but, in addition to those listed under Type Certification standards, particular attention should be paid to the following.

Requirement	Date	Issue	Title	Remarks
AN 56*	16:03.89	2	Floor Proximity Emergency Escape Path Markings	Superseded by JAR 25 at Change 12, except for required positions of emergency exit markers and distance between ais lights.
AJ ˙7	1.04.85	1	Toilet Flush Motors	Superseded by JAR 2 at Change 13 plus Amendment 90/1.
AN 59*	10.12.86	3	Aircraft Seats and Berths - Resistance to Fire	Superseded by JAR 25 at Change 12.
AN 60	1.07.86		Cabin and Toilet Fire Protection	Will be covered by FAA N 89-1, if this is adopted unchanged.
AN 61*	16.03.87	1	Improved Flammability Test Standards - Resistance to Fire	Superseded by JAR 25 at Change 13.
AN 64*	16.03.89	1	Minimum Space for Seated Passengers	
A! 0	16.09.88		Tyre Bursts in Flight-Inflation Media	Normally covered by [illegible]d design and workshop prac but needs to be stated.
AN 76*	1.04.80	3	Electrical Power Supplies For Aircraft Radio Equipment	Superseded by JAR 25 at Change 13 plus Amendment 90/1.
AN 79*	16.03.89	3	Access to and Opening of Type III/IV Exits	
AN 80	18.08.89	2	Class C and D Cargo or Baggage Compartments - Fire Containment	Superseded by JAR 25 at Change 12.
AN 81*	20.07.72	1	Emergency Power Supplies for Electrical Gyro Indicators	Superseded by JAR at Change 13 plus Amendment 90/1.
AN 83	22.08.84	1	Fire Precautions Aircraft toilets	Will be superseded by JAR NPA 25D-227 (dated 4 July 1990), if t is adopted unchanged

Additional National Design Requirements for C of A Page 3

NOTE: 1) Certain items in this list are marked with an * to denote that they should be borne in mind during the design stage.

2) As a matter of principle, any relevant Airworthiness Notices must be complied with but, in addition to those listed under Type Certification standards, particular attention should be paid to the following.

Requirement	Date	Issue	Title	Remarks
AN 85*	1.04.80	2	Automatic Direction Finding Equipment (Turbine)	Will be superseded by JAR TSO C41d when it is issued.
AN 91*	1.11.83	2	Comms Transmitters in the VHF Band 118-136MHz	For Class 3 and 4 transmitters covered by FAA TSO C37c (DO 157)
AN 93	17.11.82		Tyres & Wheels fitted to A/C in Transport Category	Covered by FAA TSO C62c.
AN 99*	1.11.83	1	Galley Equipment	Covered by JAR 25.789 and 25X.1499 and AMJ 25.1 (b) at Change 13 plus Amendment 90/1.
ANO		Latest	Equipment and Markings	The aircraft must be mark and equipped, or capable of being marked and equipped in accordance with the ANO.
ANO		Latest	Life Jackets (Spec 5)	
ANO Art 8.3*		Latest	Ditching	For aeroplanes with 31 or more passenger seats to b operated for the purposes public transport more tha 50 nm from the nearest sh line, compliance is requi with the ditching provisi of JAR 25.
CAP 513*	April 1990		Extended Range Twin Operations	If ETOPS approval is requested. To be supersed by JAR AMJ 120-42 in due course.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT	: ADDITIONAL NATIONAL DESIGN STANDARDS FOR THE ISSUE OF A CERTIFICATE OF AIRWORTHINESS IN LUXEMBOURG	IDENTIFICATION: A-4-4 STAGE : 2 PAGE 1/1
REQUIREMENTS:	National	STATUS: Closed DATE : 1 April 1993

PROBLEM:

Luxembourg has issued the following requirements:

None.

The National Co-ordinator
of Luxembourg
was signed at stage 1

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT	: ADDITIONAL NATIONAL DESIGN STANDARDS FOR THE ISSUE OF A CERTIFICATE OF AIRWORTHINESS IN THE NETHERLANDS	IDENTIFICATION: A-4-5 STAGE : 2 PAGE 1/1 (+ App.)
REQUIREMENTS:	National	STATUS: Closed DATE : 1 April 1993

PROBLEM:

The Netherlands have issued the following requirements:

ministerie van verkeer en waterstaat
Ministry of Transport and Public Works

rijksluchtvaartdienst
Department of Civil Aviation

directie luchtvaartinspectie
Aeronautical Inspection Directorate

TRANSLATION
In case of doubt or argument
the original Dutch text
prevails

Annex 16
of the Dutch Airworthiness Requirements

Requirements for airborne equipment

For parts and pieces of equipment for use on board of aircraft, the same airworthiness requirements apply as for the aircrafttype unless otherwise specified by the Director Aeronautical Inspection including the following approved or accepted specifications:

- The Technical Standard Orders (T.S.O.) according to FAR-Part 21 subpart O;
- The Minimum Performance Specification (M.P.S.) according to the Radio Technical Commission for Aeronautics (R.T.C.A.);
- The Minimum Performance Specification (M.P.S.) according to the European Organisation for Civil Aviation Electronics (EUROCAE);
- The Minimum Performance Specification (M.P.S.) according to the Society of Automotive Engineers (S.A.E.)

For radiocommunication and radionavigation-equipment, the following additional requirements apply:

a. Marker Beacon receivers:
T.S.O. C 35(d) Class A and R.T.C.A. M.P.S. DO 143 Category A or: Eurocae M.P.S. 1/WG 7/70

b. Radio Communication Transmitters:
T.S.O. C 37 B or T.S.O. C 37 C and R.T.C.A. M.P.S. DO 157 Clas 3 of 4 or: Eurocae M.P.S. E.D. 24

c. Radio Communication Receivers:
T.S.O. C 38 B or T.S.O. 38 C and R.T.C.A. M.P.S. DO 156 Class C or: Eurocao M.P.S. E.D. 23

d. V.O.R. Receivers:
T.S.O. C 40 a and R.T.C.A. M.P.S. DO 153 Category A or DO 114 (50 KC) or: T.S.O. C 40 b and R.T.C.A. M.P.S. DO 153 A Class 1 or: Eurocae M.P.S. E.D. 22 A

e. A.D.F. Receivers:
T.S.O. C 41 C Class A and R.T.C.A. M.P.S. DO 142 Category A or R.T.C.A. M.P.S. DO 179 stage 2 or: Eurocae M.P.S. 1 WG 7/69.

Conform article 6 of the Dutch airworthiness requirements the Director Aeronautical Inspection can specify otherwise in special cases.

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SPECIAL CONDITION	**A-5: Additional national design standards for operational approval**
APPLICABILITY:	B747-400F
REQUIREMENTS:	-
ADVISORY MATERIAL:	

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT	: ADDITIONAL NATIONAL DESIGN STANDARDS FOR OPERATIONAL APPROVAL	IDENTIFICATION: A-5
		STAGE : 3 PAGE 1/1
REQUIREMENTS:		STATUS: Closed
		DATE : 27 July 1993

PROBLEM:

In addition to the Joint Certification Requirements (CRI A-1), National Requirements for Operational Approval may exist.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT	: ADDITIONAL NATIONAL DESIGN STANDARDS FOR OPERATIONAL APPROVAL IN GERMANY	IDENTIFICATION: A-5-1
		STAGE : 3 PAGE 1/1 (+ app.)
REQUIREMENTS:	NATIONAL	STATUS: Closed
		DATE : 18 May 1993

PROBLEM:

Germany has issued the following requirements:

APPENDIX 5
GERMAN ADDITIONAL REQUIREMENTS FOR OPERATIONAL APPROVAL

Issue: 3
Date: 04.11.1992

Additional National Design and Administrative Requirements

FOR OPERATIONAL APPROVAL

in the Federal Republic of Germany

1. Additional design requirements

Compliance with the following design standards must be shown prior to an operational approval for commercial transport of persons and property in air transport enterprises:

Designation	LuftBO
Supplementary Equipment Required By Purpose Of Operation	Para 19
Supplementary Equipment Required By Type Of Operation	Para 20
Supplementary Equipment Required By Environmental Operating Conditions	Para 21

Designation	1 DVO LuftBO
Fire Protection	Para 4
First Aid Equipment	Para 5
Crash Axe	Para 6
Emergency Exits and Emergency Lighting	Para 7

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Note: Available LBA interpretation in english language to ANDRs for operational approval are as follows:

a) Applicable to 1. DVO LuftBO, Para 4:

LBA Guideline No. 2.07, latest issue *L. Ausg. 15.02.90*

Fire Protection of Transport Category Airplanes

...

b) Applicable to 1. DVO LuftBO, Para 7:

LBA Guideline No. 2.56, latest issue 6. Ausg. 01.02.

Emergency Exits and Emergency Lighting of Transport Category Airplanes.

2. Additional administrative requirements

2.1 Avionic Equipment

Radio communication and navigation equipment (only transmitting/receiving equipment) used for a particular operation and not being part of the Type Definition requires separate LBA certification prior to operational approval in the FRG. If such equipment is installed in an aeroplane to be delivered to the FR of Germany, the seperate LBA certification is required prior to the issuance of the C of A for export.

Note: Due to Federal Regulations radio communication and navigation equipment requires also a separate approval by the "Bundesamt für Zulassungen in der Telekommunikation (BZT)" in the FR of Germany.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR OPERATIONAL APPROVAL IN FRANCE	IDENTIFICATION: A-5-2
	STAGE : 3 PAGE 1/1
REQUIREMENTS: NATIONAL	STATUS: Closed
	DATE : 27 July 1993

PROBLEM:

France has issued the following requirements:

~~Decree on operating rules:~~

~~Arrêté du 05 Novembre 1987 sur les conditions d'utilisation des avions exploités par une entreprise de transport aérien, modifié par:~~

- ~~L'Arrêté du 28 Octobre 1988~~
- ~~L'Arrêté du 05 Avril 1989~~
- ~~L'Arrêté du 16 Fevrier 1990~~
- ~~L'Arrêté du 14 Août 1991~~
- ~~L'Arrêté du 12 Janvier 1993~~
- ~~Document STNA 09/75 OGCE~~
- ~~L'Arrêté du 05 Juillet 1990, regarding Mode S ATC transponders~~
- ~~Decree dated September 14th, 1990 regarding approval of radio equipment.~~

~~Note: Equipment performance.~~
~~For equipment qualification as required in CRI A-2, if neither the QAC nor the JTSO were retained, some special conditions must be required.~~

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR OPERATIONAL APPROVAL IN THE UNITED KINGDOM	IDENTIFICATION: A-5-3
	STAGE : 2 PAGE 1/1 (+ App.)
REQUIREMENTS: NATIONAL	STATUS: Closed
	DATE : 27 July 1993

PROBLEM:

The United Kingdom has issued the following requirements:

Additional National Design Requirements for Operational Approval Pag

NOTE: Certain Items in this list are marked with an * to denote that they should be in mind during the design stage.

Requirement	Date	Issue	Title	Remarks
Spec 7 & ANO* ANO*	8.08.62	2	Break-in Points	ANO Artice 49
Spec 10A & ANO	20.09.89	1	Flight Data Recorders	Covered by EUROCAE Docum ED55, Proposed TSO C124 JAR 25 Change 13.
S. 11 & ANO*	13.08.83	3	Cockpit Voice Recorders	Covered by EUROCAE E..., proposed TSO C123 and JAR 25 at Change 13.
Spec 12 & ANO		1	Underwater Locator Beacons	
Spec 14 & ANO*	1.09.76	2	GPWS	
Spec 15 & ANO*	23.01.87	1	Public Address Systems	
ANO*		Latest	Radio and Radar Equipment	
ANO*		Latest	Provision of Oxygen	
AN(G)R*		Latest	Performance Regulations etc.	
ANO Schedule 4		Latest	Aircraft equipment	
ANO Schedule 5		Latest	Radio and Radio Navigation Equipment	
BCAR Section N*	~~10.11.78~~ 1.8.90	85	Noise	Covered by ICAO Ann Vol I
BCAR Section M*	1.05.86	1	Emissions Certification	
BCAR Paper M847*	1.01.89	2	Emissions Certification	
CAP 513	April 1990		Extended Range Twin Operations	If ETOPS certification is requested at the start of operational approval. (This CAP will be superseded by JAR AMJ 120-42 when available.)

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR OPERATIONAL APPROVAL IN LUXEMBOURG	IDENTIFICATION: A-5-4
	STAGE : 2 PAGE 1/1
REQUIREMENTS: NATIONAL	STATUS: Closed
	DATE : 1 April 1993

PROBLEM:

Luxembourg has issued the following requirements:

None.

BOEING 747-400 FREIGHTER

CERTIFICATION REVIEW ITEM

SUBJECT : ADDITIONAL NATIONAL DESIGN STANDARDS FOR OPERATIONAL APPROVAL IN THE NETHERLANDS	IDENTIFICATION: A-5-5
	STAGE : 2 PAGE 1/1 (+ App.)
REQUIREMENTS: NATIONAL	STATUS: Closed
	DATE : 1 April 1993

PROBLEM:

The Netherlands have issued the following requirements:

THE NETHERLANDS DEPARTMENT OF CIVIL AVIATION

R L D

NATIONAL OPERATIONAL EQUIPMENT REQUIREMENTS

November 1990

(Courtesy translation. In case of doubt or argument the Dutch text prevails).

2105.1 Applicability

It is not allowed to carry out transport flights unless the requirements of Part 2105 of the Civil Air Navigation Regulations are met.

2105.9 Instruments required for IFR-flights

Requires at least:
- A gyroscopic rate of turn indicator combined with an integral slip-skid indicator.
- A gyroscopically stabilized bank and pitch indicator.
- A gyroscopically stabilized direction indicator.
- Means indicating adequate power supply of the gyroscopically stabilized instruments.
- Two sensitive pressure altimeters or one sensitive pressure altimeter and one sensitive altimeter of another type.
- A free-air temperature-indicator.
- A clock with a central sweep-second pointer.
- An airspeed indicator provided with means to prevent malfunctioning as a consequence of condensation or ice accretion.
- A rate-of-climb indicator.

In aeroplanes with a maximum certified mass in excess of 5700 kg the gyroscopic rate of turn indicator may be replaced by an additional gyroscopically stabilized bank and pitch indicator giving reliable indication in all aircraft's flight attitudes, which is powered from a source independent of the electrical generating system.

2105.10 Installations for radiocommunication

The installation for radiocommunication must be able to:
- Provide radiocommunication with the local air traffic control center.
- Receive meteorologic information during the whole flight.
- Provide radiocommunication with at least one aeronautical station and other aeronautical stations on frequencies which may be required by the authorities.
- Provide radiocommunication on the international emergency frequency 121.5 MHz.

The installation must be arranged such that failure of one required unit will not result in failure of another required unit.

2105.11 Installations for navigation

- The installation must be able:
  a) to perform flight according the navigationplan.
  b) to follow instructions of the Air traffic control services.

  - FL 100 and below:
  - one installation to receive VHF-signals of VOR's and one installation to receive NDB-signals.

  - Above FL 100:
  - one DME installation and:
  - two installations to receive VHF-signals of VOR's and one installation to receive NDB-signals (on routes where VOR is the most important means of navigations); or
  - one installation to receive VHF-signals of VOR's and two installations to receive NDB-signals (on routes where NDB is the most important means of navigation).

These installations must at least comply with the standards of ICAO Annex 10 (Aeronautical Telecommunications) part I of Book I.
In case two installations are required, one installation may be replaced by an INS or an INS based RNAV system or another installation approved by RLD.
Failure of one required installation must not result in failure of another required installation.

2105.12 Installation for landings in Instrument Meteorological Conditions (IMC)

Aeroplanes intending to land in Instrument Meteorological Conditions must have a radio-installation receiving signals and instruction necessary for an Instrument Approach Procedure (See definition Jeppesen).

2105.13 Surveillance

SSR Transponder system with 4096 codes in mode A and automatic altitude transmission in mode C in compliance with the standards of ICAO Annex 10, part I of Book I.

2105.14 Weather radar

Aeroplanes with a pressure cabin must, when carrying passengers, be provided with a weather radar-installation, when flying in IMC conditions.

2105.15 Ground Proximity Warning System

All turbine-engined aeroplanes with a maximum certified mass in excess of 5700 kg must, when flying during night or in IMC conditions, be provided with a GPWS in compliance with RLD-requirements (TSO-92A).

2

2105.17 Oxygen and oxygenmasks

Para 1: Applicable for flights at altitudes with atmospheric- pressure below 700 mb:

The aeroplane must be equipped with an installation to supply oxygen, adequate for providing:

- The crew and 10% of the number of passengers continuously with oxygen, following a period of 30 minutes during which the pressure in their compartments has been between 700 and 620 mb, as long as the pressure remains between these limits; and
- To supply the crew and passengers with oxygen during any period the pressure in their compartments will be below 620 mb.

Para 2: Applicable for flights with a pressurized aeroplane at altitudes with atmospheric pressure below 700 mb.

- The aeroplane must be equipped with an oxygen supply installation.
- The quantity of oxygen must be sufficient to provide all crew members and passengers with oxygen during any period the pressure in any of their compartments will be below 700 mb.

Para 3: A pressurized aeroplane, when flying at altitude with atmospheric pressure below 376 mb must be equipped with a warning device for dangerous loss of overpressure.

Para 4: All cockpit crew members of pressurized aeroplanes flying at altitudes with atmospheric pressure below 376 mb must have available, when seated, a mask of a type that enables immediate breathing of oxygen.

2105.19 Flights during night

When flying during night the aeroplane must be equipped with the instruments mentioned in article 2105.9 as well as:

- lighting for all instruments and installations used by the crew necessary for safe operation of the aeroplane;
- external lighting system in accordance with article 21, para 1 of "Luchtverkeersreglement";
- an electrical torch for each crewmember;
- two landing lights or one landing light with two separately powered filaments;
- lights in the passenger compartments;
- an anti-collision-light for aeroplanes with a maximum certified mass in excess of 5700 kg;
- an emergency exit lighting system for aeroplanes with a maximum certified mass in excess of 5700 kg.

3

2105.22 First aid kit

The first aid kit, contents to be approved by RLD, must be readily accessible for the passengers and its stowage location must be indicated clearly.

2105.24 Spare fuses

Spare fuses must be on board, at least 25% of the number of normally used fuses of each value with a minimum of three of each value.

2105.27 Flight recorders

Para 1: Turbine-engined airplanes with a maximum certified mass in excess of 5700 kg must be equipped with a flight recorder.

