CS-25 AMENDMENT 5 - CHANGE INFORMATION

Certification Specifications (CS) are used for establishing the certification basis for applications made after the date of entry into force of a CS including any amendments. Since the complete text of a CS, including any amendments to it, is relevant for establishing the certification basis, the Agency has decided to enact and publish all amendments to CS's as consolidated documents instead of enacting and publishing only the amended text.

Consequently, except for a note "Amdt. 25/5" under the amended paragraph, the consolidated text of CS-25 does not allow readers to see the detailed changes introduced by the new amendment. To allow readers to also see these detailed changes this document has been created. The same format as for publication of Notices of Proposed Amendments has been used to show the changes:

1. text not affected by the new amendment remains the same: unchanged
2. deleted text is shown with a strike through: ~~deleted~~
3. new text is highlighted with grey shading: new
4. ....
   Indicates that remaining text is unchanged in front of or following the reflected amendment.
   ....

CS 25 TABLE OF CONTENTS

<u>1. Add the new Subpart H in the table of contents of Book 1 and Book 2</u>

BOOK 1 – AIRWORTHINESS CODE

.....

SUBPART H - ELECTRICAL WIRING INTERCONNECTION SYSTEMS

.....

BOOK 2 – ACCEPTABLE MEANS OF COMPLIANCE (AMC)

.....

AMC – SUBPART H

.....

CS-25 BOOK 1 – AIRWORTHINESS CODE

<u>2. Amend CS 25.611 by identifying the first paragraph as (a) and adding new paragraph (b), as follows:</u>

25.611 Accessibility provisions

(a) Means must be provided to allow inspection (including inspection of principal structural elements and control systems), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Non-destructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required by CS 25.1529.

(b) Electrical wiring interconnection systems must meet the accessibility requirements of CS 25.1719

<u>3. Amend CS 25.807 by revising paragraph (d)(3)(ii) as follows:</u>

(ii) For a tail cone exit incorporating a floor level opening of not less than 51 cm (20 inches) wide by 1·52 m (60 inches) high, with corner radii not greater than one-third the width of the exit, in the pressure shell and incorporating an approved assist means in accordance with CS ~~25.809(h)~~ 25.810(a), 25 additional passenger seats.

<u>4. Amend CS 25.812 by revising paragraph (g)(2) as follows:</u>

(2) At each non-overwing emergency exit not required by CS ~~25.809(f)~~ 25.810(a) to have descent assist means the illumination must be not less than 0.3 lux (0.03 foot candle) (measured normal to the direction of the incident light) on the ground surface with the landing gear extended where an evacuee is likely

to make his first contact with the ground outside the cabin.

5. Amend CS 25.855 by removing the word “wiring” from paragraph (e) and adding new paragraph (j) as follows:

CS 25.855 Cargo or baggage compartments
(See AMC 25.857)

….

(e) No compartment may contain any controls~~, wiring~~, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that–

….

(j) Cargo or baggage compartment electrical wiring interconnection system components must meet the requirements of CS 25.1721.

6. Amend CS 25.869 by revising subparagraph (a)(2),replacing paragraph (a)(3) by a new text and deleting paragraph (a)(4) as follows:

CS 25.869 Fire protection: systems

(a) Electrical system components:

….

(2) ~~Electrical cables, terminals, and e~~Equipment in designated fire zones, that ~~are~~ is used during emergency procedures, must be at least fire resistant

(3) Electrical Wiring Interconnection System components must meet the requirements of CS 25.1713. ~~Main power cables (including generator cables) in the fuselage must be designed to allow a reasonable degree of deformation and stretching without failure and must be –~~

~~(i) Isolated from flammable fluid lines; or~~

~~(ii) Shrouded by means of electrically insulated, flexible conduit, or equivalent, which is in addition to the normal cable insulation.~~

~~(4) Insulation on electrical wire and electrical cable installed in any area of the aeroplane must be self-extinguishing when tested in accordance with the applicable portions of Part I, Appendix F.~~

7. Amend CS 25.991 by revising paragraph (a) as follows:

(a) *Main pumps*. Each fuel pump required for proper engine operation, or required to meet the fuel system requirements of this Subpart (other than those in sub-paragraph (b) of this paragraph), is a main pump. For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump approved as part of the engine.

8. Amend CS 25.1203 by revising paragraph (e) and adding a new paragraph (h) as follows:

CS 25.1203 Fire detector system.

....

(e) ~~Wiring and other c~~Components of each fire or overheat detector system in a fire zone must be at least fire-resistant.

....

(h) Electrical wiring interconnection systems for each fire or overheat detector system in a fire zone must meet the requirements of CS 25.1713 and 1731.

9. Amend CS 25.1301 by renumbering the existing paragraphs and adding a new paragraph (b) as follows:

CS 25.1301 Function and installation
(See AMC 25.1301)

(a) Each item of installed equipment must –

(~~a~~1) Be of a kind and design appropriate to its intended function;

(~~b~~2) Be labelled as to its identification, function, or operating limitations, or any applicable combination of these factors (see AMC 25.1301(~~b~~a)(2)).

(~~c~~3) Be installed according to limitations specified for that equipment.

(b) Electrical wiring interconnection systems must meet the requirements of subpart H of this CS-25.

10. Amend CS 25.1309 by adding a new paragraph (d) as follows:

CS 25.1309 Equipment, systems and installations
(See AMC 25.1309)

....

(d) Electrical wiring interconnection systems must be assessed in accordance with the requirements of CS 25.1709.

11. Amend CS 25.1353 by revising paragraphs (a) & (b) and deleting paragraph (d) as follows:

CS 25.1353 Electrical equipment and installations

(a) Electrical equipment~~,~~ and controls~~, and wiring~~ must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to the safe operation. Any electrical interference likely to be present in the aeroplane must not result in hazardous effects upon the aeroplane or its systems except under extremely remote conditions. (See AMC 25.1353 (a).)