Para 2: The flight recorder must consist of:

- a Flight Data Recorder (FDR) which must be able to present the required parameters of at least the last 25 hours of operation.
  NOTE: With regard to the required parameters the RLD policy is to follow ICAO Annex 6 para 6.3 with attachment D. Small deviations from the parameter list, e.g. as specified by the U.K. CAA are acceptable.
- a Cockpit Voice Recorder (CVR), recording from the beginning of the reading of the "before engine-starting" checklist until completion of the final checklist. The CVR must be able to present the recorded data of at least the last 30 minutes of operation.

Para 3 : The flight recorder must be constructed and installed to maximize protection against emergency landing conditions.

Para 4 : The FDR may not be switched off during flight.

Para 5 : The CVR may not be switched off during the last 30 minutes of operation, unless the captain deems this necessary to preserve registered information for later investigation.

2105.28 Installation for measuring and indication cosmic radiation

For flights above 49,000 ft altitude the aeroplane must be equipped with an installation to measure continuously the immitted cosmic radiation per unit of time and to indicate this clearly visible to one of the flight crew members as well as the total immitted quantity radiation during each flight.

2105d.1 Joint requirements for emergency and safety airborne equipment

For transport flights with aeroplanes with a maximum certified mass in excess of 5700 kg or with a passenger seating configuration, excluding pilots seats, of 10 seats or more, the requirements of ECAC Document No 18 issue 2, dated September 1988) have to be met.

SPECIAL CONDITION	**B-02: Human Factors**
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	JAR 21.16
ADVISORY MATERIAL:	CAP 681 Global Fatal Accident Review 1980 - 96; UK CAA 1998 FAA Policy Statement Number ANM-99-2 on Guidance for Reviewing Human Factors Certification Plans EN ISO 13407:1999 Human-Centred Design Processes for Interactive Systems.

A Special Condition is raised as follows:

1. Novel Features:
   Assessment of the flight deck to ascertain whether novel features are present should be conducted in accordance with JAR 21.16. In addition, some supplementary notes to support the interpretation of 'novel' for Human Factors considerations are provided. If no novel features are present the team should proceed without further reference to this Interim Policy.

2. Special Condition:
   If novel features are present, the Team should raise a Special Condition as follows:

   a) The design of the integrated Flight Deck Interface must adequately address the foreseeable performance, capability and limitations of the Flight Crew.
   b) More specifically the Authority must be satisfied with the following aspects of the Flight Deck Interface design:
   i) ease of operation [including automation]
   ii) the effects of crew errors in managing the aircraft systems, including the potential for error, the possible severity of the consequences, and the provision for recognition and recovery from error
   iii) task sharing and distribution of workload between crew members during normal and abnormal operation
   iv) the adequacy of feedback, including clear and unambiguous:
      - presentation of information
      - representation of system condition by display of system status
      - indication of failure cases, including aircraft status
      - indication when crew input is not accepted or followed by the system
      - indication of prolonged or severe compensatory action by a system when such action could adversely affect aircraft safety

3. Implementation
   It is envisaged that the Flight Test Panel would manage implementation. A proposal for interpretative material associated to the special condition is attached as appendix B. This will call for:

i) General Assessment:
A general review of Human Factors issues arising from integrated use of the flight deck.

ii) Novel features:
Careful exploration of specific Human Factors issues arising from novel items in the flight deck.

Special Condition B-02 continued

4. Appoint Assistant Specialist:

Where issues raised within the project are significant, the Team may wish to appoint a suitable Human Factors Assistant Specialist to the Flight Test Panel under the existing terms of JAA Certification / Validation Procedures / 1 1996 paragraph M/5.6. The criteria for a suitable individual are identified in Appendix C.

5. Appendices (See JAA Interim Policy 25/9)

A Determination of the Need for a Special Condition
B Guidance Notes on Showing Compliance to the Special Condition
C Criteria for a Human Factors Assistant Specialist

6. Reference Material / Related Documents

(1) CAP 681 Global Fatal Accident Review 1980 - 96; UK CAA 1998

(2) FAA Policy Statement Number ANM-99-2 on Guidance for Reviewing Human Factors Certification Plans

(3) EN ISO 13407:1999 Human-Centred Design Processes for Interactive Systems.

EQUIVALENT SAFETY FINDING	B-12: Standby Air Data System
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	FAR 25.1325(e);
ADVISORY MATERIAL:	AC 25-7B

Description of compensating design features or alternative standards which allow the granting of the ESF

Compensating Aircraft Design Features
The Primary Flight Display (PFD) failure probability is 4E-8 per flight hour. Thus, PFD failure is highly improbable and the Standby Air Data System is rarely required for continued safe flight and landing.

Compensating Flight Crew Procedures
Flight crews are trained to operate aircraft at recommended operating speeds:

- Standby Air Data System meets §25.1325(e) standard method of compliance (SMoC) with flaps 1 at or above the flaps 1 maneuver speed.
- Standby Air Data System meets §25.1325(e) SMoC with flaps 5 at or above the flaps 5 maneuver speed.
- Standby Air Data System meets §25.1325(e) SMoC with flaps 25 at V_{REF}+8 or less.
  - Normal wind additives are one half of the reported steady headwind component plus the full gust increment above the steady wind to the reference speed. (FCTM section 6)
  - The maximum wind additive is 20 knots (FCTM section 6)
  - The steady headwind correction is bled off during the flare, however the gust correction is maintained to touchdown. Plan to touchdown at V_{REF} plus the gust correction. (FCTM section 6)
- Standby Air Data System meets §25.1325(e) SMoC with flaps 30 at V_{REF}+5 or less.
  - Normal wind additives are one half of the reported steady headwind component plus the full gust increment above the steady wind to the reference speed. (FCTM section 6)
  - The maximum wind additive is 20 knots (FCTM section 6)
  - The steady headwind correction is bled off during the flare, however the gust correction is maintained to touchdown. Plan to touchdown at V_{REF} plus the gust correction. (FCTM section 6)

The effects of standby altitude errors are also mitigated when the flight crew uses other sources of altitude/flight information such as the radio altimeter, electronic glide slope information (ILS, GLS, MLS, etc.), and visual glide slope information (e.g. VASI, PAPI, etc.).
The effects of standby altitude errors are also mitigated when the flight crew applies the AFM/FCOM/QRH Standby Air Data System corrections. These AFM/FCOM/QRH corrections provide the flight crew with the means to safely and effectively compensate for residual standby air data system errors that may be of concern. The corrections are provided in the FCOM/QRH via an AFM Limitation.

The Effects of Standby Air Data System §25.1325(e) SMoC Exceedances

The Standby System altitude exceedances are limited in terms of flap detents affected, exposure, and magnitudes. Mitigations are available for the exceedences.

Summary of §25.1325(e) Compliance Issues and Mitigations			
Flaps	Airspeed	§25.1325(e) SMoC Exceedances	These SMoC Exceedances are mitigated when the flight crew uses the following procedures
1	Below 1.36 V_{SR}	Aircraft flies no more than 50 feet lower	• Flight crew operates at or above the flap 1 maneuver speed as recommended in the FCTM • Flight crew applies AFM/FCOM/QRH Standby Air Data System corrections
5	Below 1.30 V_{SR}	Aircraft flies no more than 28 feet lower	• Flight crew operates at or above the flap 5 maneuver speed as recommended in the FCTM • Flight crew applies AFM/FCOM/QRH Standby Air Data System corrections
25	Between 1.33 V_{SR} and 1.66 V_{SR}	Aircraft flies no more than 6 feet higher	• Flight crew operates at V_{REF}+5 (wind additives to V_{REF} are 8 knots or less for light weight landings and 13 knots or less for heavy weight landings) • Flight crew uses radio altimeter, instrument glide slope information and visual glide slope information • Flight crew applies AFM/FCOM/QRH Standby Air Data System corrections
30	Above 1.29 V_{SR}	Aircraft flies no more than 5 feet higher	• Flight crew operates at V_{REF}+5 (wind additives to V_{REF} are 5 knots or less for light weight landings and 8 knots or less for heavy weight landings) • Flight crew uses radio altimeter, instrument glide slope information and visual glide slope information • Flight crew applies AFM/FCOM/QRH Standby Air Data System corrections

When operated at the recommended speeds the Standby System exceedences are further limited in terms of flap detents affected and exposure. Mitigations are still available for the exceedences.

Summary of §25.1325(e) Compliance Issues at Recommended Operating Speeds			
Flaps	Airspeed	§25.1325(e) SMoC Exceedences	These SMoC Exceedences are mitigated when the flight crew uses the following procedures
25	Between ~ V_{REF25} + 10 and V_{REF25} + 20	Aircraft flies no more than 6 feet higher	• Flight crew uses radio altimeter, instrument glide slope information and visual glide slope information

Summary of §25.1325(e) Compliance Issues at Recommended Operating Speeds			
Flaps	Airspeed	§25.1325(e) SMoC Exceedences	These SMoC Exceedences are mitigated when the flight crew uses the following procedures
			• Flight crew applies AFM/FCOM/QRH Standby Air Data System corrections
30	Between ~ V_{REF30} + 5 and V_{REF30} + 20	Aircraft flies no more than 5 feet higher	• Flight crew uses radio altimeter, instrument glide slope information and visual glide slope information • Flight crew applies AFM/FCOM/QRH Standby Air Data System corrections

The Standby Air Data System §25.1325(e) SMoC exceedances are of concern only with the following improbable combination of events:

- Both Primary Flight Displays (PFD) inoperative (4.28E-8 Failures Per Flight Hour)
- Low ceiling at landing site that requires dependence on standby altimeter during an instrument approach
- Flight crew does not apply AFM/FCOM/QRH corrections for Standby Air Data System

Even if this scenario did occur, mitigation is still available when the flight crew utilizes:

- Radio altimeter
- Electronic glide slope information (e.g. ILS, GLS, etc.)
- Visual approach slope indicators (e.g. VASI, PAPI)

Explanation of how design features provide an equivalent level of safety to the level of safety intended by the regulation

The Standby Air Data System uses a simple design for maximum reliability. The Standby Air Data System uses few inputs to minimize the effects of multiple system failures and other adverse conditions. Static pressure ports are located to avoid contamination.
It is believed that given the requirement that the standby air data must reliably perform in the worst foreseeable conditions, flight safety is improved more by maximizing standby air data reliability than maximizing standby air data accuracy.
Recommended operating speeds minimize compliance exposure and exceedences.
The AFM/FCOM/QRH corrections provide the flight crew with the means to safely and effectively compensate for residual standby air data system errors that may be of concern.

SPECIAL CONDITION	C-02: Fuel Tank Pressure Loads
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	CS 25.963(d)
ADVISORY MATERIAL:	

Fuel tanks must, so far as is practical, be designed, located, and installed so that no fuel is released, in quantities sufficient to start a serious fire, in otherwise survivable emergency landing conditions; and:

(1) All fuel tanks must be able to resist rupture and to retain fuel under ultimate hydrostatic design conditions in which the pressure P within the tank varies in accordance with the formula:

$$P = 0.34 * K * L$$

where:

P = fuel pressure in psi at each point within the tank;
L = a reference distance in feet between the point of pressure and the tank farthest boundary in the direction of loading;
K = 4.5 for the forward loading condition for fuel tanks outside the fuselage contour;
K = 9 for the forward loading condition for fuel tanks within the fuselage contour;
K = 1.5 for the aft loading condition;
K = 3.0 for the inboard and outboard loading conditions for fuel tanks within the fuselage contour;
K = 1.5 for the inboard and outboard loading conditions for fuel tanks outside of the fuselage contour;

K = 6 for the downward loading condition;
K = 3 for the upward loading condition.

(2) For those (parts of) wing fuel tanks near the fuselage and near the engines, the greater of the fuel pressures resulting from subparagraphs (a) and (b) must be used:

(a) the fuel pressures resulting from subparagraph (1) above, and:
(b) the lesser of the two following conditions:

(i) Fuel pressures resulting from the accelerations as specified in CS 25.561(b)(3) considering the fuel tank full of fuel at maximum fuel density. Fuel pressures based on the 9.0g forward acceleration may be calculated using the fuel static head equal to the streamwise local chord of the tank. For inboard and outboard conditions, an acceleration of 1.5g may be used in lieu of 3.0g as specified in CS 25.561(b)(3);

(ii) Fuel pressures resulting from the accelerations as specified in CS 25.561(b)(3) considering a fuel volume beyond 85% of the maximum permissible volume in each tank using the static head associated with the 85% fuel level. A typical density of the appropriate fuel may be used. For inboard and outboard conditions, an acceleration of 1.5g may be used in lieu of 3.0g as specified in CS 25.561(b)(3).

(3) Fuel tank internal barriers and baffles may be considered as solid boundaries if shown to be effective in limiting fuel flow.

SPECIAL CONDITION	C-05: Landing Gear Criteria
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	Various CS-25 requirements
ADVISORY MATERIAL:	

Some of the requirements called out in FAA SC A-4 have evolved since the 1970's, mainly because of harmonisation efforts between JAA and FAA. In fact, the issue of unconventional landing gear arrangement itself has been the subject of a dedicated harmonisation effort between JAA and FAA. Also, the FAA SC calls out FAR 25 requirements, whereas the EASA TC Basis is based on CS-25.

For these reasons a review of FAA SC A-4 is requested to determine the appropriate EASA Special Condition on this subject.

SPECIAL CONDITION	**C-06: Sustained engine imbalance**
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	CS 25.901(c)
ADVISORY MATERIAL:	

A. EXPLANATORY NOTE

In 1988, the JAA, the FAA and organisations representing the European and United States aerospace industries, began a process to harmonise the airworthiness requirements of the European authorities and the airworthiness requirements of the United States. The objective was to achieve common requirements for the certification of large/transport aeroplanes without a substantive change in the level of safety. Other airworthiness authorities such as Transport Canada also participated in this process.

In 1991, the harmonisation effort was undertaken by the Aviation Regulatory Advisory Committee (ARAC). Under the auspices of ARAC, a working group of industry and government structural specialists of Europe, the U.S., and Canada has developed recommendations regarding design criteria and analytical methodology for assessing the engine imbalance event. These recommendations are contained in the report "Engine Windmilling Imbalance Loads - Final Report " dated July 1, 1997. The proposals contained in this NPA are derived from the recommendations in that report.

B. SAFETY JUSTIFICATION / EXPLANATION

Referred is to the background section of the proposed ACJ 25.901(c).
(Note: P-NPA 25C-305 "Engine and Auxiliary Power Unit Load Conditions" is closely related to this NPA.)

C. COST / SAFETY BENEFIT ASSESSMENT

The proposals contained in this NPA are intended to achieve common advisory material on the sustained engine imbalance conditions of JAR-25 and FAR 25. The FAA has published AC 25-24 "Sustained Engine Imbalance" on August 2, 2000.

Harmonisation of advisory material of JAR-25 and FAR 25 on this subject would yield cost savings by eliminating duplicate certification activities.

D. PROPOSALS

1. To add reference to a new ACJ in JAR 25.901(c):

(c) The powerplant installation must comply with JAR 25.1309. (See ACJ 25.901(c).)

2. To add a new ACJ 25.901(c) to read as follows:

ACJ 25.901(c)
Sustained Engine Imbalance (Interpretative Material and Acceptable Means of Compliance)

See JAR 25.901(c)

1. PURPOSE. This ACJ sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of JAR-25 related to the aircraft design for sustained engine rotor imbalance conditions.

Special Condition C-06 continued

2. RELATED JAR PARAGRAPHS.

a. JAR-25:
JAR 25.571 "Damage tolerance and fatigue evaluation of structure"
JAR 25.629 "Aeroelastic stability requirements"
JAR 25.903 "Engines"

b. JAR-E:
JAR-E 810 "Compressor and Turbine Blade Failure"
JAR-E 520 "Strength"

3. DEFINITIONS. Some new terms have been defined for the imbalance condition in order to present criteria in a precise and consistent manner. In addition, some terms are employed from other fields and may not be in general use as defined below. The following definitions apply in this ACJ:

a. Airborne Vibration Monitor (AVM). A device used for monitoring the operational engine vibration levels that are unrelated to the failure conditions considered by this ACJ.

b. Design Service Goal (DSG). The design service goal is a period of time (in flight cycles/hours) established by the applicant at the time of design and/or certification and used in showing compliance with JAR 25.571.

c. Diversion Flight. The segment of the flight between the point where deviation from the planned route is initiated in order to land at an en route alternate airport and the point of such landing.

d. Ground Vibration Test (GVT). Ground resonance tests of the aeroplane normally conducted in compliance with JAR 25.629.

e. Imbalance Design Fraction (IDF). The ratio of the design imbalance to the imbalance (including all collateral damage) resulting from tests of a single release of a turbine, compressor, or fan blade at redline speed (as usually conducted for compliance with JAR-E 810).

f. Low Pressure (LP) Rotor. The rotating system, which includes the low pressure turbine and compressor components and a connecting shaft.

g. Well Phase. The flight hours accumulated on an aeroplane or component before the failure event.

4. BACKGROUND.

a. Requirements. JAR 25.901(c) requires the powerplant installation to comply with JAR 25.1309. In addition, JAR 25.903(c) requires means of stopping the rotation of an engine where continued rotation could jeopardise the safety of the aeroplane, and JAR 25.903(d) requires that design precautions be taken to minimise the hazards to the aeroplane in the event of an engine rotor failure. JAR-E 520(c)(2) requires that data shall be established and provided for the purpose of enabling each aircraft constructor to ascertain the forces that could be imposed on the aircraft structure and systems as a consequence of out-of-balance running and during any continued rotation with rotor unbalance after shutdown of the engine following the occurrence of blade failure as demonstrated in compliance with JAR-E 810.

Special Condition C-06 continued

b. Blade Failure. The failure of a fan blade and the subsequent damage to other rotating parts of the fan and engine may induce significant structural loads and vibration throughout the airframe that may damage the nacelles, critical equipment, engine mounts, and airframe primary structure. Also, the effect of flight deck vibration on displays and equipment is of significance to the crew's ability to make critical decisions regarding the shut down of the damaged engine and their ability to carry out other operations during the remainder of the flight. The vibratory loads resulting from the failure of a fan blade have traditionally been regarded as insignificant relative to other portions of the design load spectrum for the aeroplane. However, the progression to larger fan diameters and fewer blades with larger chords has changed the significance of engine structural failures that result in an imbalanced rotating assembly. This condition is further exacerbated by the fact that fans will continue to windmill in the imbalance condition following engine shut down. Current rules require provisions to stop the windmilling rotor where continued rotation could jeopardise the safety of the aeroplane. However, large high bypass ratio fans are practically impossible to stop in flight.

c. Shaft Support Failure. Service experience has shown that failures of shaft bearings and shaft support structure have also resulted in sustained high vibratory loads similar to the sustained imbalance loads resulting from fan blade loss.

d. Imbalance Conditions. There are two sustained imbalance conditions that may affect safe flight: the windmilling condition and a separate high power condition.

(1) Windmilling Condition. The windmilling condition results after the engine is spooled down but continues to rotate under aerodynamic forces. The windmilling imbalance condition results from shaft support failure or loss of a fan blade along with collateral damage. This condition may last until the aeroplane completes its diversion flight, which could be several hours.

(2) High Power Condition. The high power imbalance condition occurs immediately after blade failure but before the engine is shut down or otherwise spools down. This condition addresses losing less than a full fan blade which may not be sufficient to cause the engine to spool down on its own. This condition may last from several seconds to a few minutes. In some cases it has hampered the crew's ability to read instruments that may have aided in determining which engine was damaged.

e. The information provided in this ACJ is derived from the recommendations in the report "Engine Windmilling Imbalance Loads - Final Report," dated July 1, 1997.

f. The criteria presented in this ACJ are based on a statistical analysis of 25 years of service history of high by-pass ratio engines with fan diameters of 1.52 metres (60 inches) or greater. Although the study was limited to these larger engines, the criteria and methodology are also acceptable for use on smaller engines.

5. EVALUATION OF THE WINDMILLING IMBALANCE CONDITIONS.

a. Objective. It should be shown by a combination of tests and analyses that after partial or complete loss of an engine fan blade, including collateral damage, or after shaft support failure, the aeroplane is capable of continued safe flight and landing.

b. Evaluation. The evaluation should show that during continued operation at windmilling engine rotational speeds, the induced vibrations will not cause damage that would jeopardise continued safe flight and landing. The degree of flight deck vibration should not prevent the flightcrew from operating the aeroplane in a safe manner. This includes the ability to read and accomplish checklist procedures.

Special Condition C-06 continued

This evaluation should consider:

(1) The damage to airframe primary structure including, but not limited to, engine mounts and flight control surfaces,

(2) The damage to nacelle components, and

(3) The effects on critical equipment (including connectors) mounted on the engine or airframe.

c. Blade Loss Imbalance Conditions.

(1) Windmilling Blade Loss Conditions. The duration of the windmilling event should cover the expected diversion time of the aeroplane. An evaluation of service experience indicates that the probability of the combination of a 1.0 IDF and a 1-hour diversion is on the order of 10^{-7} to 10^{-8} while the probability of the combination of a 1.0 IDF and a 3-hour diversion is 10^{-9} or less. Therefore, with an IDF of 1.0, it would not be necessary to consider diversion times greater than 3 hours. In addition, the 3-hour diversion should be evaluated using nominal and realistic flight conditions and parameters. The following two separate conditions with an IDF of 1.0 are prescribed for application of the subsequent criteria which are developed consistent with the probability of occurrence:

(a) A 1-hour diversion flight.

(b) If the maximum diversion time established for the aeroplane exceeds 1 hour, a diversion flight of a duration equal to the maximum diversion time, but not exceeding 3 hours.

(2) Aeroplane Flight Loads and Phases.

(a) Loads on the aeroplane components should be determined by dynamic analysis. At the start of the windmill event, the aeroplane is assumed to be in level flight with a typical payload and realistic fuel loading. The speeds, altitudes, and flap configurations considered may be established according to the Aeroplane Flight Manual (AFM) procedures. The analysis should take into account unsteady aerodynamic characteristics and all significant structural degrees of freedom including rigid body modes. The vibration loads should be determined for the significant phases of the diversion profiles described in paragraphs 5c(1)(a) and (b) above.

(b) The significant phases are:

1 The initial phase during which the pilot establishes a cruise condition;

2 The cruise phase;

3 The descent phase; and

4 The approach to landing phase.

(c) The flight phases may be further divided to account for variation in aerodynamic and other parameters. The calculated loads parameters should include the accelerations needed to define the vibration environment for the systems and flight deck evaluations. A range of windmilling frequencies to account for variation in engine damage and ambient temperature should be considered.

Special Condition C-06 continued

(3) Strength Criteria.

(a) The primary airframe structure should be designed to withstand the flight and windmilling vibration load combinations defined in paragraphs 1, 2, and 3 below.

1 The peak vibration loads for the flight phases in paragraphs 5c(2)(b)1 and 3 above, combined with appropriate 1g flight loads. These loads should be considered limit loads, and a factor of safety of 1.375 should be applied to obtain ultimate load.

2 The peak vibration loads for the approach to landing phase in paragraph 5c(2)(b)4 above, combined with appropriate loads resulting from a positive symmetrical balanced manoeuvring load factor of 1.15 g. These loads should be considered as limit loads, and a factor of safety of 1.375 should be applied to obtain ultimate load.

3 The vibration loads for the cruise phase in paragraph 5c(2)(b)2 above, combined with appropriate 1g flight loads and 70 percent of the flight manoeuvre loads up to the maximum likely operational speed of the aeroplane. These loads are considered to be ultimate loads.

4 The vibration loads for the cruise phase in paragraph 5c(2)(b)2 above, combined with appropriate 1g flight loads and 40 percent of the limit gust velocity of JAR 25.341 as specified at V_C (design cruising speed) up to the maximum likely operational speed of the aeroplane. These loads are considered to be ultimate loads.

(b) In selecting material strength properties for the static strength analyses, the requirements of JAR 25.613 apply.

(4) Assessment of Structural Endurance.

(a) Criteria for fatigue and damage tolerance evaluations of primary structure are summarised in Table 1 below. Both of the conditions described in paragraphs 5c(1)(a) and (b) above should be evaluated. Different levels of structural endurance capability are provided for these conditions. The criteria for the condition in paragraph 5c(1)(b) are set to ensure at least a 50 percent probability of preventing a structural component failure. The criteria for the condition in paragraph 5c(1)(a) are set to ensure at least a 95 percent probability of preventing a structural component failure. These criteria are consistent with the probability of occurrences for these events discussed in paragraph 5(c)(1) above.

(b) For multiple load path and crack arrest "fail-safe" structure, either a fatigue analysis per paragraph 1 below, or damage tolerance analysis per paragraph 2 below, may be performed to demonstrate structural endurance capability. For all other structure, the structural endurance capability should be demonstrated using only the damage tolerance approach of paragraph 2 below. The definitions of multiple load path and crack arrest "fail-safe" structure are the same as defined for use in showing compliance with JAR 25.571, "Damage tolerance and fatigue evaluation of structure."

1 Fatigue Analysis. Where a fatigue analysis is used for substantiation of multiple load path "fail-safe" structure, the total fatigue damage accrued during the well phase and the windmilling phase should be considered. The analysis should be conducted considering the following:

(aa) For the well phase, the fatigue damage should be calculated using an approved load spectrum (such as used in satisfying the requirements of JAR 25.571) for the durations specified in Table 1. Average material properties may be used.

Special Condition C-06 continued

(bb) For the windmilling phase, fatigue damage should be calculated for the diversion profiles using a diversion profile consistent with the AFM recommended operations, accounting for transient exposure to peak vibrations, as well as the more sustained exposures to vibrations. Average material properties may be used.

(cc) For each component, the accumulated fatigue damage specified in Table 1 should be shown to be less than or equal to the fatigue damage to failure of the component.

2 Damage Tolerance Analysis. Where a damage tolerance approach is used to establish the structural endurance, the aeroplane should be shown to have adequate residual strength during the specified diversion time. The extent of damage for residual strength should be established, considering growth from an initial flaw assumed present since the aeroplane was manufactured. Total flaw growth will be that occurring during the well phase, followed by growth during the windmilling phase. The analysis should be conducted considering the following:

(aa) The size of the initial flaw should be equivalent to a manufacturing quality flaw associated with a 95 percent probability of existence with 95 percent confidence (95/95).

(bb) For the well phase, crack growth should be calculated starting from the initial flaw defined in paragraph 5c(4)(b)2(aa) above, using an approved load spectrum (such as used in satisfying the requirements of JAR 25.571) for the duration specified in Table 1. Average material properties may be used.

(cc) For the windmilling phase, crack growth should be calculated for the diversion profile starting from the crack length calculated in paragraph 5c(4)(b)2(bb) above. The diversion profile should be consistent with the AFM recommended operation accounting for transient exposure to peak vibrations as well as the more sustained exposures to vibrations. Average material properties may be used.

(dd) The residual strength for the structure with damage equal to the crack length calculated in paragraph 5c(4)(b)2(cc) above should be shown capable of sustaining the combined loading conditions defined in paragraph 5c(3)(a) above with a factor of safety of 1.0.

Special Condition C-06 continued

TABLE 1 - Fatigue and Damage Tolerance

	Condition	Paragraph 5c(1)(a)	Paragraph 5c(1)(b)
	Imbalance Design Fraction (IDF)	1.0	1.0
	Diversion time	A 60-minute diversion	The maximum expected diversion[6]
Fatigue Analysis[1,2] (average material properties)	Well phase	Damage for 1 DSG	Damage for 1 DSG
	Windmilling phase	Damage due to 60 minutes diversion under a 1.0 IDF imbalance condition.	Damage due to the maximum expected diversion time[6] under a 1.0 IDF imbalance condition
	Criteria	Demonstrate no failure[7] under twice the total damage due to the well phase and the windmilling phase.	Demonstrate no failure[7] under the total damage (unfactored) due to the well phase and the windmilling phase.
Damage Tolerance[1,2] (average material properties)	Well phase	Manufacturing quality flaw[5] (MQF) grown for 1 DSG	Manufacturing quality flaw[5] (MQF) grown for 1/2 DSG
	Windmilling phase[3,4]	Additional crack growth for 60 minute diversion with an IDF = 1.0	Additional crack growth for the maximum diversion[6] with an IDF = 1.0
	Criteria	Positive margin of safety with residual strength loads specified in 5c(3)(a) for the final crack length	Positive margin of safety with residual strength loads specified in 5c(3)(a) for the final crack length

Notes:

1 *The analysis method that may be used is described in paragraph 5 (Evaluation of the Windmilling Imbalance Conditions) of this ACJ.*

[2] *Load spectrum to be used for the analysis is the same load spectrum qualified for use in showing compliance with JAR 25.571, augmented with windmilling loads as appropriate.*

[3] *Windmilling phase is to be demonstrated following application of the well phase spectrum loads*.

[4] *The initial flaw for damage tolerance analysis of the windmilling phase need not be greater than the flaw size determined as the detectable flaw size plus growth under well phase spectrum loads for one inspection period for mandated inspections.*

[5] *MQF is the manufacturing quality flaw associated with 95/95 probability of existence. (Reference - 'Verification of Methods For Damage Tolerance Evaluation of Aircraft Structures to FAA Requirements', Tom Swift FAA, 12th International Committee on Aeronautical Fatigue, 25 May 1983, Figures 42, and 43.)*

Special Condition C-06 continued

[6] *Maximum diversion time for condition 5c(1)(b) is the maximum diversion time established for the aeroplane, but need not exceed 180 minutes. This condition should only be investigated if the diversion time established for the aeroplane exceeds 60 minutes.*

[7] *The allowable cycles to failure may be used in the damage calculations.*

(5) Systems Integrity.

(a) It should be shown that systems required for continued safe flight and landing after a blade-out event will withstand the vibratory environment defined for the windmilling conditions and diversion times described above. For this evaluation, the aeroplane is assumed to be dispatched in its normal configuration and condition. Additional conditions associated with the Master Minimum Equipment List (MMEL) need not be considered in combination with the blade-out event.

(b) The initial flight environmental conditions are assumed to be night, instrument meteorological conditions (IMC) en route to nearest alternate airport, and approach landing minimum of 300 feet and 3/4 mile or runway visual range (RVR) 4000 or better.

(6) Flightcrew Response. For the windmilling condition described above, the degree of flight deck vibration shall not inhibit the flightcrew's ability to continue to operate the aeroplane in a safe manner during all phases of flight.

d. Shaft Support Failure. To evaluate these conditions, the low pressure (LP) rotor system should be analysed with each bearing removed, one at a time, with the initial imbalance consistent with the airborne vibration monitor (AVM) advisory level. The analysis should include the maximum operating LP rotor speed (assumed bearing failure speed), spool down, and windmilling speed regions. The effect of gravity, inlet steady air load, and significant rotor to stator rubs and gaps should be included. If the analysis or experience indicates that secondary damage such as additional mass loss, secondary bearing overload, permanent shaft deformation, or other structural changes affecting the system dynamics occur during the event, the model should be revised to account for these additional effects. The objective of the analyses is to show that the loads and vibrations produced by the shaft support failure event are less than those produced by the blade loss event across the same frequency range.

6. ANALYSIS METHODOLOGY.

a. Objective of the Methodology. The aeroplane response analysis for engine windmilling imbalance is a structural dynamic problem. The objective of the methodology is to develop acceptable analytical tools for conducting dynamic investigations of imbalance events. The goal of the windmilling analyses is to produce loads and accelerations suitable for structural, systems, and flight deck evaluations.

b. Scope of the Analysis. The analysis of the aeroplane and engine configuration should be sufficiently detailed to determine the windmilling loads and accelerations on the aeroplane. For aeroplane configurations where the windmilling loads and accelerations are shown not to be significant, the extent and depth of the analysis may be reduced accordingly.

c. Results of the Analysis. The windmilling analyses should provide loads and accelerations for all parts of the primary structure. The evaluation of equipment and human factors may require additional analyses or tests. For example, the analysis may need to produce floor

vibration levels, and the human factors evaluation may require a test (or analysis) to subject the seat and the human subject to floor vibration.

Special Condition C-06 continued

7. MATHEMATICAL MODELLING.

a. Components of the Integrated Dynamic Model. Aeroplane dynamic responses should be calculated with a complete integrated airframe and engine analytical model. The aeroplane model should be to a similar level of detail to that used for certification flutter and dynamic gust analyses, except that it should also be capable of representing asymmetric responses. The dynamic model used for windmilling analyses should be representative of the aeroplane to the highest windmilling frequency expected. The integrated dynamic model consists of the following components:

(1) Airframe structural model,

(2) Engine structural model,

(3) Control system model,

(4) Aerodynamic model, and

(5) Forcing function and gyroscopic effects.

b. Airframe Structural Model. An airframe structural model is necessary in order to calculate the response at any point on the airframe due to the rotating imbalance of a windmilling engine. The airframe structural model should include the mass, stiffness, and damping of the complete airframe. A lumped mass and finite element beam representation is considered adequate to model the airframe. This type of modelling represents each airframe component, such as fuselage, empennage, and wings, as distributed lumped masses rigidly connected to weightless beams that incorporate the stiffness properties of the component. A full aeroplane model capable of representing asymmetric responses is necessary for the windmilling imbalance analyses. Appropriate detail should be included to ensure fidelity of the model at windmilling frequencies. A more detailed finite element model of the airframe may also be acceptable. Structural damping used in the windmilling analysis may be based on Ground Vibration Test (GVT) measured damping.

c. Engine Structural Model.

(1) Engine manufacturers construct various types of dynamic models to determine loads and to perform dynamic analyses on the engine rotating components, its static structures, mounts, and nacelle components. Dynamic engine models can range from a centreline two-dimensional (2D) model, to a centreline model with appropriate three-dimensional (3D) features such as mount and pylon, up to a full 3D finite element model (3D FEM). Any of these models can be run for either transient or steady state conditions.

(2) These models typically include all major components of the propulsion system, such as the nacelle intake, fan cowl doors, thrust reverser, common nozzle assembly, all structural casings, frames, bearing housings, rotors, and a representative pylon. Gyroscopic effects are included. The models provide for representative connections at the engine-to-pylon interfaces as well as all interfaces between components (e.g., inlet-to-engine and engine-to-thrust reverser). The engine that is generating the imbalance forces should be modelled in this level of detail, while the undamaged engines that are operating normally need only to be modelled to represent their sympathetic response to the aeroplane windmilling condition.

Special Condition C-06 continued

(3) Features modelled specifically for blade loss windmilling analysis typically include fan imbalance, component failure and wear, rubs (blade to casing, and intershaft), and resulting stiffness changes. Manufacturers whose engines fail the rotor support structure by design during the blade loss event should also evaluate the effect of the loss of support on engine structural response during windmilling.

(4) Features that should be modelled specifically for shaft support failure windmilling events include the effects of gravity, inlet steady air loads, rotor to stator structure friction and gaps, and rotor eccentricity. Secondary damage should be accounted for, such as additional mass loss, overload of other bearings, permanent shaft deformation, or other structural changes affecting the system dynamics, occurring during rundown from maximum LP rotor speed and subsequent windmilling.

d. Control System Model. The automatic flight control system should be included in the analysis unless it can be shown to have an insignificant effect on the aeroplane response due to engine imbalance.

e. Aerodynamic Model. The aerodynamic forces can have a significant effect on the structural response characteristics of the airframe. While analysis with no aerodynamic forces may be conservative at most frequencies, this is not always the case. Therefore, a validated aerodynamic model should be used. The use of unsteady three-dimensional panel theory methods for incompressible or compressible flow, as appropriate, is recommended for modelling of the windmilling event. Interaction between aerodynamic surfaces and main surface aerodynamic loading due to control surface deflection should be considered where significant. The level of detail of the aerodynamic model should be supported by tests or previous experience with applications to similar configurations. Main and control surface aerodynamic derivatives should be adjusted by weighting factors in the aeroelastic response solutions. The weighting factors for steady flow (k=0) are usually obtained by comparing wind tunnel test results with theoretical data.

f. Forcing Function and Gyroscopic Forces. Engine gyroscopic forces and imbalance forcing function inputs should be considered. The imbalance forcing function should be calibrated to the results of the test performed under JAR-E 810.

8. VALIDATION.

a. Range of Validation. The analytical model should be valid to the highest windmilling frequency expected.

b. Aeroplane Structural Dynamic Model. The measured ground vibration tests (GVT) normally conducted for compliance with JAR 25.629 may be used to validate the analytical model throughout the windmilling range. These tests consist of a complete airframe and engine configuration subjected to vibratory forces imparted by electro-dynamic shakers.

(1) Although the forces applied in the ground vibration test are small compared to the windmilling forces, these tests yield reliable linear dynamic characteristics (structural modes) of the airframe and engine combination. Furthermore, the windmilling forces are far less than would be required to induce non-linear behaviour of the structural material (i.e. yielding). Therefore, a structural dynamic model that is validated by ground vibration test is considered appropriate for the windmilling analysis.

Special Condition C-06 continued

(2) The ground vibration test of the aeroplane may not necessarily provide sufficient information to assure that the transfer of the windmilling imbalance loads from the engine is accounted for correctly. The load transfer characteristics of the engine to airframe interface via the pylon should be validated by test and analysis correlation. In particular, the effect of the point of application of the load on the dynamic characteristics of the integrated model should be investigated in the ground vibration test by using multiple shaker locations.