(b) ~~Cables must be grouped, routed and spaced so that damage to essential circuits will be minimised if there are faults in cables, particularly heavy current-carrying cables.~~ Electrical Wiring Interconnection System components must meet the requirements of 25.1703, 25.1707, 25.1711 and 25.1717.

….

(d) Reserved ~~Electrical cables and cable installations must be designed and installed as follows:~~

~~(1) The electrical cables used must be compatible with the circuit protection devices required by CS 25.1357, such that a fire or smoke hazard cannot be created under temporary or continuous fault conditions.~~

~~(2) Means of permanent identification must be provided for electrical cables, connectors and terminals.~~

~~(3) Electrical cables must be installed such that the risk of mechanical damage and/or damage caused by fluids, vapours or sources of heat, is minimised.~~

….

12. Amend CS 25.1357 by adding a new paragraph (f) as follows:

CS 25.1357 Circuit protective devices

….

(f) ~~Reserved~~ For aeroplane systems for which the ability to remove or reset power during normal operations is necessary, the system must be designed so that circuit breakers are not the primary means to remove or reset system power, unless specifically designed for use as a switch. (see AMC 25.1357(f)).

….

13. Amend CS 25.1411 by revising paragraph (c) as follows:

(c) *Emergency exit descent device*. The stowage provisions for the emergency exit descent device required by CS ~~25.809(f)~~ 25.810(a) must be at the exits for which they are intended.

14. Add a new Subpart H to read as follows:

SUBPART H - ELECTRICAL WIRING INTERCONNECTION SYSTEM

CS 25.1701 Definition
(See AMC 25.1701)

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

(1) Wires and cables.

(2) Bus bars.

(3) The termination point on electrical devices, including those on relays, interrupters, switches, contactors, terminal blocks, and circuit breakers and other circuit protection devices.

(4) Connectors, including feed-through connectors.

(5) Connector accessories.

(6) Electrical grounding and bonding devices and their associated connections.

(7) Electrical splices.

(8) Materials used to provide additional protection for wires, including wire insulation, wire sleeving, and conduits that have electrical termination for the purpose of bonding.

(9) Shields or braids.

(10) Clamps and other devices used to route and support the wire bundle.

(11) Cable tie devices.

(12) Labels or other means of identification.

(13) Pressure seals.

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

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

(1) Electrical equipment or avionics that is qualified to environmental conditions and testing procedures when those conditions and procedures are -

(i) Appropriate for the intended function and operating environment, and

(ii) Acceptable to the Agency.

(2) Portable electrical devices that are not part of the type design of the aeroplane. This includes personal entertainment devices and laptop computers.

(3) Fibre optics.

CS 25.1703 Function and Installation; EWIS
(See AMC 25.1703)

(a) Each EWIS component installed in any area of the aeroplane must:

(1) Be of a kind and design appropriate to its intended function.

(2) Be installed according to limitations specified for the EWIS components.

(3) Function properly when installed.

(4) Be designed and installed in a way that will minimise mechanical strain.

(b) The selection of wires must take into account known characteristics of the wire in relation to each particular installation and application in order to minimise the risk of wire damage, including any arc tracking phenomena.

(c) The design and installation of the main power cables, including generator cables, in the fuselage must allow for a reasonable degree of deformation and stretching without failure.

(d) EWIS components located in areas of known moisture accumulation must be adequately protected to minimise any hazardous effect due to moisture.

(e) EWIS modifications to the original type design must be designed and installed to the same standards used by the original aeroplane manufacturer or other equivalent standards acceptable to the Agency.

CS 25.1705 Systems and Functions; EWIS

(a) EWIS associated with systems required for type certification or by operating rules must be considered an integral part of that system and must be considered in showing compliance with the applicable requirements for that system.

(b) For systems to which the following rules apply, the components of EWIS associated with those systems must be considered an integral part of that system or systems and must be considered in showing compliance with the applicable requirements for that system.

(1) CS 25.773(b)(2) Pilot compartment view.

(2) CS 25.854 Lavatory fire protection

(3) CS 25.858 Cargo compartment fire detection systems

(4) CS 25.981 Fuel tank ignition prevention.

(5) CS 25.1165 Engine ignition systems.

(6) CS 25.1203 Fire-detector systems

(7) CS 25.1303(b) Flight and Navigation Instruments

(8) CS 25.1310 Power source Capacity and Distribution

(9) CS 25.1316 System lightning protection

(10) CS 25.1331(a)(2) Instruments using a power supply

(11) CS 25.1351 General.

(12) CS 25.1355 Distribution system.

(13) CS 25.1360 Precautions against injury.

(14) CS 25.1362 Electrical supplies for emergency conditions.

(15) CS 25.1365 Electrical appliances, motors, and transformers.

(16) CS 25.1431(c) and (d) Electronic equipment.

CS 25.1707 System Separation; EWIS
(See AMC 25.1707)

(a) Each EWIS must be designed and installed with adequate physical separation from other EWIS and aeroplane systems so that an EWIS component failure will not create a hazardous condition. Unless otherwise stated, for the purposes of this paragraph, adequate physical separation must be achieved by separation distance or by a barrier that provides protection equivalent to that separation distance.

(b) Each EWIS must be designed and installed such that any electrical interference likely to be present in the aeroplane will not result in hazardous effects upon the aeroplane or its systems except under extremely remote conditions.

(c) Wires and cables carrying heavy current and their associated EWIS components must be designed and installed to ensure adequate physical separation and electrical isolation, so that damage to essential circuits will be minimised under fault conditions.