(3) Structural damping values obtained in the ground vibration tests are considered conservative for application to windmilling dynamic response analysis. Application of higher values of damping consistent with the larger amplitudes associated with windmilling analysis should be justified.

c. Aerodynamic Model. The dynamic behaviour of the whole aeroplane in air at the structural frequency range associated with windmilling is normally validated by the flight flutter tests performed under JAR 25.629.

d. Engine Model. The model is validated based on dedicated vibration tests and results of the JAR-E 810 fan blade loss test. In cases where compliance with JAR-E 810 is granted by similarity instead of test, the model should be correlated to prior experience.

(1) Validation of the engine model static structure, including the pylon, is achieved by a combination of engine and component tests that include structural tests on major load path components. The adequacy of the engine model to predict rotor critical speeds and forced response behaviour is verified by measuring engine vibratory response when imbalances are added to the fan and other rotors. Vibration data are routinely monitored on a number of engines during the engine development cycle, thereby providing a solid basis for model correlation.

(2) While the validation aspects listed above are important for representation of the windmilling loads, the fan blade loss correlation is also pertinent to the windmilling event

because the event involves predicting the response of the entire propulsion system under a high level imbalance load. Correlation of the model against the JAR-E 810 test is a demonstration that the model accurately predicts initial blade release event loads, any rundown resonant response behaviour, frequencies, potential structural failure sequences, and general engine movements and displacements. To enable this correlation to be performed, instrumentation of the blade loss engine test is used (e.g. high speed cinema and video cameras, accelerometers, strain gauges, continuity wires, and shaft speed tachometers).

9. HIGH POWER IMBALANCE CONDITION.

a. An imbalance condition equivalent to 50 percent of one blade at cruise rotor speed considered to last for 20 seconds may be assumed. It should be shown that attitude, airspeed, and altimeter indications will withstand the vibratory environment of the high power condition and operate accurately in that environment. Adequate cues should be available to determine which engine is damaged. Strength and structural endurance need not be considered for this condition.

SPECIAL CONDITION	C-16: Design Roll Manoeuvre
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	CS 25.349(a)
ADVISORY MATERIAL:	

Replace CS 25.349(a) by:

(a) Manoeuvring: the following conditions, speeds and cockpit roll control motions (except as the motions may be limited by pilot effort) must be considered in combination with an aeroplane load factor from zero to two-thirds of the limit positive manoeuvring load factor. In determining the resulting control surface deflections the torsional flexibility of the wing must be considered in accordance with JAR/CS 25.301(b):

(1) Conditions corresponding to maximum steady rolling velocities and conditions corresponding to maximum angular accelerations must be investigated. For the angular acceleration conditions zero rolling velocity may be assumed in the absence of a rational time history investigation of the manoeuvre.

(2) At V_A sudden movement of the cockpit roll control up to the limit is assumed. The position of the cockpit roll control must be maintained until a steady roll rate is achieved and then must be returned suddenly to the neutral position.

(3) At V_C, the cockpit roll control must be moved suddenly and maintained so as to achieve a roll rate not less than that obtained in sub-paragraph (2) of this paragraph.

(4) At V_D, the cockpit roll control must be moved suddenly and maintained so as to achieve a roll rate not less than one-third of that obtained in sub-paragraph (2) of this paragraph.

EQUIVALENT SAFETY FINDING	D-01: Fuselage Doors
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	CS 25.783
ADVISORY MATERIAL:	NPA 25D-301

Context - Description of compensating design features or alternative standards which allow the granting of the ESF

Because NPA 25D-301 is not included in the applicable CS 25 requirements for B747-800/800F these amended requirements are not available for use as "elect to comply" under the provision of Part 21.A.17(a)(1)(ii), but may be considered as Equivalent Safety Findings, under the provision of Part 21.21(c)(2), where applicable.

The scope of NPA 25D301 is to revise and reorganize the existing rules in CS 25 to provide the following:

1. Clarification of the existing design requirements for doors.
2. Definitive criteria for the door design requirements that are currently covered in the existing rules by general text.
3. Additional fail-safe requirements and detailed door design requirements, based on the recommendations of the NTSB and the ATA, and on current industry practice.

The Team accepts that this NPA 25D-301 represents an equivalent level of safety for the applicable CS 25 requirements affected by the NPA and the applicant may elect to comply with the requirements of the NPA 25D-301. In this case the compliance demonstration to NPA 25D-301 will therefore be identified as an Equivalent Safety Finding issue.

This is applicable to the following fuselage doors:

- Main Deck Side Cargo Door (MDSCD)
- Forward Lower Lobe Cargo Door (FLLCD)
- Aft Lower Lobe Cargo Door (ALLCD)

Explanation of how design features provide an equivalent level of safety to the level of safety intended by the regulation

Three specific NPA 25D-301 (25.783) paragraphs are complied with to establish an equivalent level of safety with affected applicable CS 25 requirements:

1. *§(a)(4) "and it must not be possible to restore power to the door during flight."*
2. *§(d)(3)(iii) be designed so that, during pressurized flight, no single failure in the locking system would prevent the locks from restraining the latches necessary to secure the door*
3. *§(d)(8) Each door that could result in a hazard if not closed, must have means to prevent the latches from being moved to the latched position unless the door is closed*

Boeing addressed these additional requirements through the following design features:

1. The requirements of §25.783(a)(4) are met by the use of the ground handling busses for powering the MDSCD control system and power drive units. The ground handling busses are energized only on the ground.

2. The MDSCD lock mechanism consists of a manual handle at one end and vent panels at the other end with the lock torque tube & attached locks in between. The handle contains a spring loaded pin latch which keeps the handle in the stowed door locked position which also keeps the vent panels shut. During pressurized flight, the pressure acting on the vent panels also keeps them shut in the door locked position. With the handle and vent panels held in the door locked position, no single failure during pressurized flight will unlock the locks, thus the requirements of §25.783(d)(3)(iii) are met.

3. With respect to §25.783(d)(8) the MDSCD is electrically sequenced preventing latches from being moved to the latched position, unless the door is closed.

The MDSCD, FLLCD, and ALLCD mechanisms and systems are functionally identical with respect to the description above.

The MDSCD, FLLCD and ALLCD were assessed as compliant with the above three additional requirements and therefore present an equivalent level of safety for the applicable CS 25 requirements affected by the NPA 25D-301.

SPECIAL CONDITION	**D-03: High Altitude Operation / High Cabin Heat Load**
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25.831, CS 25.841, CS 25.903, CS 25.1309
ADVISORY MATERIAL:	

The operation of aeroplanes at altitudes above 41 000 ft involves specific risks for aircraft occupants, and is a kind of operation for which CS-25 does not contain adequate safety standards. Therefore, in accordance with IR 21, § 21A.16B, the EASA considers that there is a need to define Special Conditions.

INT/POL/25/16 issue 1 has been published by the JAA on June 1, 2003 to make sure that the same set of requirements will be applied consistently on all new and ongoing certification programs.

The Special Conditions provided in appendix is proposed for application to B747-8F and B747-8 certification and is based on JAA INT/POL/25/16. Similar Conditions have been required in the past on small executive aeroplanes and more recently on the Boeing 787 and another Very Large Transport Aeroplane.

APPENDIX
SPECIAL CONDITION SC D-03 - SYSTEM OPERATION ABOVE 41 000ft

A - PRESSURE VESSEL INTEGRITY
For the damage tolerance evaluation, in addition to the damage sizes critical for residual strength, the damage sizes critical for depressurisation decay must be considered, taking also into account the (normal) unflawed pressurised cabin leakage rate. The resulting leakage rate must not result in the cabin altitude exceeding the cabin altitude time history shown in Figure 4.

B - VENTILATION
In lieu of the requirements of JAR 25.831(a), the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort and fatigue and to provide reasonable passenger comfort during normal operating conditions and also in the event of any probable failure of any system which could adversely affect the cabin ventilating air. For normal operations, crew members and passengers must be provided with at least 0·55 lb/min of fresh air per person or the equivalent in filtered, recirculated air based on the volume and composition at the corresponding cabin pressure altitude of not more than 8000 ft.
The supply of fresh air in the event of the loss of one source, should not be less than 0·4 lb/min per person for any period exceeding five minutes. However, reductions below this flow rate may be accepted provided that the compartment environment can be maintained at a level which is not hazardous to the occupant (text of the ACJ 25.831(a) of JAR-25 change 15).

C - AIR CONDITIONNING
In addition to the requirements of JAR 25.831, paragraphs (b) through (e), the cabin cooling system must be designed to meet the following conditions during flight above 15 000 ft mean sea level (MSL):

1. After any probable failure, the cabin temperature-time history may not exceed the values shown in Figure 1.
2. After any improbable failure, the cabin temperature-time history may not exceed the values shown in Figure 2.

Other temperatures standards could be accepted by the JAA if they provide an equivalent level of safety.

D - PRESSURISATION

In addition to the requirements of JAR 25.841, the following apply:

1. The pressurisation system, which includes for this purpose bleed air, air conditioning and pressure control systems, must prevent the cabin altitude from exceeding the cabin altitude-time history shown in Figure 3 after each of the following:

   a) Any probable double failure in the pressurisation system (JAR 25.1309 may be applied).

   b) Any single failure in the pressurisation system combined with the occurrence of a leak produced by a complete loss of a door seal element, or a fuselage leak through an opening having an effective area 2.0 times the effective area which produces the maximum permissible fuselage leak rate approved for normal operation, whichever produces a more severe leak.

2. The cabin altitude-time history may not exceed that shown in Figure 4 after each of the following:

   a) The pressure vessel opening or duct failure resulting from probable damage (failure effect) while under maximum operating cabin pressure differential due to a tyre burst, loss of antennas or stall warning vanes, or any probable equipment failure (bleed air, pressure control, air conditioning, electrical source(s) ...) that affects pressurisation.

   b) Complete loss of thrust from engines.

3. In showing compliance with paragraph D.1 and D.2 of this special condition, it may be assumed that an emergency descent is made by an approved emergency procedure. A 17-seconds crew recognition and reaction time must be applied between cabin altitude warning and the initiation of emergency descent.
For flight evaluation of the rapid descent, the test article must have the cabin volume representative of what is expected to be normal

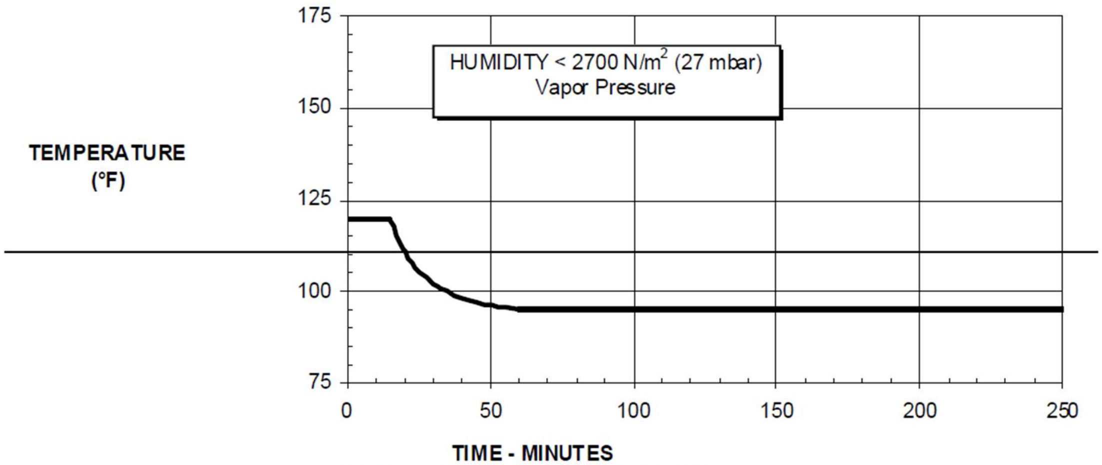
4. Engine rotor failures must be assessed according to the requirements of JAR 25.903(d)(1).

In considering paragraph 8.d(2) of AMJ 20-128A, consideration must be given to the practicability and feasibility of minimising the depressurisation effects, assessing each aircraft configuration on a case-by-case basis, and taking into account the practices in the industry for each configuration.

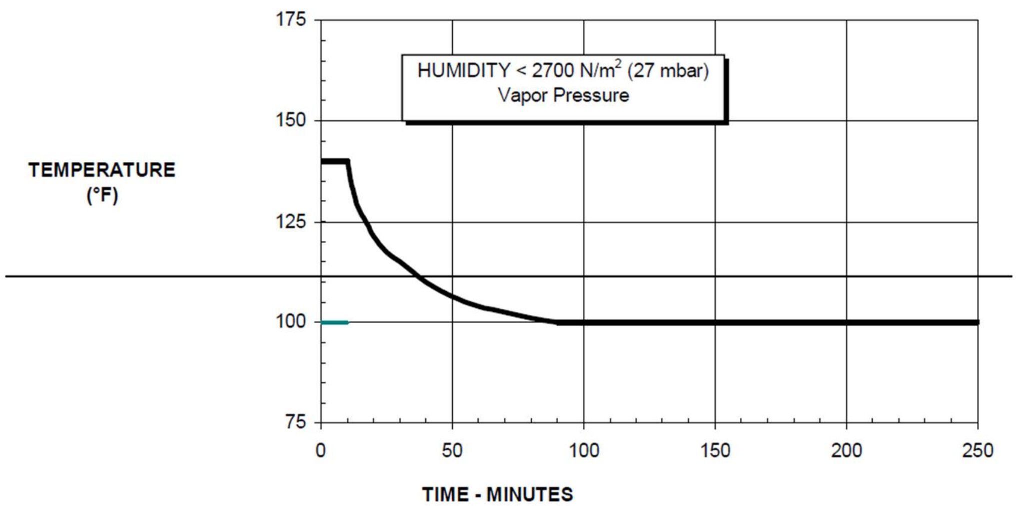
E - OXYGEN EQUIPMENT AND SUPPLY

1. A continuous flow oxygen system must be provided for the passengers.

2. A quick-donning pressure demand mask with mask-mounted regulator must be provided for each pilot. Quick-donning from the stowed position must be demonstrated to show that the mask can be withdrawn from the stowage and donned within 5 seconds.



TIME - TEMPERATURE RELATIONSHIP
FIGURE 1



TIME - TEMPERATURE RELATIONSHIP
FIGURE 2

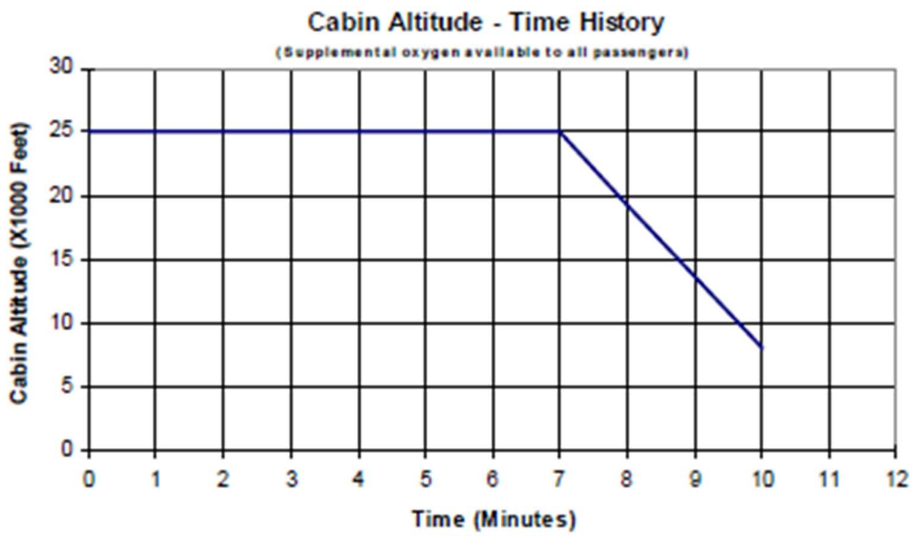


Figure 3

NOTE: For figure 3, time starts at the moment cabin altitude exceeds 8,000 feet during depressurization. If depressurization analysis shows that the cabin altitude limit of this curve is exceeded, the following alternate limitations apply: After depressurization, the maximum cabin altitude exceedence is limited to 30,000 feet. The maximum time the cabin altitude may exceed 25,000 feet is 2 minutes; time starting when the cabin altitude exceeds 25,000 feet and ending when it returns to 25,000 feet.

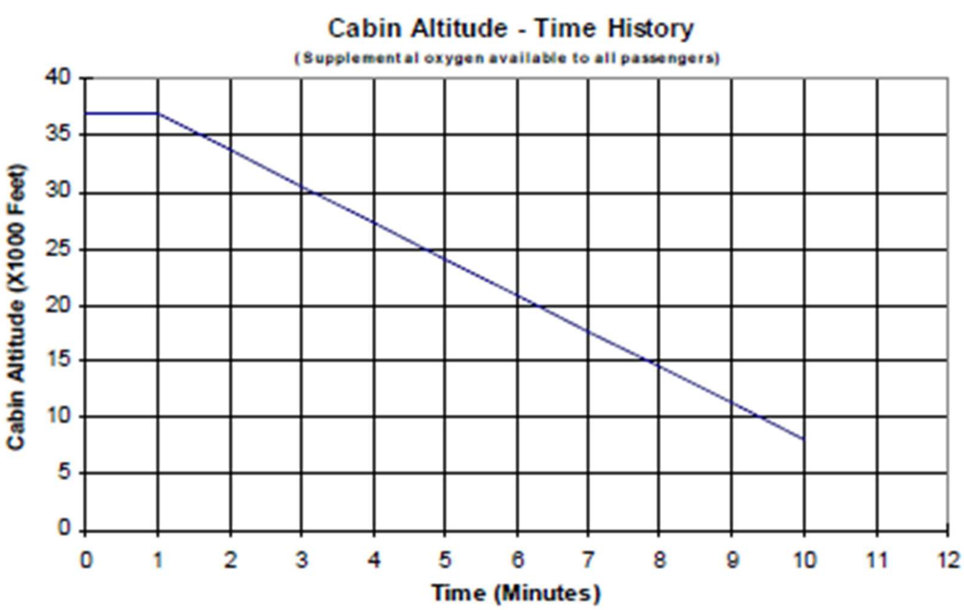


Figure 4

NOTE: For figure 4, time starts at the moment cabin altitude exceeds 8,000 feet during depressurization. If depressurization analysis shows that the cabin altitude limit of this curve is exceeded, the following alternate limitations apply: After depressurization, the maximum cabin altitude exceedence is limited to 40,000 feet. The maximum time the cabin altitude may exceed 25,000 feet is 2 minutes; time starting when the cabin altitude exceeds 25,000 feet and ending when it returns to 25,000 feet.