(d) Each EWIS associated with independent aeroplane power sources or power sources connected in combination must be designed and installed to ensure adequate physical separation and electrical isolation so that a fault in any one aeroplane power source EWIS will not adversely affect any other independent power sources. In addition:

(1) Aeroplane independent electrical power sources must not share a common ground terminating location, and

(2) Aeroplane system's static grounds must not share a common ground terminating location with any of the aeroplane independent electrical power sources.

(e) Except to the extent necessary to provide electrical connection to the fuel systems components the EWIS must be designed and installed with adequate physical separation from fuel lines and other fuel system components, such that

(1) An EWIS component failure will not create a hazardous condition, and

(2) Fuel leakage onto EWIS components will not create a hazardous condition.

(f) Except to the extent necessary to provide electrical connection to the hydraulic systems components the EWIS must be designed and installed with adequate physical separation from hydraulic lines and other hydraulic system components, such that

(1) An EWIS component failure will not create a hazardous condition, and

(2) Hydraulic fluid leakage onto EWIS components will not create a hazardous condition.

(g) Except to the extent necessary to provide electrical connection to the oxygen systems components the EWIS must be designed and installed with adequate physical separation from oxygen lines and other oxygen system components, such that an EWIS component failure will not create a hazardous condition.

(h) Except to the extent necessary to provide electrical connection to the water/waste systems components the EWIS must be designed and installed with adequate physical separation from water/waste lines and other water/waste system components, such that

(1) An EWIS component failure will not create a hazardous condition, and

(2) Water/waste leakage onto EWIS components will not create a hazardous condition.

(i) Electrical wiring interconnection systems must be designed and installed with adequate physical separation between the EWIS and flight or other mechanical control systems cables, and associated system components such that,

(1) Chafing, jamming, or other interference are prevented, and

(2) An EWIS component failure will not create a hazardous condition, and

(3) Failure of any flight or other mechanical control systems cables or systems components will not damage EWIS and create a hazardous condition.

(j) Electrical wiring interconnection systems must be designed and installed with adequate physical separation between the EWIS components and heated equipment, hot air ducts, and lines such that;

(1) An EWIS component failure will not create a hazardous condition, and

(2) Hot air leakage or generated heat onto EWIS components will not create a hazardous condition.

(k) For systems for which redundancy is required either by specific certification requirements, operating rules or by CS 25.1709, each applicable EWIS must be designed and installed with adequate physical separation.

(l) Each EWIS must be designed and installed so there is adequate physical separation between it and other aeroplane components and structure, and so that_the EWIS is protected from sharp edges and corners, in order to minimise potential for abrasion/chafing, vibration damage, and other types of mechanical damage.

CS 25.1709 System Safety; EWIS
(See AMC 25.1709)

EWIS must be designed and installed so that:

(a) Each catastrophic failure condition

(1) is extremely improbable; and

(2) does not result from a single failure; and

(b) Each hazardous failure condition is extremely remote.

CS 25.1711 Component identification; EWIS
(See AMC 25.1711)

(a) EWIS components must be labelled or otherwise identified using a consistent method that facilitates identification of the EWIS component, its function, and its design limitations, if any.

(b) For systems for which redundancy is required either by specific certification requirements, operating rules or by CS 25.1709, concerned EWIS components must be particularly identified with its component part number, function, and separation requirement for bundles;

(1) The identification must be placed along the wire, cable or wire bundles at appropriate intervals and in areas of the aeroplane so they are readily visible to maintenance, repair, or alteration personnel.

(2) If an EWIS component cannot be marked physically, then others means of identification must be provided.

(c) The identifying markings required by sub-paragraphs (a) and (b) must remain legible throughout the expected service life of the EWIS component.

(d) The means used for identifying each EWIS component as required by this paragraph must not have an adverse effect on the performance of that component throughout its expected service life.

(e) Identification for EWIS modifications to the type design must be consistent with the identification scheme of the original type design.

CS 25.1713 Fire Protection; EWIS
(See AMC 25.1713)

(a) All EWIS components must meet the applicable fire and smoke protection requirements of CS 25.831(c) and CS 25.863.

(b) EWIS components that are located in designated fire zones and are necessary during emergency procedures must be at least fire resistant.

(c) Insulation on electrical wire and electrical cable, including materials used to provide additional protection for the wire and cable installed in any area of the aeroplane, must be self-extinguishing when tested in accordance with the applicable portions of Part I of Appendix F.

CS 25.1715 Electrical bonding and protection against static electricity; EWIS
(See AMC 25.1715)

(a) EWIS components used for electrical bonding and protection against static electricity must meet the requirements of CS 25.899.

(b) Electrical bonding provided by EWIS components must provide an adequate electrical return path under both normal and fault conditions, on aeroplanes having earthed electrical systems (see CS 25.1353(e)).

CS 25.1717 Circuit protective devices; EWIS
(See AMC 25.1717)

EWIS components must be designed and installed so they are compatible with the circuit protection devices required by CS 25.1357, so that a fire or smoke hazard cannot be created under temporary or continuous fault conditions.

CS 25.1719 Accessibility Provisions; EWIS
(See AMC 25.1719)

Means must be provided to allow for inspection of EWIS and the replacement of its components as necessary for continued airworthiness.

CS 25.1721 Protection of EWIS
(See AMC 25.1721)

(a) No cargo or baggage compartment may contain any EWIS whose damage or failure may affect safe operation, unless the EWIS is protected so that:

(1) It cannot be damaged by the movement of cargo or baggage in the compartment.

(2) Its breakage or failure will not create a fire hazard.

(b) EWIS must be designed and installed to minimise damage and risk of damage to EWIS by movement of people in the aeroplane during all phases of flight, maintenance, and servicing.

(c) EWIS must be designed and installed to minimise damage and risk of damage to EWIS by items carried onto the aeroplane by passengers or cabin crew.