SPECIAL CONDITION	**D-06: Fire Resistance of Thermal Insulation Material**
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	CS 25.856 & Appendix F
ADVISORY MATERIAL:	FAR25 appendix F (section F25.6)

The current flammability requirements focus almost exclusively on materials located in occupied compartments (CS 25.853) and cargo compartments (CS 25.855). The potential for an in-flight fire is not limited to those specific compartments. Thermal/acoustic insulation is installed throughout the fuselage in other areas, such as electrical/electronic compartments or surrounding air ducts, where the potential exists for materials to spread fire as well. A Special Condition is needed to add requirements which will enhance safety by reducing the incidence and severity of cabin fires, particularly those in inaccessible areas where thermal and acoustic insulation materials are installed, and providing additional time for evacuation by delaying the entry of post-crash fires into the cabin.

In the interests of harmonisation, EASA panel 8b proposes to adopt wording for a Special Condition to CS25, identical to the text of FAR25.856(a) along with the test method specified in new Part VI to Appendix F as incorporated at amendment 25-111. The text for the new requirement is detailed below and appropriate guidance material to amend Appendix F of CS25 is included as Appendix 1 to this CRI.

New CS25.856:

> "Thermal/acoustic insulation material installed in the fuselage must meet the flame propagation test requirements of part VI of Appendix F to CS25, or other approved equivalent test requirements. This requirement does not apply to "small parts," as defined in subpart I of Appendix F to CS25."

Also, to maintain consistency with existing requirements, this special condition amends CS 25.853(a) and CS 25.855(d) as follows:

> " JAR 25.853 Compartment interiors.
> (a) Except for thermal/acoustic insulation materials, materials (including finishes or decorative surfaces applied to the materials) must meet the applicable test criteria prescribed in part I of appendix F or other approved equivalent methods, regardless of the passenger capacity of the aeroplane. "

> " JAR 25.855 Cargo or baggage compartments.
> (d) Except for thermal/acoustic insulation materials, all other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in part I of appendix F or other approved equivalent methods. "

SPECIAL CONDITION	D-09: Installation of Crew Rest Compartment
APPLICABILITY:	B747-8
REQUIREMENTS:	JAR 25.561(b), JAR 25.812(b)(1)(i), JAR 25.854, JAR 25.855, JAR 25.857, JAR 25.858, JAR 25.1423(g), JAR 25.1439
ADVISORY MATERIAL:	

1. CRC occupancy is not allowed during Taxi, Take off and Landing (TT&L) phases except for the Flight Crew Rest Compartments where Special Condition 21 applies. The Cabin Crew Rest Compartments (CCRC) shall not be occupied for Taxi, Take off and Landing. During flight, occupancy of the CRC is limited to the total number of bunks and / or seats that are installed in the compartment.

    a. There must be appropriate placards, inside and outside each entrance to the CRC to indicate:

        i. The maximum number of crewmembers allowed during flight and,

        ii. That occupancy is restricted to operating crewmembers trained in the use of emergency equipment, emergency procedures and the systems of the CRC,

        iii. That smoking is prohibited in the CRC,

        iv. That the crew rest area is limited to the stowage of crew personal luggage and must not be used for the stowage of cargo or passenger baggage.

    b. There must be at least one ashtray on the inside and outside of any entrance to the CRC.

    c. A limitation in the Airplane Flight Manual or other suitable means must be established to restrict occupancy to crewmembers and to specify the phases of flight occupancy that are allowed for each installed CRC.

    d. For each occupant permitted in the CRC, there must be an approved seat or berth that must be able to withstand the maximum flight loads when occupied.

2. For all doors installed, there must be a means to preclude anyone from being trapped inside the CRC. If a locking mechanism is installed, it must be capable of being unlocked from the outside without the aid of special tools. The lock must not prevent opening from the inside of the compartment at any time.

3. There must be at least two emergency evacuation routes, which could be used by each occupant of the CRC to rapidly evacuate to the passenger decks. The secondary evacuation route is not required for CRC located at a passenger deck level and when the CRC is a small room designed for only one occupant for short time duration, such as a changing area or lavatory or it can be shown that no one can be trapped in the CRC due to fire (inside or outside the CRC), mechanical or structural failure.

    a. The routes must be located with sufficient separation within the CRC, and between the evacuation routes, to minimize the possibility of an event, either inside or outside of the crew rest compartment, rendering both routes inoperative.

Special Condition D-09 continued

b. The routes must be designed to minimize the possibility of blockage, which might result from fire (inside or outside the CRC), mechanical or structural failure, or persons standing below or against crew rest exits doors or hatches. If there is low headroom at or near the evacuation route, provisions must be made to prevent or to protect occupants (of the CRC) from head injury. The use of evacuation routes must not be dependent on any powered device. If a crew rest exit route is in an area where there are passenger seats, a maximum of five passengers may be displaced from their seats temporarily during the evacuation process of an incapacitated person(s). If the evacuation procedure involves the evacuee stepping on seats, the seats must not be damaged to the extent that they would not be acceptable for occupancy during an emergency landing.

c. Emergency evacuation procedures, including the emergency evacuation of an incapacitated occupant from the CRC, must be established and demonstrated.

d. There must be a limitation in the Airplane Flight Manual or other suitable means requiring that crewmembers be trained in the use of evacuation routes.

e. There must be a means to prevent passengers on the passenger decks from entering the CRC in the event of an emergency, including an emergency evacuation, or when no flight attendant is present.

f. The means of opening CRC doors and hatches must be simple and obvious. In addition, the CRC doors and hatches must be able to be closed from outside.

g. It must be shown by actual demonstration that the maximum allowed number of CRC occupants can easily evacuate the CRC using the main access route. This demonstration must also be performed using the alternate evacuation route.

4. The evacuation of an incapacitated person (representative of a ninety-fifth percentile male in size, at the corresponding weight) must be demonstrated for all evacuation routes. The number of crewmembers, which may provide assistance in the evacuation from inside, are limited by the available space. Additional assistance may be provided by up to three persons in the passenger compartment.

5. The following signs and placards must be provided in the CRC, these requirements may be subject to specific evaluation and possibly to a finding of equivalent level of safety:

   a. At least one exit sign, located near each crew rest door or hatch, meeting the requirements of JAR 25.812(b)(1)(i),

   b. An appropriate placard located conspicuously on or near each crew rest emergency exit door or hatch that defines the location and the operating instructions for each evacuation route.

   c. Placards must be readable from a distance of 30 inches under emergency lighting conditions.

   d. The door or hatch handles and evacuation path operating instruction placards must be illuminated to at least 160 microlamberts under emergency lighting conditions.

Special Condition D-09 continued

6. There must be a means in the event of failure of the aircraft's main power system, or of the normal CRC lighting system, for emergency illumination to be automatically provided for the CRC.

    a. This emergency illumination must be independent of the main lighting system.

    b. The sources of general cabin illumination may be common to both the emergency and the main lighting systems if the power supply to the emergency lighting system is independent of the power supply to the main lighting system.

    c. The illumination level must be sufficient for the occupants of the CRC to locate and transfer to the passenger cabin by means of each evacuation route.

    d. The illumination level must be sufficient, with the privacy curtains in the closed position, for each occupant of the crew rest to locate a deployed oxygen mask.

7. There must be means for two-way voice communications between crewmembers on the flight deck and occupants of the CRC. There must also be two-way communications between the occupants of the CRC and each flight attendant station required to have a public address system microphone per JAR 25.1423(g) in the passenger cabin. In addition, the public address system must include provisions to provide only the relevant information to the crewmembers in the CRC (e.g., fire in flight, aircraft depressurization, etc.). That is, provisions must be provided so that occupants of the CRC will not be disturbed with normal, non-emergency announcements made to the passenger cabin.

8. There must be a means for manual activation of an aural emergency alarm system, audible during normal and emergency conditions, to enable crewmembers on the flight deck and at each pair of required floor level emergency exits to alert occupants of the CRC of an emergency situation. Use of a public address or crew interphone system will be acceptable, provided an adequate means of differentiating between normal and emergency communications is incorporated. The system must be powered in flight, after the shutdown or failure of all engines and auxiliary power units (APU), for a period of at least ten minutes.

9. There must be a means, readily detectable by seated or standing occupants of the CRC, which indicates when seat belts should be fastened. Seat belt type restraints must be provided for berths and must be compatible for the sleeping attitude during cruise conditions. There must be a placard on each berth requiring that these restraints be fastened when occupied. If compliance with any of the other requirements of these special conditions is predicated on specific head location, there must be a placard identifying the head position.

10. Means must be provided to cover turbulence. If the seat backs do not provide a firm handhold, or if there is no seat installed, there must be a handgrip or rail to enable persons to steady themselves while in the CRC, in moderately rough air.

11. The following safety equipment must also be provided in the CRC:

    a. At least one approved hand-held fire extinguisher appropriate for the kinds of fires likely to occur,

Special Condition D-09 continued

b. One Portable Protective Breathing Equipment (PBE) devices approved to European Technical Standard Order (ETSO)-C116 or equivalent and meeting JAR 25.1439, closed to each hand-held fire extinguisher

c. One flashlight

12. A smoke or fire detection system (or systems) must be provided that monitors each occupiable area within the CRC, including those areas partitioned by curtains. Each system (or systems) must provide:

    a. A visual indication to the flight crew within one minute after the start of a fire

    b. An aural warning in the CRC, and

    c. A warning in the passenger decks. This warning must be readily detectable by a flight attendant, taking into consideration the positioning of flight attendants throughout the passenger compartment during various phases of flight.

13. A means to fight and suppress a fire when the CRC is not occupied must be provided. This means can either be a built-in extinguishing system or manual hand held bottle extinguishing system.

    a. The design shall be such that any fire within the compartment can be controlled without entering the compartment or the design of the access provisions must allow crewmembers equipped for fire fighting to have unrestricted access to the compartment.

    b. If a built-in fire extinguishing system is used in lieu of manual fire fighting, the system must have adequate capacity to suppress any fire occurring in the crew rest compartment, considering the fire threat, volume of the compartment, the ventilation rate and the minimum performance standards (MPS) that have been established for the agent being used. In addition it must be shown that a fire will be contained within a controlled volume meeting the requirements of Appendix F, Part III.

    c. The fire fighting procedures must describe the methods to search the crew rests for fire sources(s).Training and procedures must be demonstrated by test and documented in the suitable manuals.

    d. The time for a crewmember on the passenger deck to react to the fire alarm, to don the fire fighting equipment and to gain access to the crew rest compartment must not exceed the time for the compartment to become smoke-filled, making it difficult to locate the fire source.

    e. The in-flight accessibility of large enclosed stowage compartments and the subsequent impact on the crewmembers' ability to effectively reach any part of the compartment with the contents of a hand fire extinguisher may require additional fire protection considerations similar to those required for inaccessible compartments such as Class C cargo compartments.

14. There must be a means provided to exclude hazardous quantities of smoke or extinguishing agent originating in the CRC from entering any other occupiable compartment.

Special Condition D-09 continued

a. Small quantities of smoke may penetrate from the crew rest compartment into other occupied areas during the one-minute smoke detection time.

b. When built in fire extinguishing systems are used, there must be a provision in the fire fighting procedures to ensure that all door(s) and hatch(es) at the crew rest compartment emergency exits are closed after evacuation of the crew rest and during fire fighting.

c. Smoke entering any occupiable compartment when access to the CRC is open must dissipate within five minutes after the access to the CRC is closed.

d. In the case of a CRC immediately adjacent to and on the same deck as passenger seated areas the smoke penetration requirements of (a) to (c) above do not apply. However, it must be demonstrated that the complete fire detection and fire fighting procedure can be conducted effectively without causing a hazard to passengers due to excess quantities of smoke and / or extinguishant accumulating and remaining in occupied areas.

15. When a CRC is installed or enclosed as a removable module in part of a cargo compartment or located directly adjacent to a cargo compartment without an intervening cargo compartment wall, the following applies:

    a. Any wall of the module (container) forming part of the boundary of the reduced cargo compartment, subject to direct flame impingement from a fire in the cargo compartment and including any interface item between the module (container) and the airplane structure or systems, must meet the applicable requirements of JAR 25.855.

    b. Means must be provided so that the fire protection level of the cargo compartment meets the applicable requirements of JAR 25.855, JAR 25.857 and JAR 25.858 when the module (container) is not installed.

    c. Use of the emergency evacuation route must not require occupants of the CRC to enter the cargo compartment in order to return to the passenger compartment.

16. There must be a supplemental oxygen system equivalent to that provided for passenger decks for each seat and berth in the CRC (automatic drop down system with means by which the oxygen masks can be manually deployed from the flight deck). The system must provide an aural and visual warning to warn the occupants of the CRC to don oxygen masks in the event of decompression. The warning must activate before the cabin pressure altitude exceeds 15,000 feet. The aural warning must sound continuously for a minimum of five minutes or until a reset push button in the CRC is pressed. Procedures for crew rest occupants in the event of decompression must be established. These procedures must be transmitted to the operator for incorporation into their training programs and appropriate operational manuals.

17. The following requirements apply to CRC that are divided into several sections by the installation of curtains or partitions:

    a. To compensate for sleeping occupants, there must be an aural alert that can be heard in each section of the CRC that accompanies automatic presentation of supplemental oxygen masks. A visual indicator that occupants must don an oxygen mask is required in each section where seats or berths are not installed.

Special Condition D-09 continued

A minimum of two supplemental oxygen masks are required for each seat or berth.

b. A placard is required adjacent to each curtain that visually divides or separates, for privacy purposes, the CRC into small sections. The placard must require that the curtain(s) remains open when the private section it creates is unoccupied.

c. For each section of the CRC created by the installation of a curtain, the following requirements of these special conditions must be met with the curtain open or closed:

   i. No smoking placard (Special Condition No. 1),
   ii. Emergency illumination (Special Condition No. 6),
   iii. Emergency alarm system (Special Condition No. 8),
   iv. Seat belt fasten signal or return to seat signal as applicable (Special Condition No. 9), and
   v. The smoke or fire detection system (Special Condition No. 12).

d. CRC visually divided to the extent that evacuation could be affected must have exit signs that direct occupants to the primary evacuation route. The exit signs must be provided in each separate section of the CRC, except for curtained bunks, and must meet the requirements of JAR 25.812(b)(1)(i).

e. For sections within an CRC that are created by the installation of a partition with a door separating the sections, the following requirements of these special conditions must be met with the door open or closed:

   i. There must be a secondary evacuation route from each section to the passenger decks, or alternatively, it must be shown that any door between the sections has been designed to preclude anyone from being trapped inside the compartment. Removal of an incapacitated occupant from within this area must be considered. A secondary evacuation route from a small room designed for only one occupant for short time duration, such as a changing area or lavatory, is not required. However, removal of an incapacitated occupant from within a small room, such as a changing area or lavatory, must be considered.

   ii. Any door between the sections must be shown to be openable when crowded against.

   iii. There may be no more than one door between any seat or berth and the primary emergency exit.

   iv. There must be exit signs in each section meeting the requirements of JAR 25.812(b)(1)(i) that direct occupants to the primary stairway outlet. For single bed or small compartments reduced sizes might be acceptable.

   v. Special Conditions No. 1 (no smoking placards), No. 6 (emergency illumination), No. 8 (emergency alarm system), No. 9 (fasten seat belt signal or return to seat signal as applicable) and No. 12 (smoke or fire detection system) must be met with the door open or closed.

Special Condition D-09 continued

vi. Special Conditions No. 7 (two-way voice communication) and No. 11 (emergency fire fighting and protective equipment) must be met independently for each separate section except for lavatories or other small areas that are not intended to be occupied for extended periods of time.

18. Materials (including finishes or decorative surfaces applied to the materials) must comply with the flammability requirements of § 25.853(a). Mattresses must comply with the flammability requirements of § 25.853(c).

19. The addition of a lavatory within the CRC would require the lavatory to meet the same requirements as those for a lavatory installed on the passenger decks except that JAR 25.854 (a) is replaced by the Special Condition No. 12 for smoke detection.

20. Where a waste disposal receptacle is fitted, it must be equipped with an automatic fire extinguisher that meets the performance requirements of JAR 25.854(b).

21. The following additional requirements apply to Flight Crew Rest Compartments (FCRC) that may be occupied during Taxi, Take off and Landing (TT&L):

    a. During TT&L, occupancy of the FCRC is limited to the total number of installed seats approved to the flight / ground load conditions and emergency landing conditions.

    b. For the configuration of the FCRC including seats occupiable for TT&L, these seats must be able to withstand crash load conditions and therefore comply with all related requirements (25.561 & 25.562). This CRI does not address any side facing attitude seats or bunks occupiable for TT&L and, therefore, in such cases, further considerations will be required.

    c. Doors installed across emergency egress routes must have a means to latch them in the open position. The latching means must be able to withstand the loads imposed upon it when the door is subjected to the ultimate inertia forces, relative to the surrounding structure, listed in JAR 25.561(b).

    d. Doors or hatches that separate the FCRC compartment from a passenger deck must not adversely affect evacuation of occupants (slowing evacuation by encroaching into aisles, for example) or cause injury to those occupants during opening or while open.

    e. A placard must be displayed in a conspicuous place on the crew rest entrance door and any other door(s) installed across emergency egress routes of the crew rest, that requires these doors to be latched open during TT&L when the crew rest is occupied.

    f. An assessment must be done on design features affecting access to the evacuation routes. The design features that should be considered include, but are not limited to, seat deformations in accordance with 25.561(d) and 25.562(c)(8), seat back break over, the elimination of rigid structure that reduces access from one part of the compartment to another, the elimination of items that are known to be the cause of potential hazards, supplemental restraint devices to retain items of mass that could hinder evacuation if broken loose and load path isolation between components that contain the evacuation routes.

Special Condition D-09 continued

g. There must be a limitation in the Airplane Flight Manual or other suitable means requiring that crewmembers be trained in the use of evacuation routes. This training must instruct them to ensure that the crew rest (i.e., seats, doors, etc.) is in its proper TT&L configuration. The limitation must furthermore restrict occupancy to flight crewmembers who the pilot in command has determined are able to rapidly use the evacuation routes. Placards inside and outside the FCRC must be provided accordingly.

SPECIAL CONDITION	D-16: Application of heat release and smoke density requirements to seat materials
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25 853(d) Appendix F Part IV & V
ADVISORY MATERIAL:	

1. Except as provided in paragraph 3 of this special condition, compliance with CS 25, 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 0.13935 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 0.41805 m² (4.5 square feet) excluded on any portion of the assembly (e.g., outboard seat place 0.0929 m² (1 square foot), middle 0.0929 m² (1 square foot), and inboard 0.23225 m² (2.5 square feet)).

3. Seats do not have to meet the test requirements of CS 25, 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.

SPECIAL CONDITION	**D-22: Type C Passenger Exits**
APPLICABILITY:	B747-8
REQUIREMENTS:	CS25.783, 25.785, 25.807, 25.810, 25.813
ADVISORY MATERIAL:	

CS 25.783(h):

Each Type C passenger entry door in the side of the fuselage must meet the applicable emergency exit requirement of 25.807 to 25.813 for a Type II or larger passenger exit (including those identified below).

CS 25.785(h):

A flight attendant seat must be located near the Type C emergency exits.

CS 25.807(a)(8):

A Type C exit is a floor level exit with a rectangular opening of not less than 762 mm (30 inches) wide by 1.219 mm (48 inches) high, with corner radii not greater than 254 mm (10 inches).

CS 25.807(d)(2):

~~The maximum number of passenger seats permitted for each pair of Type C exits is 55. There must be at least two Type C exits, one in each side of the fuselage.~~
For passenger seating configurations greater than 299 seats, each emergency exit in the side of the fuselage must be either a Type A, a Type I, or a Type C. The maximum number of passenger seats permitted for each pair of Type C exits is 55. There must be at least two Type C exits, one in each side of the fuselage.

CS 25.810(a)(1)(ii):

Assisting means installed at Type C exits must be automatically erected within 10 seconds from the time the opening means of the exit is actuated.

CS 25.813(a):

~~Passageways between individual passenger areas and those leading to Type C emergency exits must be unobstructed and at least 20 inches wide.~~
There must be a passageway leading from the nearest main aisle to each Type C emergency exit and between individual passenger areas. Each passageway leading to Type C emergency exits must be unobstructed and at least 51 cm (20 inches) wide. If two or more main aisles are provided, there must be an unobstructed cross aisle at least 51 cm (20 inches) wide leading directly to each passageway between the nearest main aisle and the exit.

CS 25.813(b):

An assist space must be provided at one side of a Type C exit.

SPECIAL CONDITION	D-23: Security related Design Standards
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	Part 21A.16
ADVISORY MATERIAL:	Amdt 97 of ICAO Annex 8 FAR 25.795 Amdt. 25-127 EASA NPA 2009-07 Security related Design Standards

CS 25.795 Security considerations.

(see AMC 25.795)

(a) Protection of flight deck. If a secure flight deck door is required by operating rules, the bulkhead, door, and any other accessible boundary separating the flightcrew compartment from occupied areas installation must be designed to:

(1) Resist forcible intrusion by unauthorized persons and be capable of withstanding impacts of 300 Joules (221.3 footpounds) at the critical locations on the door , as well as a 1113 Newton (250 pound) constant tensile load on accessible handholds, including the doorknob or handle (See AMC 25.795(a)(1)), and

(2) Resist penetration by small arms fire and fragmentation devices by meeting the following projectile definitions and projectile speeds (See AMC 25.795(a)(2)).

(i) Demonstration Projectile #1. A 9 mm full metal jacket, round nose (FMJ RN) bullet with nominal mass of 8.0 g (124 grain) and reference velocity 436 m/s (1430 ft/s)

(ii) Demonstration Projectile #2. A .44 Magnum, jacketed hollow point (JHP) bullet with nominal mass of 15.6 g (240 grain) and reference velocity 436 m/s (1430 ft/s)

(b) Aeroplanes with a certificated passenger seating capacity of more than 60 persons or a maximum take-off weight of over 45 500 Kg (100 000 lb) must be designed to limit the effects of an explosive or incendiary device as follows:

(1) Flight deck smoke protection. Means must be provided to limit entry of smoke, fumes, and noxious gases into the flight deck.

(2) Passenger cabin smoke protection. Except for aeroplanes intended to be used solely for the transport of cargo, means must be provided to prevent passenger incapacitation in the cabin resulting from smoke, fumes, and noxious gases as represented by the initial combined volumetric concentrations of 0.59% carbon monoxide and 1.23% carbon dioxide.

(3) Cargo compartment fire suppression. An extinguishing agent must be capable of suppressing a fire. All cargo-compartment fire suppression-system components must be designed to withstand the following effects, including support structure displacements or adjacent materials displacing against the distribution system:

(i) Impact or damage from a 13 mm (0.5-inch) -diameter aluminium sphere travelling at 131 m/s (430 feet per second); NPA 2009-07 14 Jul 2009

(ii) A 103 kPa (15 psi) pressure load if the projected surface area of the component is greater than 0,4 square meter (4 square feet). Any single dimension greater than 1,2 meters (4 feet) may be assumed to be 1,2 meters (4 feet) in length; and

(iii) A 15 cm (6-inch) displacement, except where limited by the fuselage contour, from a single point force applied anywhere along the distribution system where relative movement between the system and its attachment can occur.

(iv) Paragraphs (b)(3)(i) through (iii) of this paragraph do not apply to components that are redundant and separated in section or are installed remotely from the cargo compartment.

Special Condition D-23 continued

(c) An aeroplane with a certificated passenger seating capacity of more than 60 persons or a maximum take-off weight of over 45 500 Kg (100,000 lbs) must comply with the following:

(1) Least risk bomb location. Except for aeroplanes intended to be used solely for the transport of cargo, an aeroplane must include a designated location where a bomb or other explosive device could be placed to best protect integrity of the structure and flight-critical systems from damage in the case of detonation.

(2) Survivability of systems.

(i) Except where impracticable, redundant aeroplane systems necessary for continued safe flight and landing must be physically separated, at a minimum, by an amount equal to a sphere of diameter

$$D = 2\sqrt{(H_0 / \pi)}$$

(where H0 is defined under paragraph 25.365(e)(2) and D need not exceed 1,54 meters (5.05 feet).

The sphere is applied everywhere within the fuselage-limited by the forward bulkhead and the aft bulkhead of the passenger cabin and cargo compartment beyond which only one-half the sphere is applied.

(ii) Where compliance with sub-paragraph (c)(2) (i) of this paragraph is impracticable, other design precautions must be taken to maximize the survivability of those systems.

(3) Interior design to facilitate searches. Except for aeroplanes intended to be used solely for the transport of cargo, design features must be incorporated that will deter concealment or promote discovery of weapons, explosives, or other objects from a simple inspection in the following areas of the aeroplane cabin:

(i) Areas above the overhead bins must be designed to prevent objects from being hidden from view in a simple search from the aisle. Designs that prevent concealment of objects with volumes 0.33 cubic decimetre (20 cubic inches) and greater satisfy this requirement.

(ii) Toilets must be designed to prevent the passage of solid objects greater than 5 cm (2.0 inches) in diameter.

(iii) Passenger life preservers, stored at each passenger seat location, or their storage locations must be designed so that tampering is evident.

AMC 25.795

Security considerations Referenced Documentation:
FAA memorandum, Subject Information: Certification of strengthened Flight Deck Doors on Transport Category Airplanes, Original release 6 November 2001.

AMC 25.795(a)(1)

Flight deck intrusion resistance. Referenced Documentation:
Federal Aviation Administration Advisory Circular (AC) 25.795-1A, Flight deck Intrusion Resistance, issue

date 10 January 2002 24 October 2008.

Special Condition D-23 continued

AMC 25.795(a)(2)

Flight deck penetration resistance. Referenced Documentation:

Federal Aviation Administration Advisory Circular (AC) 25.795-2A, Flight deck Penetration Resistance, issue date 10 January 2002 24 October 2008. Level IIIA of the (US) National Institute of Justice, Ballistic Resistance of Personal Body Armor, NIJ Standard 0101.04, Office of Science and Technology, Washington, D.C. 20531, September 2000.

Federal Aviation Administration Advisory Circular (AC) 25.795-3, Flight deck Protection (smoke and fumes), issue date 24 October 2008.

Federal Aviation Administration Advisory Circular (AC) 25.795-4, Passenger Cabin Smoke Protection, issue date 24 October 2008.

Federal Aviation Administration Advisory Circular (AC) 25.795-5, Cargo Compartment Fire Suppression, issue date 24 October 2008.

Federal Aviation Administration Advisory Circular (AC) 25.795-6, Least Risk Bomb Location, issue date 24 October 2008.

Federal Aviation Administration Advisory Circular (AC) 25.795-7, Survivability of Systems, issue date 24 October 2008.

Federal Aviation Administration Advisory Circular (AC) 25.795-8, Interior design to facilitate searches, issue date 24 October 2008.

EQUIVALENT SAFETY FINDING	**D-24: Fuselage Doors**
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	CS 25.811(f) Amdt 2
ADVISORY MATERIAL:	

Description of compensating design features or alternative standards which allow the granting of the ESF

CS 25.811(f)(2) states the following:
"*Each outside marking including the band must have colour contrast to be readily distinguishable from the surrounding fuselage surface. The contrast must be such that if the reflectance of the darker colour is 15% or less, the reflectance of the lighter colour must be at least 45%. 'Reflectance' is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker colour is greater than 15% at least a 30% difference between its reflectance and the reflectance of the lighter colour must be provided.*"

For configurations with the exit band on the door, an equivalent level of safety to CS 25.811(f) is shown if the reflectance difference between the exit band and the fuselage area below the door sill is at least 30 percent provided that the following conditions exist:

1) The door sill width does not exceed 5 inches at the centerline of the door.
2) The reflectance difference of the remaining area, including the exit band and the door surface above it at the base of the door, exceeds the minimum EASA standards.
3) If the ends of the door sill on the main deck doors extend up more than 4 inches above the base of the door, the reflectance evaluation above the 4 inches is conducted between the exit band and the door sill.
4) if the ends of the door sill on the upper deck doors extend up more than 12 inches above the base of the door, the reflectance evaluation above the 12 inches is conducted between the exit band and the door sill.

EQUIVALENT SAFETY FINDING	**D-25: Door Sill Reflectance**
APPLICABILITY:	B747-8/-8F
REQUIREMENTS:	CS 25.811(f) Amdt 2
ADVISORY MATERIAL:	

Description of compensating design features or alternative standards which allow the granting of the ESF

CS 25.811(f)(2) states the following:

"Each outside marking including the band must have colour contrast to be readily distinguishable from the surrounding fuselage surface. The contrast must be such that if the reflectance of the darker colour is 15% or less, the reflectance of the lighter colour must be at least 45%. 'Reflectance' is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker colour is greater than 15% at least a 30% difference between its reflectance and the reflectance of the lighter colour must be provided."

It is considered that a difference in reflectance of 25% between the metal door sill and the exit door 2-inch band is equivalent to the requirements of CS 25.811(f) provided the difference of the remaining area, especially the band to the fuselage below the sill, exceeds the minimum EASA standards (30%).

SPECIAL CONDITION	**D-30: Installation of seats with inflatable restraints**
APPLICABILITY:	B747-8
REQUIREMENTS:	CS25.562, 25.785
ADVISORY MATERIAL:	

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:

Special Condition D-30 continued

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 maneuvers 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.

Special Condition D-30 continued

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, provided the occupant's seat remains intact.

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).

SPECIAL CONDITION	D-37: Door 2 stairs
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25.811, CS 25.812
ADVISORY MATERIAL:	

1. The stair must have essentially straight route segments with a landing at each significant change in segment direction

2. The stair must have essentially rectangular treads.

3. The stair must have entrance, exit, and gradient characteristics that would allow with the airplane in level attitude and in each attitude resulting from the collapse of any one or more legs of the landing gear, the passengers of the upper deck, with assistance of a crewmember, to commingle with passengers of the main deck during an emergency evacuation and exit the airplane through a main deck exit. This must be shown by demonstration, test, analysis, or a combination thereof.

4. The stair must accommodate the carriage of an incapacitated person from the upper deck to the main deck. The crew member procedures for such carriage must be established.

5. The stair must be located so as to provide evacuees an adequate decent rate under probable emergency conditions, including a condition in which a person falls or is incapacitated while on it.

6. The stair must be designed and located to minimize damage to it during an emergency landing or ditching.

7. General illumination must be provided so that when measured along the center lines of each tread and landing the illumination is not less than 0.05 foot-candle in lieu of compliance to CS 25.812(c) amendment 25-2.

8. Means must be provided to assist the occupants in locating the stairway in conditions of dense smoke as part of compliance to CS 25.811(c), amendment 25-2.

9. An emergency exit sign meeting CS 25.812(b)(1)(i), amendment 25-2 must be provided in the upper deck near the stairway visible to passengers approaching along the main aisle as required by CS 25.811(d)(1) amendment 25-2.

10. Floor proximity lighting required by CS 25.812(e) must be provided along the stair.

11. At least one flight attendant is required on the upper deck during taxi, takeoff and landing when passengers occupy the upper deck.

12. The stairwell must have a handrail on at least one side in order to allow people to steady themselves during foreseeable conditions, including but not limited to the condition of gear collapse on the ground and moderate turbulence in flight. The handrail(s) must be constructed, so that there will be no obstruction on them which will cause the user to release his/her grip on the handrail or will hinder the continuous movement of the hands along the handrail. Handrail(s) must be terminated in a manner, which will not obstruct pedestrian travel or create a hazard. Person’s representative of the 5% female and the 95% male must demonstrate adequacy of the design.

Special Condition D-37 continued

13. The public address system must be audible in the stairway during all flight phases.

14. “No smoking” and “return to seat” signs must be installed and must be visible in the stairway both going up and down and at the stairway entrances.

15. Means must be provided at the stairway to retard the propagation of fire and the transmission of smoke between the passenger decks. This means must be readily available for placement if needed. For compliance to this SC, post-crash fire/smoke without ECS ventilation must be considered.

SPECIAL CONDITION	**D-44: Upper deck**
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25.803, 25.809; 25.807
ADVISORY MATERIAL:	

The proposed special condition for the stairs between upper deck are as follows:

1. Passenger Emergency Lighting System

   a. The upper deck emergency lighting system power supplies must be independent of the main deck emergency lightning system power supplies.

   b. The upper deck emergency lightning system must be designed so that after any single transverse vertical separation of the fuselage during a crash landing, not more than 25 percent of all required electrically illuminated emergency lights in the upper deck are rendered inoperative, in addition to the upper deck emergency light that are directly damaged by separation.

2. Interdeck Communication

   An intercom and a two-way alerting means between passenger decks and between each passenger deck and the flight deck must be provided that meet the following requirements:

   a. They must remain operable in the event of the loss of the main power supply.

   b. They must be capable of providing crewmember on all decks an immediate indication of emergency situation on any deck.

SPECIAL CONDITION	**D-45: Door 1 Extendable Escape Slide**
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25.810(a)(1)(iii)
ADVISORY MATERIAL:	

1. The extendable escape slide must receive FAA TSO C69c or latest FAA TSO authorization published at the time of the TSO application for the door 1 slide/raft.

2. In addition to the requirements of CS 25.810(a)(1)(iii) for usability in conditions of landing gear collapse, the deployed escape slide in the extended mode must demonstrate an evacuation rate of 45 persons per minute per lane at the sill height corresponding to activation of the extension.

3. Reserved.

4. Pitch sensor tolerances and accuracy must be taken into account when demonstrating compliance with 14 CFR 25.1309(a) for the escape slide in both extended and unextended modes.

5. a) There must be a “slide extension” warning such that the cabin crew is immediately made aware of the need to deploy the extendable section of the slide. The ability to provide such a warning must be available for ten minutes after the airplane is immobilized on the ground.
(b) There must be a positive means for the cabin crew to determine that the extendable portion of the slide has been fully erected.

6. Whenever passengers are carried on the main deck of the airplane there must be a cabin crew member stationed on each side of the airplane located near each Door 1 exit. This special condition must be included in the flight manual as a limitation.

EQUIVALENT SAFETY FINDING	**D-GEN-7: Flammability Testing Hierarchy**
APPLICABILITY:	B747-8
REQUIREMENTS:	-
ADVISORY MATERIAL:	N/A

Similarly with the ELoS granted by FAA in FAA IP C-5, an Equivalent Safety Finding with flammability requirements applicable as per 25.853(a) can be achieved by showing that the same panel construction meets heat release rate requirements of CS-25 Appendix F Part IV.

Panels that according to CS 25.853 are required to be tested per Appendix F Parts I, IV and V need only be tested per Parts IV and V. The data generated to meet the requirements of Appendix F Part IV for a certain panel can be used to substantiate compliance with CS 25.853(a) for the same panel.

Boeing is requested to specify in flammability test plans and reports the reference to the heat release test data that are considered adequate to substantiate compliance with CS 25.853(a).

SPECIAL CONDITION	D-GEN8: Installation of Oblique Seats
APPLICABILITY:	B747-100/-200/-300/-400/-8
REQUIREMENTS:	CS 25.785(c), CS 25.562
ADVISORY MATERIAL:	N/A

The special condition applies to seats with an occupant facing direction greater than 18° and no greater than 45° relative to the aircraft longitudinal axis.

Seats installed at angles greater than 30° relative to the aircraft longitudinal axis must have an energy absorbing rest or shoulder harness and must satisfy the special condition.

The installation of oblique seats must comply with the additional performance standards outlined in Section 10 of SAE AS6316 (Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft), dated 28 June 2017, which is reported below.

10. ADDITIONAL PERFORMANCE STANDARDS FOR OBLIQUE FACING SEATS

This section provides standards and information not provided in AS8049C necessary to run and evaluate dynamic tests on oblique facing seats. The test set ups and orientations are exactly as described in AS8049C. Test 1 is commonly referred to as the vertical test and is defined in AS8049C, Section 5.3.1.1. Test 2 is commonly referred to as the horizontal test and is defined in AS8049C, Sections 5.3.1.2 and 5.3.1.3. Information relevant to the conducting of both these tests is contained throughout AS8049C, Section 5.3.
10.1 Test 1 - Structural and Occupant Injury Evaluation (AS8049C, Section 5.3.1.1)

10.1.1 Occupant Simulation

For Test 1, an ATD representing a 50th percentile male as defined in 49 CFR Part 572, Subpart B, or an equivalent shall be used to simulate each occupant. See AS8049 5.3.2 for further information on ATDs and equivalency standards.

10.1.2 Contactable Items

Items contactable by the occupant shall be included in the test, replaced with a part shown to create a conservative test condition, or excluded based upon a rational analysis. Any replaced or excluded part shall be documented together with a rational analysis substantiating the action.

Items that do not influence the test such as trim, placards, wires, finishes, etc., may be omitted from the test article.

10.1.3 Occupant Injury Criteria

The injury criteria listed in AS8049C are applicable to this test.

10.2 Test 2 - Structural Evaluation (AS8049C, Sections 5.3.1.2 and 5.3.1.3)

10.2.1 Occupant Simulation

For Test 2 (structural evaluation), an ATD representing a 50th percentile male as defined in 49 CFR Part 572, Subpart B, or an equivalent shall be used to simulate each occupant. See AS8049 5.3.2 for further information on ATDs and equivalency standards.

10.2.2 Contactable Items

Items contactable by the occupant shall be included in the test, replaced with a part shown to create a conservative test condition, or excluded based upon a rational analysis. Any replaced or excluded part shall be documented together with a rational analysis substantiating the action.