CS 25.1723 Flammable fluid protection; EWIS
(See AMC 25.1723)

EWIS components must be considered to be a potential ignition source in each area where flammable fluid or vapours might escape by leakage of a fluid system and must meet the requirements of CS 25.863.

CS 25.1725 Powerplants; EWIS

(a) EWIS associated with any powerplant must be designed and installed so that the failure of an EWIS component will not prevent the continued safe operation of the remaining powerplants or require immediate action by any crew member for continued safe operation, in accordance with the requirements of CS 25.903(b).

(b) Design precautions must be taken to minimise hazards to the aeroplane due to EWIS damage in the event of a powerplant rotor failure or of a fire originating within the powerplant, which burns through the powerplant case, in accordance with the requirements of CS 25.903(d)(1).

CS 25.1727 Flammable Fluid Shutoff Means; EWIS

EWIS associated with each flammable fluid shutoff means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect operation of the flammable fluid shutoff means in accordance with the requirements of CS 25.1189.

CS 25.1729 Instructions for Continued Airworthiness; EWIS

The applicant must prepare Instructions for Continued Airworthiness applicable to EWIS in accordance with the requirements of CS 25.1529 and Appendix H paragraphs H25.4 and H25.5.

CS 25.1731 Powerplant and APU fire detector system; EWIS

(a) EWIS that are part of each fire or overheat detector system in a fire zone must be at least fire-resistant.

(b) No EWIS component of any fire or overheat detector system for any fire zone may pass through another fire zone, unless:

(1) It is protected against the possibility of false warnings resulting from fires in zones through which it passes; or

(2) Each zone involved is simultaneously protected by the same detector and extinguishing system.

15. Amend CS 25J991 by revising paragraph (a) as follows:

(a) Main pumps. Each fuel pump required for proper essential APU operation, or required to meet the fuel system requirements of this subpart (other than those in sub-paragraph (b) of this paragraph), is a main pump. For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump approved as part of the APU.

16. Add "and 25.1729" to the end of H25.1 paragraph (a) in Appendix H as follows:

H25.1 General

(a) This Appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by CS 25.1529 and CS 25.1729.

….

17. Amend H25.4 Airworthiness Limitations Section in Appendix H to read:

H25.4 Airworthiness Limitations Section

(a) The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth –

(1) Each mandatory replacement time, structural inspection interval, and related structural inspection procedure approved under CS 25.571; and

(2) *Reserved*

(3) Any mandatory replacement time of EWIS components as defined in CS 25.1701 (see AMC Appendix H 25.4(a)(3)).

(b) If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads: 'The Airworthiness Limitations Section is approved and variations must also be approved'.

18. Add a new H 25.5 EWIS ICA in Appendix H as follows:

H25.5 Electrical Wiring Interconnection System Instructions for Continued Airworthiness

The applicant must prepare Instructions for Continued Airworthiness applicable to Electrical Wiring Interconnection System as defined in CS 25.1701. (see AMC Appendix H 25.5)

CS-25 BOOK 2 - ACCEPTABLE MEANS OF COMPLIANCE (AMC)

19. AMC 25.951(d): Delete the entire AMC 25.951(d):

~~AMC 25.951(d)~~
~~Fuel System – General~~

~~Acceptable means of compliance with CS 25.951(d) include one of the following:~~

~~(1) Incorporation of a Agency-approved system that re-circulates the fuel back into the fuel system.~~

~~(2) Capping or securing the pressurisation and drain valve.~~

~~(3) Manually draining the fuel from a holding tank into a container.~~

20. AMC 25.1301(b): Delete paragraph 1 and make paragraph 2 a stand-alone paragraph to be re-titled as:

AMC 25.1301(~~b~~a)(2)
Function and Installation

~~1. Adequate means of identification should be provided for all cables, connectors and terminals. The means employed should be such as to ensure that the identification does not deteriorate under service conditions.~~

~~2.~~ When pipelines are marked for the purpose of distinguishing their functions, the markings should be such that the risk of confusion by maintenance or servicing personnel will be minimised. Distinction by means of colour markings alone is not acceptable. The use of alphabetic or numerical symbols will be acceptable if recognition depends upon reference to a master key and any relation between symbol and function is carefully avoided. Specification ISO.12 version 2ED 1987 gives acceptable graphical markings.

21. Insert the following new AMC 25.1357(f):

AMC 25.1357(f)
System Power Removal

(1) Subparagraph 25.1357(f) requires that circuit breakers are not used as the primary means to remove or reset system power for those aeroplane systems for which the ability to remove or reset power during normal operation is necessary.

(2) It is not the intent of the requirement that every electrically powered system in the aeroplane has a means to remove power other than a circuit breaker. The phrase "normally requiring power removal" is used to distinguish between aeroplane systems normally turned on and off during normal operations,

and those systems normally powered at all times, such as flight deck multi-function displays or the flight-management computer. But if, for example, the flight-management computer did require power cycling regularly, for whatever reason, this system would be required to have a means to do this other than using the circuit breakers.

(3) Systems requiring power removal during normal operations should be designed so that power is removed from the system as closely as practical to the source of power instead of simply deactivating the outputs of the systems power supplies.

(4) A separate, or integrated, power switch may be used to show compliance with CS 25.1357(f). If an integrated switch is used (that is, a switch that controls power to multiple aeroplane systems), then it must be shown that removing or resetting power for those multiple systems will not adversely affect safe flight.

(5) A switch-rated circuit breaker can be used if it is shown to be appropriately rated for the number of switch cycles expected to be executed during the service life of the system or of the circuit breaker.

22. Insert the following new AMCs to Subpart H

AMC – SUBPART H

AMC 25 Subpart H
Correlation with previous amendment of CS-25

The following table provides correlation between CS-25 Subpart H and CS-25 amendment 4:

Subpart H paragraph	Subparagraph	Based on previous CS-25 paragraph
CS 25.1701 Definition	(a)	none
	(b)	none
	(c)	none
CS 25.1703 Function and installation; EWIS	(a)(1)	CS 25.1301(a)
	(a)(2)	CS 25.1301(c)
	(a)(3)	CS 25.1309(a)
	(a)(4)	none
	(b)	none
	(c)	CS 25.869(a)(3)
	(d)	none
	(e)	none
CS 25.1705 Systems and functions; EWIS	(a)	none
	(b)(1)	CS 25.773(b)(2)
	(b)(2)	CS 25.854

Subpart H paragraph	Subparagraph	Based on previous CS-25 paragraph
	(b)(3)	CS 25.855
	(b)(4)	CS 25.857
	(b)(5)	CS 25.858
	(b)(6)	CS 25.981
	(b)(7)	CS 25.1165
	(b)(8)	CS 25.1203
	(b)(9)	CS 25.1303(b)
	(b)(10)	CS 25.1310
	(b)(11)	CS 25.1316
	(b)(12)	CS 25.1331(a)(2)
	(b)(13)	CS 25.1351
	(b)(14)	CS 25.1355
	(b)(15)	CS 25.1360
	(b)(16)	CS 25.1362
	(b)(17)	CS 25.1365
	(b)(18)	CS 25.1431(c) & (d)
CS 25.1707 System separation; EWIS	(a)	CS 25.1353(a)
	(b)	CS 25.1353(a)
	(c)	CS 25.1353(b)
	(d)(1)	CS 25.1351(b)(1)
	(d)(2)	CS 25.1351(b)(2)
	(e)(1)	CS 25.869(a)(3)(i)
	(e)(2)	CS 25.869(a) (3)(ii) CS 25.1353(d)(3)
	(f)(1)	CS 25.869(a)(3)(i)
	(f)(2)	CS 25.869(a) (3)(ii) CS 25.1353(d)(3)
	(g)	CS 25.1353(d)(3)
	(h)(1) (h)(2)	CS 25.1353(d)(3)
	(i)(1) (i)(2) (i)(3)	CS 25.1353(d)(3)
	(j)(1) (j)(2)	CS 25.1353(d)(3)
	(k)	none
	(l)	CS 25.1353(d)(3)
CS 25.1709 System safety; EWIS	(1)(i)	CS 25.1309(b)(1)
	(1)(ii)	CS 25.1309(b)(1)
	(2)	CS 25.1309(b)(2)
CS 25.1711 Component identification; EWIS	(a)	CS 25.1301(b)
	(b)(1)	none

Subpart H paragraph	Subparagraph	Based on previous CS-25 paragraph
	(b)(2)	none
	(c)	CS 25.1353(d)(2)
	(d)	none
	(e)	none
CS 25.1713 Fire protection; EWIS	(a)	CS 25.869(a)(1)
	(b)	CS 25.869(a)(2)
	(c)	CS 25.869(a)(4)
CS 25.1715 Electrical bonding and protection against static electricity; EWIS	(a)	CS 25.899
	(b)	none
	(b)(12)	CS 25.1331(a)(2)
	(b)(13)	CS 25. 1351
	(b)(14)	CS 25. 1355
	(b)(15)	CS 25.1360
	(b)(16)	CS 25.1362
	(b)(17)	CS 25.1365
	(b)(18)	CS 25.1431(c) CS 25.1431(d)
CS 25.1717 Circuit protection devices; EWIS		CS 25.1353(d)(1)
CS 25.1719 Accessibility provisions; EWIS		CS 25.611
CS 25.1721 Protection of EWIS	(a)(1)	CS 25.855(e)(1)
	(a)(2)	CS 25.855(e)(2)
	(b)	none
	(c)	none
CS 25.1723 Flammable fluid protection; EWIS		CS 25.863(b)(3)
CS 25.1725 Powerplants; EWIS	(a)	CS 25.903(b)
	(b)	CS 25.903(d)(1)
CS 25.1727 Flammable fluid shutoff means; EWIS		CS 25.1189(d)
CS 25.1729 Instructions for Continued Airworthiness; EWIS		CS 25.1529
CS 25.1731 Powerplant and APU fire detector system; EWIS	(a)	CS 25.1203(e)
	(b)(1)	CS 25.1203(f)(1)
	(b)(2)	CS 25.1203(f)(2)

Note: The term “none” in the above table indicates that the paragraph did not exist in the CS-25 amendment 4.

AMC 25.1701

Definition

1 Paragraph CS 25.1701 defines EWIS for the purposes of complying with the subpart H requirements and other EWIS-related requirements of CS 25. CS 25.1701 clearly identifies which wires and components these requirements apply to. Although this definition is located in subpart H to CS 25, it applies to all EWIS requirements regardless of location within CS 25.

2 Subparagraph CS 25.1701(a) defines EWIS as 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. The term “wire” means bare or insulated wire used for the purpose of electrical energy transmission, grounding, or bonding. This includes electrical cables, coaxial cables, ribbon cables, power feeders, and data busses.

3 Subparagraph CS 25.1701(a) of the requirement provides a listing of the component types that are considered part of the EWIS. These component types are listed as items CS 25.1701(a)(1) through CS 25.1701(a)(13). While these are the most widely used EWIS components it is not an all inclusive list. There may be components used by an applicant to support transmission of electrical energy that are not listed but meet the EWIS definition. They will be EWIS components subject to EWIS related regulatory requirements.