Items that do not influence the test such as trim, placards, wires, finishes, etc., may be omitted from the test article.

10.2.3 Selection of Test Conditions

AS8049C Section 5.3.6 provides requirements applicable to all structural evaluation tests. In addition, due to the lack of seat symmetry about the load direction, both yaw directions (±10°), relative to the aircraft longitudinal axis, shall be tested to show structural integrity of the seat system, unless previous testing and/or rational analysis can demonstrate that a single yaw direction encompasses all critical structural aspects of the seat and its attachments.

10.2.4 Combining Structural and Occupant Injury Tests

Combining the structural evaluation test(s) with the occupant injury test(s) is not recommended. If the applicant decides to combine the tests, the additional set up to ensure the ATD contacts the supporting structure at the correct contact point to collect the necessary occupant injury criteria shall be documented. This document provides no guidance or recommendations on this topic.

10.3 Test 2 - Occupant Injury Evaluation (AS8049C, Section 5.3.1.2)

10.3.1 Occupant Simulation

For Test 2 (occupant injury evaluation), an FAA Hybrid III ATD shall be used. A floor under the ATD’s feet shall be used.

10.3.2 Contactable Items and Occupant Injury Assessments

Items contactable by the occupant shall be included in the test, replaced with a part shown to create a conservative test condition, or excluded based upon a rational analysis. Any replaced or excluded part shall be documented together with a rational analysis substantiating the action.

Damage or failure of these items shall be assessed to ensure that valid results have been obtained and that no sharp edges, injurious protrusions or egress impediments have been produced.

The aircraft fittings, or track, need not be representative. Any bracing or reinforcement of items included in the test shall be documented and shown to create a conservative test condition.

Items that do not influence the test such as trim, placards, wires, finishes, etc., may be omitted from the test article.

10.3.3 Selection of Test Conditions

AS8049C, Section 5.3.6 and Table 2 in this document provide the requirements for all occupant injury evaluation tests. Data from previous tests, simulation, or rational analysis shall be used to determine the critical case(s). When determining the critical case(s) all yaw angles within the ±10° range must be considered. Multiple tests may be necessary to examine all injury criteria. Tests that only evaluate injury criteria do not require floor deformation.

10.3.4 Occupant Injury Criteria

Table 2 – Occupant injury criteria

Body Part	**Injury Criterion**
Head	(1) HIC ≤ 1000 (AS8049C, Section 5.3.9.4) in the event of head contact with seats, or other structure (including airbags), ① or (2) HIC 15 ≤ 700 (49 CFR 571.208) in the event of head contact with an airbag only ② ①Following a test, calculate HIC. If this value is ≤1000, the test is successful. If HIC is >1000, and contact is made with the seat or other structure, regardless of airbag usage, the test has failed. ②Use of HIC 15 is permitted as an alternate to HIC if the ATD head only contacts an airbag and makes no head contact with the seat or other structure. ATD head contact with the seat or other structure, through the airbag, or contact subsequent to contact with the airbag requires the use of HIC. HIC 15 is not applicable if head contact has occurred. The following evaluations of the test data should be used to determine if head contact has occurred: a. A review of the dynamic test videos and evaluation of the ATD head path movement, head contact, and head reaction at contact should be made. There should be a noticeable change in the head movement at the time of contact. b. A review and evaluation of the ATD head acceleration plots (x, y, z, and resultant) should be made. The resultant ATD head acceleration plot during the time period in which the critical HIC calculation was made should show an abrupt change in the head acceleration.
Neck	Nij (49 CFR 571.208) (1) Nij shall be below 1.0, where Nij = Fz/Fzc + My/Myc, and Nij critical values: (a) Fzc = 1530 pounds (6805 N) tension (b) Fzc = 1385 pounds (6160 N) compression (c) Myc = 229 foot-pounds (310 Nm) in flexion

Body Part	Injury Criterion
	(d) Myc = 100 foot-pounds (136 Nm) in extension (2) Peak Fz shall be below 937 pounds (4168 N) in tension and 899 pounds (3999 N) in compression. (3) Rotation of the head about its vertical axis relative to the torso is limited to 105° in either direction from forward-facing. (4) Concentrated loading on the neck is unacceptable during any phase of the test and the neck shall not carrying any load between the ATD and the seat system. Incidental contact of the neck, such as a sliding motion against a flat surface, or a headrest, during rebound may be acceptable. (Visual evidence and load data shall be collected during the test to show that neck contact is not load carrying.)
Shoulder	(1) Where upper torso straps are used, tension loads in individual straps shall not exceed 1750 pounds (7784 N). If dual straps are used for restraining the upper torso, the total strap tension loads shall not exceed 2000 pounds (8896 N). (2) The upper torso restraint straps (where installed) shall remain on the ATD's shoulder during the impact.
Thorax	Significant contact between the thorax and seat system structure is not permitted during initial impact, except for intentional contact with an airbag or shoulder restraint. For example, contact with a corner or protrusion would be significant contact and be unacceptable. Sliding along a smooth wall is not significant contact and could be acceptable, provided all other injury criteria are met. Rebound contact that produces an x direction acceleration exceeding 20g for more than 3ms is not permitted.
Abdomen	Significant contact between the abdomen and seat structure is not permitted except for intentional contact with an airbag or seat cushion.
Spine	1) The lumbar spine force (Fz) shall not exceed 1200 pounds (5338 N) tension and 1500 pounds (6673 N) compression. (2) Spine forces and moments shall be recorded using a six axis load cell and shall be reported. This data is collected for knowledge gathering. There are no pass/fail criteria associated with this data except as noted above for Fz.
Pelvis	(1) The pelvic restraint shall remain on the ATD's pelvis during the impact and rebound phases of the test. Provided that the pelvic restraint remains on the ATD's pelvis, trapping of the belt between the ATD leg and the pelvis is acceptable. (2) The load-bearing portion of the bottom of the ATD pelvis must not translate beyond the edges of its seat's bottom seat-cushion supporting structure.
Femur	(1) Where leg contact with seats or other structure occurs, the axial compressive load in each femur shall not exceed 2250 pounds (10008 N). (2) Axial rotation of the upper leg shall be limited to 35° in the strike direction from the nominal seated position. Evaluation during rebound is not biofidelic and need not be considered.

Body Part	Injury Criterion
All	Contact between the head, pelvis, torso, or shoulder area of one ATD with the adjacent-seated ATD's head, pelvis, torso, or shoulder area is not allowed. Contact during rebound is allowed.

10.4 Restraint Systems

10.4.1 General Design

The design and installation of restraint systems shall prevent unbuckling or detachment due to applied inertial forces or impact of the hands/arms of the occupant during Tests 1 and 2.

10.4.2 Airbags

Airbag systems include inflatable restraints and structure mounted airbags.

For seats with airbag systems, it shall be shown that the system will deploy and provide protection under emergency conditions where it is necessary to prevent serious injury. The system shall provide a consistent approach to injury protection throughout the range of occupants two year old child to 95th percentile male, whether it is designed to manage injury parameters (HIC, Nij, Neck Rotation, etc.) or occupant motion. The system shall be included in each of the certification tests as it would be installed in the airplane. If airbag systems influence the test results, they shall be active during the test.

Airbag systems may also be used to control occupant motion. The intended function of the airbag system shall be demonstrated during each applicable test.

Oblique seating systems including airbags shall be shown to meet the occupant injury criteria of Table 2 throughout the entire range of yaw that encompasses the installation angle ±10° relative to the aircraft longitudinal axis.

Other considerations for airbag systems are outside the scope of this document.

10.5 Other Considerations

10.5.1 Recording of Shoulder Harness Loads

If a shoulder belt incorporating an airbag is used, care shall be taken when placing the webbing load cell to ensure that an accurate measurement is made and that the load cell does not affect the performance of the airbag.

10.5.2 ATD Placement

As an alternative to AS8049C, Section 5.3.8.3(b) through (e), the following procedure has been found to be adequate from previous experience for placing the ATD in a consistent manner for Test 2 and to determine the nominal (1g) seated position for Test 1:

1. Lower the ATD vertically into the seat while simultaneously (see Figure 3 for illustration):
    a. Aligning the midsagittal plane (a vertical plane through the midline of the body; dividing the body into right and left halves) with the middle of the seat place.
    b. Applying a horizontal x-axis direction (in the ATD coordinate system) force of approximately 20 pounds (89N) to the torso at the intersection of the midsagittal plane and lower sternum of the HII or FAA HIII at the midsagittal plane, to compress the seat back cushion.
    c. Keeping the upper legs as horizontal as possible by supporting them just behind the knees, or using an equivalent procedure.

2. Once all lifting devices have been removed from the ATD:
    a. Rock the ATD slightly to settle it in the seat.
    b. Separate the knees by about 100 mm (4 inches).
    c. Position the HII or FAA HIII hands on top of its upper legs.
    d. Position the feet such that the centerlines of the lower legs are approximately parallel to a lateral vertical plane (in the aircraft coordinate system).

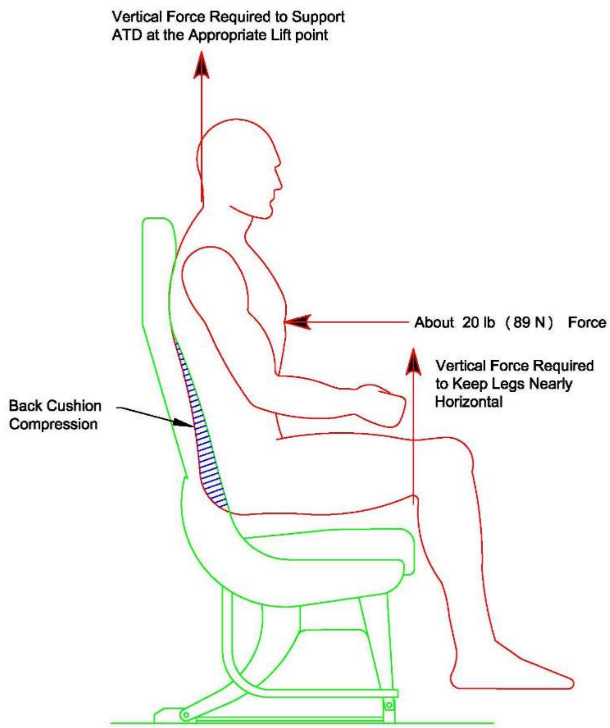


FIGURE 3 - ATD Placement

SPECIAL CONDITION	D-GEN9: Incorporation of Inertia Locking Device in Dynamic Seats
APPLICABILITY:	B747-100/-200/-300/-400/-8
REQUIREMENTS:	CS 25.785, CS 25.562
ADVISORY MATERIAL:	N/A

1) Level of Protection provided by Inertia Locking Device(s) (ILD)

The ILD is a mechanically deploying feature of a seat with a fore/aft tracking system. The ILD will self-activate only in the event of a predetermined aircraft loading condition such as that occurring during crash or emergency landing. The ILD will interlock the seat tracking mechanism so as to prevent excessive seat forward translation. EASA considers that a minimum level of protection should be provided if the device does not deploy. It must be demonstrated by test that the seat and attachments, when subject to the emergency landing dynamic conditions specified in CS 25.562 and with the ILD not deploying, do not suffer structural failure that could result in:

a. separation of the seat from the aircraft floor,
b. separation of any part of the seat that could form a hazard to the seat occupant or any other aircraft occupant,
c. failure of the occupant restraint or any other condition that could result in the occupant separating from the seat. However, failure of the occupant restraint may occur where it can be demonstrated that the seat occupant cannot form a hazard to any other aircraft occupant. This would normally only be agreed by the Agency on the basis of physical separation of the seat from other seats in the aircraft, for example in a mini-suite type arrangement.

2) Protection provided below and above the ILD Actuation Condition

The normal means of satisfying the structural and occupant protection requirements of CS 25.562 result in a non-quantified but nominally predictable progressive structural deformation and/or reduction of injury severity for impact conditions less than the maximum specified by the rule. A seat using the ILD technology however involves a step change in protection for impacts below and above that at which the ILD activates and deploys to its 'retention' position. This could result in the effects of the impact, for example structural deformation and occupant injury criteria, being higher at an intermediate impact condition than that resulting from the maximum.

It is acceptable for these effects to have such non-linear or step change characteristics provided that they do not exceed the allowable maximum at any condition at which the ILD 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.

3) Intermediate Pulse Shape

The existing ideal triangular maximum severity pulse is defined in FAA AC 25.562.1B. 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.

4) Protection over a range of crash pulse vectors

The device will be tested at the CS 25.562 specified crash pulse vectors of 14g at 30 degrees to the vertical and 16g at the horizontal. In addition it shall be shown that the device will also operate at a range of crash pulse vectors between those specified.

5) Protection during Secondary Impacts

The design of the ILD shall be such that if there is more than one impact, for the final impact that is above the severity at which the device is intended to deploy, the maximum protection of the device must be provided.

6) Protection of Occupants other than 50th percentile

The ILD shall not affect compliance of the seat and installation with CS 25 requirements, or those of this Special Condition, with respect to protecting the specified range of occupant sizes.

7) It must be shown that any inadvertent operation of the device, for example during extreme flight manoeuvres, does not affect the performance of the seat during a subsequent emergency landing.

8) The installation of the ILD on the seat shall be physically protected from any contamination likely to occur during operation, e.g. drink, food etc. The installation should also be protected against other foreign object ingress.

9) The effects of wear and criticality of manufacturing tolerances should be considered with respect to reliability and adverse effect on operation of the ILD. In addition other possible effects that may render the device inoperative must be taken into account such as aging/drying of lubricants and corrosion.

10) The design, installation and operation of the ILD shall be such that it is possible, by maintenance action, to check the functioning, i.e. movement, of the device in-situ.

11) A method of functional checking and a maintenance check interval should be established (if applicable).

12) If there is a need to include any means to release an inadvertently operated device (i.e. that has engaged in a non-crash condition where the seat could otherwise remain in-situ on the aircraft), this function shall not introduce additional hidden failures.

SPECIAL CONDITION	**D-GEN10: Installation of suite type seating**
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25.785(h), CS 25.813(e)
ADVISORY MATERIAL:	FAA AC 25-17A

1. Only single occupancy of the Mini-suite is allowed during taxi, take-off and landing.
2. The mini-suite entrance must only provide access to the specific mini-suite.
3. Mini-suites must not provide the required egress path for any passenger other than 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.
6. The mini-suite door(s) must be open during taxi, take-off and landing.
7. A hold open retention mechanism for mini-suite doors must be provided and must hold the doors open under CS 25.561(b) emergency landing conditions.
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 CS 25.561(b) emergency landing conditions.
9. There must be a means by which cabin crew can readily check that all mini-suite doors are fully open and in the latched condition.
10. There must be means to prevent the seated mini-suite occupant from operating the doors and thus ensure that the doors remain open during 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. Operating instruction materials necessary to provide adequate compliance with SC 5, 9 and 10, considering also the number of individual mini suites, shall be discussed and agreed with EASA and shall be provided to the operator for incorporation into their cabin crew training programs and associated operational manuals. This may affect the minimum acceptable number of cabin crew required to operate the aeroplane.
13. In the TT&L configuration, the mini-suite must provide an unobstructed access to the main aisle having a width of at least 30 cm (12 inches) at a height lower than 64 cm (25 inches) from the floor, and of at least 38 cm (15 inches) at a height of 64 cm (25 inches) and more from the floor. A narrower width not less than 23 cm (9 inches) at a height below 64 cm (25 inches) from the floor may be approved when substantiated by tests found necessary by the Agency. A narrower width at a height above 64 cm (25 inches) from the floor may be approved by the Agency considering compensating factors in the design that facilitate egress to the aisle.

14. In addition, the mini-suite must have an Emergency Passage Feature (EPF) to allow for evacuation of the mini-suite occupant in the event a door closes and becomes jammed during an emergency landing. The EPF must provide a free aperture for passage into the aisle consistent with SC 13 or meeting the requirements of CS 25.807 applicable to a Type IV size emergency exit. If the EPF consists of frangible and/or removable elements they must be easily broken/removed by the occupant of the mini-suite when a door becomes jammed. If an EPF consists of dual independent sliding doors opening in opposite directions, the remaining unobstructed access width with one door in the fully closed position must be consistent with SC 13 or meet the requirements of CS 25.807 applicable to a Type IV emergency size exit. The occupant of the mini-suite

must be made aware of the EPF and its way of operation. In no case shall the occupant using the EPF have to rely on another occupant to assist in passage.
15. The height of the mini suite walls and doors must be such that a 95th percentile male can fit between them and the aeroplane interior furnishing.
16. No mechanism to latch the door(s) in the closed position shall be provided.

17. The mini-suite door(s) must be openable from the inside or outside with 25 pounds force or less regardless of power failure conditions.
18. If the mini-suite doors are electrically powered, in the event of loss of power to the mini-suite with the door(s) open, the door(s) must remain latched in the open position.
19. The mini-suites installation must not encroach into any required main aisle, cross aisle or passage ways.
20. No mini-suite door may impede main aisle or cross aisle egress paths in the open, closed or translating position.
21. The mini-suite doors must remain easily openable, even with a crowded aisle.
22. The seat of the Cabin Crew responsible for a suite area must be located to provide a direct view of the egress path from each mini-suite and of each main aisle adjacent to the mini-suites.

SPECIAL CONDITION	D-GEN11: Installation of structure mounted airbags
APPLICABILITY:	B747-8
REQUIREMENTS:	CS 25.785, CS 25.562
ADVISORY MATERIAL:	N/A

1) HIC Characteristic

The existing means of controlling Front Row Head Injury Criterion (HIC) result in an unquantified but normally predictable progressive reduction of injury severity for impact conditions less than the maximum specified by the rule. Airbag technology however involves a step change on 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 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 airbag 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 25.562-1B. 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 structure mounted airbag 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 injury criteria but evidence from head paths etc. to determine likely areas of impact.

The same philosophy may be used for structure mounted airbags 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 seat occupants in any other position or configuration than seated alone upright, as specified in FAA AC 25.562-1B. However, it must be shown that the structure mounted airbag does not, in itself, form a hazard to any occupant in a brace position or a person in between the brace position and upright 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) Airbag Deployment

Effects of the deflection and deformation of the structure to which the airbag is attached must be taken into account when evaluating deployment and location of the inflated airbag. The effect of loads imposed by airbag deployment, or stowedcomponents where applicable, must also be taken into account.
The HIC test may be performed with the airbag deploying from a rigid test fixture provided that the above factors and the occupant size considerations in paragraph 4) are taken into account. A rational analysis supported by static deployment tests would be acceptable.