4 CS 25.1701(b) says that EWIS components located inside shelves, panels, racks, junction boxes, distribution panels, and back-planes of equipment racks (e.g., circuit board back-planes, wire integration units, external wiring of equipment) are covered by the EWIS definition. These components are included in the EWIS definition because the equipment they are inside of or part of, is typically designed and made for a particular aeroplane model or series of models. So the requirements that apply to aeroplane EWIS components must be applied to the components inside that equipment. These contrast with avionics components that must be sent back to their manufacturer or a specialized repair shop for service. Components inside shelves, panels, racks, junction boxes, distribution panels, and back-planes of equipment racks are maintained, repaired, and modified by the same personnel who maintain, repair, and modify the EWIS in the rest of the aeroplane. For example, in an electrical distribution panel system separation must be designed and maintained within the panel just like the EWIS leading up to that panel. Identification of components inside the panel is just as important as outside the panel since the wiring inside the panel is treated much the same. Also, while this type of equipment is designed for its intended function and is manufactured and installed to the same standards as other EWIS, it is typically not qualified to an environmental standard such as EUROCAE ED-14 / RTCA DO-160.

5 There are some exceptions to the EWIS definitions and those are given in CS 25.1701(c). Paragraph excepts EWIS components inside the following equipment, and the external connectors that are part of that equipment:

5.1 Electrical equipment or avionics that is qualified to environmental conditions and testing procedures when those conditions and procedures are –

- appropriate for the intended function and operating environment, and

- acceptable to the Agency.

5.2 Portable electrical devices that are not part of the type design of the aeroplane including personal entertainment devices and laptop computers.

5.3 Fibre optics.

6 The first exception means EWIS components located inside avionic or electrical equipment such as flight management system computers, flight data recorders, VHF radios, primary flight displays, navigation displays, generator control units, integrated drive generators, and galley ovens, if this equipment has been tested to industry-accepted environmental testing standards. Examples of acceptable standards are EUROCAE ED-14 / RTCA DO-160, and equipment qualified to a European Technical Standard Order (ETSO)

7 An applicant may use any environmental testing standard if the applicant can demonstrate that the testing methods and pass/fail criteria are at least equivalent to the widely accepted standards of EUROCAE ED-14 / RTCA DO-160, or a specific ETSO. Applicants should submit details of the environmental testing standards and results of the testing that demonstrate the equipment is suited for use in the environment in which it will be operated.

AMC 25.1703
Function And Installation; EWIS

1 CS 25.1703 requires that applicants select EWIS components that are of a kind and design appropriate to their intended function just as CS 25.1301 requires this for other pieces of equipment installed on the aeroplane. Factors such as component design limitations, functionality, and susceptibility to arc tracking and moisture or other known characteristics of the particular component must be considered.

2 Subparagraph 25.1703(a)(1) requires that each EWIS component be of a kind and design appropriate to its intended function. In this context, the requirement means that components must be qualified for airborne use, or otherwise specifically assessed as acceptable for their intended use. To be “appropriate” means that the equipment is used in a manner for which it was designed. For example, a wire rated at 150 degrees Celsius would not be appropriate for installation if that installation would cause the wire to operate at a temperature higher than 150 degrees Celsius. Wire and other components made for household or consumer products use may not be appropriate for airborne use because they are manufactured for the consumer market and not for use in an airborne environment. Other factors that must be considered for EWIS component selection are mechanical strength, voltage drop, required bend radius, and expected service life.

3. Subparagraph 25.1703(a)(2) requires that EWIS components be installed according to their limitations. As used here, limitations means the design and installation requirements of the particular EWIS component. Examples of EWIS component limitations are maximum operating temperature, degree of moisture resistance, voltage drop, maximum current-carrying capability, and tensile

strength. EWIS component selection and installation design must take into account various environmental factors including, but not limited to, vibration, temperature, moisture, exposure to the elements or chemicals (de-icing fluid, for instance), insulation type, and type of clamp.

4 Subparagraph 25.1703(a)(3) requires that EWIS function properly when installed. The key word in understanding the intent of this paragraph is "properly," as that relates to airworthiness of the aeroplane. For an EWIS component to function properly means that it must be capable of safely performing the function for which it was designed. For example, the fact that an in-flight entertainment (IFE) system fails to deliver satisfactory picture or sound quality is not what the term "properly" refers to. This is not a safety issue and therefore not a concern for certification aspects. The failure of an EWIS component has the potential for being a safety hazard whether it is part of a safety-related system or an IFE system. Therefore, EWIS components must always function properly (safely) when installed, no matter what system they are part of and any malfunction of the EWIS must not degrade the airworthiness of the aeroplane (refer to CS 25.1709 for terminology relating to failure classifications).

5 Subparagraph 25.1703(a)(4) requires that EWIS components be designed and installed so mechanical strain is minimised. This means the EWIS installation must be designed so that strain on wires would not be so great as to cause the wire or other components to fail. This paragraph requires that adequate consideration be given to mechanical strain when selecting wire and cables, clamps, strain relieves, stand-offs, and other devices used to route and support the wire bundle when designing the installation of these components.

6 Subparagraph 25.1703(b) requires that selection of wires take into account known characteristics of different wire types in relation to each specific application, to minimise risk of damage. It is important to select the aircraft wire type whose construction matches the application environment. The wire type selected should be constructed for the most severe environment likely to be encountered in service. This means, for example, that insulation types susceptible to arc tracking should not be used in areas exposed to high vibration and constant flexing in a moisture-prone environment.

7 Subparagraph 25.1703(c) contains the requirement formerly located in CS 25.869(a)(2) that design and installation of the main power cables allow for a reasonable degree of deformation and stretching without failure. Although it is now located in CS 25.1703(c), the meaning of the requirement has not changed. The reason for this requirement is the same as for CS 25.993(f), which requires that each fuel line within the fuselage be designed and installed to allow a reasonable degree of deformation and stretching without leakage. The idea is that the fuselage can be damaged with partial separation or other structural damage without the fuel lines or electrical power cables breaking apart. Allowing for a certain amount of stretching will help to minimise the probability of a fuel-fed fire inside the fuselage. As it is used in this requirement, a "reasonable degree of deformation and stretching" should be about 10% of the length of the electrical cable.

8 Subparagraph 25.1703(d) requires that EWIS components located in areas of known moisture build-up be adequately protected to minimise moisture's

hazardous effects. This is to ensure that all practical means are used to ensure damage from fluid contact with components does not occur. Wires routed near a lavatory, galley, hydraulic lines, severe wind and moisture problem areas such as wheel wells and wing trailing edges, and any other area of the aeroplane where moisture collection could be a concern must be adequately protected from possible adverse effects of exposure to moisture.

9 EWIS component selection

9.1 Expected service life.

Expected service life is a factor needing consideration in selecting EWIS components to use. Expected service life means the expected service lifetime of the EWIS. This is not normally less than the expected service life of the aircraft structure. If the expected service life requires that all or some of the EWIS components be replaced at certain intervals, then these intervals must be specified in the ICA as required by CS 25.1529. If the aircraft service life is extended, then EWIS components should be taken into account.

9.2 Qualified components.

EWIS components should be qualified for airborne use or specifically assessed as acceptable for the intended use and be appropriate for the environment in which they are installed.

Aircraft manufacturers list approved components in their manuals, such as the standard wiring practices manual (ATA Chapter 20). Ideally, only the components listed in the applicable manual or approved substitutes should be used for the maintenance, repair or modification of the aircraft. EWIS modifications to the original type design should be designed and installed to the same standards used by the original aircraft manufacturer or other equivalent standards acceptable to the Agency. This is because the manufacturer’s technical choice of an EWIS component is not always driven by regulatory requirements alone. In some cases specific technical constraints would result in the choice of a component that exceeds the minimum level required by the regulations.

9.3 Mechanical strength. EWIS components should have sufficient mechanical strength for their service conditions.

a. The EWIS should be installed with sufficient slack so that bundles and individual wires are not under undue tension.

b. Wires connected to movable or shock-mounted equipment should have sufficient length to allow full travel without tension on the bundle to the point where failure of the EWIS could occur.

c. Wiring at terminal lugs or connectors should have sufficient slack to allow for two re-terminations without replacement of wires, unless other design considerations apply. This slack should be in addition to the drip loop and the allowance for movable equipment.

d. In order to prevent mechanical damage wires should be supported by suitable clamps or other devices at suitable intervals. The design should be such that the failure of a single clamp will not in itself result in the wire or wire bundle coming into contact with other wires, equipment, structure, fluid lines, control cables, or other items that could cause damage to the wire. Because of in-service experience with abrasion and chafing of wires contained in troughs, ducts, or conduits justification should be given if additional support of the wires will not be used. The supporting devices should be of a suitable size and type, with the wires and cables held securely in place without damage to the insulation as per Society of Automotive Engineers SAE AS50881 or equivalent standard

9.4 Minimum bend radius.

To avoid damage to wire insulation, the minimum radius of bends in single wires or bundles should be in accordance with the wire manufacturer's specifications. Guidance on the minimum bend radius can be found in the manufacturer's standard wiring practices manual. Other industry standards such as AECMA EN3197 or SAE AS50881 also contain guidance on minimum bend radius. For example, SAE AS50881b states: "For wiring groups, bundles, or harnesses, and single wires and electrical cables individually routed and supported, the minimum bend radius shall be ten times the outside diameter of the largest included wire or electrical cable. At the point where wiring breaks out from a group, harness or bundle, the minimum bend radius shall be ten times the diameter of the largest included wire or electrical cable, provided the wiring is suitably supported at the breakout point. If wires used as shield terminators or jumpers are required to reverse direction in a harness, the minimum bend radius of the wire shall be three times the diameter at the point of reversal providing the wire is adequately supported."

9.5 Coaxial cable damage.

Damage to coaxial cable can occur when the cable is clamped too tightly or bent sharply (normally at or near connectors). Damage can also be incurred during unrelated maintenance actions around the coaxial cable. Coaxial cable can be severely damaged on the inside without any evidence of damage on the outside. Installation design should minimise the possibility of such damage. Coaxial cables have a minimum bend radius. SAE AS50881b states: "The minimum radius of bend shall not adversely affect the characteristics of the cable. For flexible type coaxial cables, the radius of bend shall not be less than six times the outside diameter. For semi-rigid types, the radius shall not be less than ten times the outside diameter."

9.6 Wire bundle adhesive clamp selection.

Certain designs use adhesive means to fasten bundle supports to the aircraft structure. Service history shows that these can work loose during aircraft operation, either as a result of improper design or inadequate surface preparation. You should pay particular attention to the selection and methods used for affixing this type of wire bundle support.

9.7 Wire bundle routing.

Following are some considerations that should go into the design of an EWIS installation.

a. Wire bundles should be routed in accessible areas that are protected from damage from personnel, cargo, and maintenance activity. As far as practicable they should not be routed in areas in where they are likely to be used as handholds or as support for personal equipment or where they could become damaged during removal of aircraft equipment (reference CS 25.1719 and 25.1721).

b. Wiring should be clamped so that contact with equipment and structure is avoided. Where this cannot be accomplished, extra protection, in the form of grommets, chafe strips, etc., should be provided. Wherever wires cannot be clamped, protective grommets should be used, wherever wires cannot be clamped, in a way that ensures clearance from structure at penetrations. Wire should not have a preload against the corners or edges of chafing strips or grommets.

c. As far as practicable wiring should be routed away from high-temperature equipment and lines to prevent deterioration of insulation (reference CS 25.1707(j)).

d. Wiring routed across hinged panels, should be routed and clamped so that the bundle will twist, rather than bend, when the panel is moved. When not possible, the bending radius must be in accordance with the acceptable minimum bundle radius.