8) The probability of inadvertent deployment must be shown to be acceptably low and in accordance with the severity of the failure condition resulting. The seated occupant must not be seriously injured as a result of the structure mounted airbag deployment. Inadvertent deployment must not cause a hazard to the aircraft or cause injury to anyone who may be positioned close to the structure mounted airbag (e.g. seated in an adjacent seat or standing adjacent to the airbag installation or the subject seat). Cases where the inadvertently deploying structure mounted airbag is near a seated occupant or an empty seat must be considered.

9) It must be demonstrated that the structure mounted airbag when deployed does not impair access to the seatbelt or harness release means, 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 structure mounted airbag activation system prior to each flight, or the integrity of the structure mounted airbag activation system must be demonstrated to reliably operate between inspection intervals.

11) It must be shown that the structure mounted airbag 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 CS 25.1316 with associated guidance material for indirect effects of lightning. Electro static discharge must also be considered.

13) The equipment must meet the requirements for HIRF.

14) The structure mounted airbag mechanisms and controls must be protected from external contamination associated with that which could occur on or around passenger seating.

15) The structure mounted airbag installation must be protected from the effects of fire such that no hazard to occupants will result.

16) The structure mounted airbag 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 structure mounted airbag.

17) The structure mounted airbag must function properly after loss of normal aircraft electrical power and after a transverse separation in the fuselage at the most critical location. A separation at the location of the airbag does not have to be considered.

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 CS-25 Appendix F, Part 1, Paragraph (b)(4), is not currently available.
In recognition of the overall safety benefit given by the installation of structure mounted airbags, and in lieu of this standard, it is acceptable for the material of inflatable bag to have an average burn rate of no greater than 2.5 inches/minute when tested using the horizontal flammability test of CS-25 Appendix F, part I, paragraph (b)(5).

19) Structure mounted airbag systems should not introduce additional hazards in respect to occupant safety when compared to certified systems.

20) In case structure mounted airbag systems are installed in or close to passenger evacuation routes (other than for the passenger seat the airbag is mounted for) a possible impact on emergency evacuation (e.g. hanging in the aisle, building a potential trip hazard, etc.) should be evaluated.

21) The airbag, once deployed, must not adversely affect the emergency lighting system (i.e. block escape path lighting to the extent that the light(s) no longer meet their intended function).

22) Neck Injury Criteria: The installation of the structure mounted airbag must protect the occupant from experiencing serious neck injury. The assessment of neck injury must be conducted with the airbag activated unless there is reason to also consider that the neck injury potential would be higher below the airbag activation threshold. If so, additional tests may be required. EASA finds that it is appropriate to use the following neck injury criteria, which are the same applied to oblique and side-facing seats installation, and are based on the use of the FAA Hybrid III ATD:

a) The neck loads and moments during the entire impact event are limited as follows:

The N_{ij} must be below 1.0, where $N_{ij} = F_z/F_{zc} + M_y/M_{yc}$, and N_{ij} intercepts limited to:
F_{zc} = 1530 Ib for tension
F_{zc} = 1385 Ib for compression
M_{yc} = 229 Ib·ft in flexion
M_{yc} = 100 Ib·ft in extension

b) In addition, peak F_Z must be below 937 Ib in tension and 899 Ib in compression.

c) Available biomechanics texts, citing relevant research literature[1], indicate that there is a high risk of injury for head rotation over 114. To account for the degree of uncertainty in determining the rotation angle from observation of test video, rotation of the head about its vertical axis relative to the torso is limited to 105 degrees in either direction from forward-facing.

d) Concentrated loading on the neck is unacceptable during any phase of the test and the neck shall not carrying any load between the ATD and the seat system. Incidental contact of the neck, such as a sliding motion against a flat surface, or a headrest, during rebound may be acceptable. Visual evidence and load data shall be collected during the test to show that neck contact is not load carrying.

[1] *"Accidental Injury, Biomechanics and Prevention", Third Edition 2015, N. Yoganandan, A. Nahum, J. Melvin editors, Chapter 11"Neck Injury Biomechanics", R Nightingale, B. Myers, N. Yoganandan, Section 11.4.3 "Torsion".* In that section, 114 degrees is cited from a study by Myers as the "rotation required to produce injury in the cadaver". The injury cited is "atlantoaxial dislocation" which is an AIS-3 (Serious) injury.

SPECIAL CONDITION	E-14: Fuel Quantity Indicating System
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	Part 21A.16 (a)(3), CS 25.1305(a)(2), CS 25.1309
ADVISORY MATERIAL:	

Replace the current CS 25.1305(a) (2) with the following requirement:

(a)(2) A fuel quantity indicating system, which:

(i) displays to the crew the total quantity of usable fuel on board,

(ii) is capable of indicating to the crew the total quantity of usable fuel in each tank

(iii) provides a low fuel level warning for any tank and/or collector cell that should not be depleted of fuel in normal operations. This warning must be such that:

(1) it is provided to the crew in a timely manner in order to allow continued safe flight and landing,

(2) its correct functioning is not affected by any single failure that could cause an erroneous indication of the normal fuel gauging system.

(iv) provides adequate fuel system information to the crew, including alerts, that consider abnormal fuel management or transfer between tanks, and possible fuel leaks in the tanks, the fuel lines and other fuel system components and the engines.

SPECIAL CONDITION	F-01: HIRF Protection
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	CS 25 Amendment 1 JAA INT/POL/25/2
ADVISORY MATERIAL:	N/A

a) HIRF environments
Table I lists the Certification HIRF environment required by SC F- 01 sub-paragraph (a).
Table II lists the Normal HIRF environment required by SC F- 01 sub-paragraph (b).

b) Test levels for complying with SC F- 01 sub-paragraph (c)
As a minimum, one of the following sets of equipment test levels shall be used:

(1) From 10 kHz to 400 MHz, use conducted susceptibility tests with CW and 1 kHz square wave modulation of depth greater than 90 percent. The conducted susceptibility current shall start at 0.6 mA at 10 kHz, increasing 20 dB per frequency decade to 30 mA at 500 kHz. From 500 kHz to 400 MHz, the conducted susceptibility current shall be 30 mA. From 100 MHz to 400 MHz, use radiated susceptibility tests at 20 V/m peak, with CW and 1 kHz square wave modulation of depth greater than 90 percent. From 400 MHz to 8 GHz, use radiated susceptibility tests at 150 V/m peak with pulse modulation of 0.1 percent duty cycle with 1 kHz pulse repetition frequency. This signal should be switched on and off at a rate of 1 Hz with a duty cycle of 50 percent. Also, from 400 MHz to 8 GHz, use radiated susceptibility tests at 28 V/m peak with 1 kHz square wave modulation of depth greater than 90 percent. This signal should be switched on and off at a rate of 1 Hz (ref. ED-14D/DO-160D, Section 20, Cat. R).

(2) Or, from 10 kHz to 400 MHz, use conducted susceptibility tests with CW and 1 kHz square wave modulation of depth greater than 90 percent. The conducted susceptibility current shall start at 0.6 mA at 10 kHz, increasing 20 dB per frequency decade to 30 mA at 500 kHz. From 500 kHz to 400 MHz, the conducted susceptibility current shall be 30 mA. From 100 MHz to 400 MHz, use radiated susceptibility tests at 20 V/m peak, with CW and 1 kHz square wave modulation of depth greater than 90 percent. From 400 MHz to 8 GHz, use radiated susceptibility tests at 150 V/m peak with pulse modulation of 4 percent duty cycle with a 1 kHz pulse repetition frequency. This signal should be switched on and off at a rate of 1 Hz with a duty cycle of 50 percent (ref. ED-14D/DO-160D, Section 20, Cat. R).

(3) Or, the test level to be used during equipment testing may be based on the Normal HIRF environment in Table II with allowance made for aircraft attenuation using aircraft transfer function/attenuation curves. Testing must cover the frequency band of 10 kHz to 8 GHz.

c) Test levels for complying with F- 01 sub-paragraph (d)
As a minimum, the following equipment test level shall be used:

From 10 kHz to 400 MHz, use conducted susceptibility tests, starting at 0.15 mA at 10 kHz, increasing 20 dB per frequency decade to 7.5 mA at 500 kHz. From 500 kHz to 400 MHz, use conducted susceptibility tests at 7.5 mA. From 100 MHz to 8 GHz, use radiated susceptibility tests at 5 V/m (ref. ED-14D/DO-160D, Section 20, CAT T).

d) Test procedures
AC/AMJ 20.1317 Final Draft Issue (EEHWG Document WG-327 dated November 98) and EUROCAE ED-14D/RTCA Document DO-160D, Section 20 should be referred to for the applicability of tests and test details.

Special Condition F-01 continued

TABLE I
CERTIFICATION HIRF ENVIRONMENT

FREQUENCY	FIELD STRENGTH (V/m)	
	PEAK	AVERAGE
10 kHz - 100 kHz	50	50
100 kHz - 500 kHz	50	50
500 kHz - 2 MHz	50	50
2 MHz - 30 MHz	100	100
30 MHz - 70 MHz	50	50
70 MHz - 100 MHz	50	50
100 MHz - 200 MHz	100	100
200 MHz - 400 MHz	100	100
400 MHz - 700 MHz	700	50
700 MHz - 1 GHz	700	100
1 GHz - 2 GHz	2000	200
2 GHz - 4 GHz	3000	200
4 GHz - 6 GHz	3000	200
6 GHz - 8 GHz	1000	200
8 GHz - 12 GHz	3000	300
12 GHz - 18 GHz	2000	200
18 GHz - 40 GHz	600	200

TABLE II
NORMAL HIRF ENVIRONMENT

FREQUENCY	FIELD STRENGTH (V/m)	
	PEAK	AVERAGE
10 kHz - 100 kHz	20	20
100 kHz - 500 kHz	20	20
500 kHz - 2 MHz	30	30
2 MHz - 30 MHz	100	100
30 MHz - 70 MHz	10	10
70 MHz - 100 MHz	10	10
100 MHz - 200 MHz	30	10
200 MHz - 400 MHz	10	10
400 MHz - 700 MHz	700	40
700 MHz - 1 GHz	700	40
1 GHz - 2 GHz	1300	160
2 GHz - 4 GHz	3000	120
4 GHz - 6 GHz	3000	160
6 GHz - 8 GHz	400	170
8 GHz - 12 GHz	1230	230
12 GHz - 18 GHz	730	190
18 GHz - 40 GHz	600	150

SPECIAL CONDITION	**F-22: Security Assurance Process to isolate or protect the Aircraft systems and networks from internal and external security threats**
APPLICABILITY:	B747-8/B747-8F
REQUIREMENTS:	CS 25.1301, 25.1309, 25.1431, 25.1529
ADVISORY MATERIAL:	AMC 25.1309, RTCA/DO-178B/ED-12B, RTCA/DO-254/ED-80 CCIMB 2004-01 (Information Technology Security Evaluation, version 2.2, dated January 2004 or later approved versions)

a. The applicant shall ensure security protection of the systems and networks of the aircraft from access by unauthorized sources, both internal and external, if their corruption (including hardware, software, data) by an inadvertent or intentional attack would impair safety of flight, and

b. The applicant shall ensure that the security threats to the aircraft (including those possibly caused by maintenance activity or any unprotected connecting equipment/devices) or from the on-board passengers, are identified, assessed and risk mitigation strategies are implemented to protect the aircraft systems from all adverse impacts on safety of flight, and

c. The applicant shall ensure that continued airworthiness of the aircraft is maintained, including all post Type Certificate modifications, which have an impact on the approved network security safeguards, by establishing appropriate procedures.

Note:

Safety of flight	In the context of the security aspects addressed in this CRI "**safety of flight**" is defined as an aircraft state where a security threat on affected systems and/or functions in the ACD and AISD can compromise the safe continuation of this phase of flight. Affected systems and/or functions can be varying depending on the flight phase where the security threat will compromise safety of flight.

SPECIAL CONDITION	F-GEN-11: Non-rechargeable Lithium Batteries Installations
APPLICABILITY:	B747-100, -200B, -200C, -200F, SP, -300 / B747-400, -400BCF, -400F / B747-8, -8F
REQUIREMENTS:	CS 25.601, 25.863, 25.1353(c)
ADVISORY MATERIAL:	N/A

In lieu of the requirements of CS 25.1353(c) (1) through (c)(4), non-rechargeable Lithium batteries and battery installations must comply with the following special conditions:

1. Be designed so that safe cell temperatures and pressures are maintained under all foreseeable operating conditions to preclude fire and explosion.

2. Be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

3. Not emit explosive or toxic gases in normal operation, or as a result of its failure, that may accumulate in hazardous quantities within the airplane.

4. Must meet the requirements of CS 25.863(a) through (d).

5. Not damage surrounding structure or adjacent systems, equipment or electrical wiring of the airplane from corrosive fluids or gases that may escape and that may cause a major or more severe failure condition.

6. Have provisions to prevent any hazardous effect on airplane structure or essential systems caused by the maximum amount of heat it can generate due to any failure of it or its individual cells.

7. Have a means to detect its failure and alert the flight crew in case its failure affects safe operation of the aircraft.

8. Have a means for the flight crew or maintenance personnel to determine the battery charge state if its function is required for safe operation of the airplane.

Note 1: A battery system consists of the battery and any protective, monitoring and alerting circuitry or hardware inside or outside of the battery. It also includes vents (where necessary) and packaging. For the purpose of this special condition, a battery and battery system are referred to as a battery.

Note 2: These special conditions apply to all non-rechargeable lithium battery installations in lieu of 25.1353(c)(1) through (c)(4). Section 25.1353(c)(1) through (c)(4) will remain in effect for other battery installations.

Note 3: For Very Small Non-rechargeable Lithium Batteries (equal or less than 2 Watt-hour of energy), an acceptable MoC with this Special Conditions is showing these batteries compliant with Underwriters Laboratories (UL) 1642 or UL 2054.

Note 4: For the purpose of SCs 7 and 8, “safe operation of the airplane” is defined as continued safe flight and landing following failures or other non-normal conditions. The following are examples of devices with batteries that are not required for continued safe flight and landing of the airplane: emergency locator transmitters, underwater locator beacons, seat belt air bag initiators and flashlights. A backup flight instrument with a non-rechargeable lithium battery is an example that would be required for safe operation of the airplane.

Due to missing a more appropriate standard, RTCA DO 227 with a Risk assessment at A/C level is an acceptable MoC to the SC contained in this CRI.

EQUIVALENT SAFETY FINDING	**G-GEN1: Instructions for Continued Airworthiness**
APPLICABILITY:	B747-8, -8F
REQUIREMENTS:	CS 25.1529, CS25 Appendix H
ADVISORY MATERIAL:	N/A

Description of compensating design features or alternative standards which allow the granting of the ESF

EASA acknowledges Boeing Position expressed in the FAA Issue Paper ELOS G-8 as subject "*Inclusion of Airworthiness Limitations with the Boeing ICA Manuals*", closed at stage 4 March 27, 2013 (see Appendix A) and concurs with Boeing and FAA's Position.

FAA Issue Paper ELOS G-8 is accepted and adopted by EASA.

IP G-8 'Inclusion of Airworthiness Limita

EQUIVALENT SAFETY FINDING	**G-GEN2: Engine and APU Fire Switch Handle Design**
APPLICABILITY:	B747-400, -400BCF, -400F / B747-8, -8F
REQUIREMENTS:	CS 25.601, 25.863, 25.1353(c)
ADVISORY MATERIAL:	N/A

Description of compensating design features or alternative standards which allow the granting of the ESF

On Boeing Models 747-400/-8/-8F, 757, 767, 777 (including the 777-8/-9), and 787 airplanes, the engine and APU fire switch handles are black but indicate red during detected fire conditions or when the FIRE/OVHT test switch is pushed. The conditionally illuminated red control indications serve to decrease cockpit visual noise within the flight deck during normal operations while providing control distinction when required. Illumination of an engine or APU fire control switch gives clear and prompt indication that a fire has been detected in the respective engine or APU compartment. The fire switch handles will display red only under detected fire conditions. This coincides with the Boeing quiet, dark flight deck philosophy and is an improvement to fire indication. The illuminated red color coding under all lighting conditions of the fire switch handle following a detected engine or APU fire provides prompt and accurate annunciation to the flight crew allowing users to quickly identify these controls.

The fire switch handles have a mechanical lock to prevent inadvertent operation. The locking feature is automatically unlocked in response to engine and APU fire indications, or requires a separate and distinct crew action to unlock when the handle is required for use in procedures other than in response to annunciated fire warnings. The mechanical lock will prevent inadvertent crew action.

Additionally, crew checklists contain requirements to "confirm" which engine fire switch handle should be pulled for any emergency for which there is a necessity to insure that the correct fire switch handle is pulled. Flight crews are trained to identify and operate the fire switch handles during initial and recurrent type rating. The fire switch handles are distinctive and unique flight deck controls and common to Boeing models including the 737, 747, 757, 767, 777 and 787 with respect to their shape and method of operation. Except for the 747, placement and location of the handles are common across all Boeing models and are adjacent to fuel cut-off handles.

Considerable service experience of the Boeing commercial fleet having the same design of fire switch handle has shown no adverse history of incidents or accidents related to this design.

Explanation of how design features provide an equivalent level of safety to the level of safety intended by the regulation

Under an annunciated fire condition in an engine or APU compartment, the fire switch handles are brightly illuminated in a red color. The illumination is sufficient for crew identification and crew alerting in all lighting conditions. The illumination of the fire switch handles is not required by 14 CFR part 25 or CS-25 regulations and is considered a compensating design feature to support a finding that the fire switch handle design provides an equivalent level of safety to that intended by § 25.1555(d)(1) under annunciated fire conditions. Illumination of the fire switch handle following a detected engine or APU fire provides prompt and accurate annunciation to the flight crew, and thus provides an equivalent level of safety to a fire switch handle that was colored red as required by the rule.

The fire switch handles have a mechanical lock to prevent inadvertent operation. Because one of the considerations in requiring emergency controls to be red under § 25.1555(d)(1) is to assist in preventing accidental selection or improper operation by flight crews, this locking feature is considered to be a compensating feature in support of the equivalent level of safety. The locking feature is automatically unlocked in response to engine and APU fire indications, or requires a separate and distinct crew action to unlock when the handle is required for use in procedures other than in response to annunciated fire warnings. The mechanical lock will prevent inadvertent crew action and thus the design feature provides an equivalent level of safety in this regard.

SPECIAL CONDITION	**H-01: Enhanced Airworthiness Programme for Aeroplane Systems – ICA on EWIS**
APPLICABILITY:	B717, B727, B737, B747, B757, B767, B777, DC-10, MD 11, DC-8, DC-9, MD-80, MD 90 (all FAR 26.11 affected models)
REQUIREMENTS:	PART 21A.16B(a)(3), 21A.3B(c)(1), CS 25.1529 & Appendix H
ADVISORY MATERIAL:	AMC 25 Subpart H

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.

Special Condition H-01 continued

(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 -