9.8 Conduits.

Conduits should be designed and manufactured so that potential for chafing between the wiring and the conduit internal walls is minimised.

a. Non-metallic conduit. Insulating tubing (or sleeving) is sometimes used to provide additional electrical, environmental, and limited additional mechanical protection or to increase the external wire dimension. Insulating tubing should not be considered as the sole mechanical protection against external abrasion of wire because it does not prevent external abrasion. At best, it provides only a delaying action against the abrasion. The electrical and mechanical properties of the tubing need to be considered to ensure that it its use is appropriate for the type of protection that the designer intends it to be used for. Additional guidance on the use of insulating tubing or sleeving is given in AMC 25.1707 paragraph (2)(c).

b. Metallic conduit. The ends of metallic conduits should be flared and the interior surface treated to reduce the possibility of abrasion.

9.9 Connector selection.

The connector used for each application should be selected only after a careful determination of the electrical and environmental requirements.

a. Particular attention should be given to any use of components with dissimilar metals, because this may cause electrolytic corrosion.

b. Environment-resistant connectors should be used in applications that will be subject to fluids, vibration, temperature extremes, mechanical shock, corrosive elements, etc.

c. Sealing plugs and contacts should be used in unused connector cavities where necessary. In addition, firewall class connectors incorporating sealing plugs should be able to prevent the penetration of the fire through the aircraft firewall connector opening and continue to function without failure for a specified period of time when exposed to fire.

d. When electromagnetic interference and radio frequency interference (EMI and RFI) protection is required, Special attention should be paid to the termination of individual and overall shields. Back shell adapters designed for shield termination, connectors with conductive finishes, and EMI grounding fingers are available for this purpose.

9.10 Splice selection.

Environmentally sealed splices should be used in accordance with the requirements of the airframe manufacturer's standard wiring practices or SAE AS81824/1, or equivalent specification, particularly in un-pressurized and severe wind and moisture problem (SWAMP) areas. However, the possibility of fluid contamination in any installation needs to be considered.

a. Splices in pressurised areas. In pressurised areas, pre-insulated splices conforming to SAE AS7928, or equivalent specification, may be used if these types of splices are listed as acceptable for use by the manufacturer in their standard wiring practices manual. The possibility of fluid contamination in any installation should also be considered.

b. Mechanically protected splices. Mechanical splices allow maintenance personnel an alternative method to using a heat gun for splices in fuel vapour areas on post-delivery aircraft. The generally available environmental splices use heat shrink material that needs application of heat. Most of these heat sources cannot be used in flammable vapour areas of an aircraft without proper precautions. Mechanical splices are acceptable for use in high temperature and fuel vapour areas, provided the splice is covered with a suitable plastic sleeve, such as a dual wall shrink sleeve or high temperature tape, such as Teflon, wrapped around the splice and tied at both ends. If high temperature tape is used, it should be permanently secured at both ends. Mechanical splices should be installed according to the airframe manufacturer's standard practices, or equivalent specification. The manufacturer's standard wiring practices manual should provide part number detail and best practices procedures for mechanical splices. It should also detail the applicability of each of the recommended splices for all required critical aeroplane installations.

c. Aluminium wire splice. Splices for aluminium wires should be in accordance with the requirements of the airframe manufacturers' standard practices or SAE AS70991, MS25439, or equivalent specification. Conditions that result in excessive voltage drop and high resistance at junctions that may ultimately lead to failure of the junction should be avoided. The preferable location for aluminium splices is in pressurized areas. To avoid contamination from foreign particles the crimp tool should be dedicated to aluminium wire crimping.

9.11 Wire selection.

a. Installation environment.

(1) Careful attention should be applied when deciding on the type of wire needed for a specific application. Due consideration should be given such that the wire's construction properly matches the application environment. For each installation, you should select wire construction type suitable for the most severe environment likely to be encountered in service. For example use a wire type that is suitable for flexing for installations involving movement, use a wire type that has a high temperature rating for higher temperature installations.

(2) When considering the acceptability of wire, you should refer to the industry standards defining acceptable test methods for aircraft wire, including arc tracking test methods. (e.g. EN3475, SAE AS4373, or alternative manufacturer standards)

(3) Wires such as fire detection, fire extinguishing, fuel shutoff, and fly-by-wire / engine control system wiring that must operate during and after a fire must be selected from wire types qualified to provide circuit integrity after exposure to fire for a specified period.

b. Wire insulation selection.

Wire insulation type should be chosen according to the environmental characteristics of wire routing areas. One wire insulation characteristic of particular concern is arc tracking. Arc tracking is a phenomenon in which a conductive carbon path forms across an insulating surface. A breach in the insulation allows arcing and carbonizes the insulation. The resulting carbon residue is electrically conductive. The carbon then provides a short circuit path through which current can flow. This can occur on either dry or wet wires. Certain types of wire insulation are more susceptible to arc tracking than others, and wire insulated with aromatic polyimide is one. Therefore, its use should be limited to applications where it will not be subjected to high moisture, high vibration levels, or abrasion, or where flexing of the wire will occur. There are new types of aromatic polyimide insulated wire, such as hybrid constructions (e.g., the aromatic polyimide tape is the middle layer, and the top and bottom layer is another type of insulation such as Teflon tape) which are less susceptible to arc tracking.

c. Mechanical strength of wire.

Wires should be sufficiently robust to withstand all movement, flexing, vibration, abrasion and other mechanical hazards to which they may be reasonably subjected on the aeroplane. Generally, conductor wire should be stranded to minimise fatigue breakage. Refer to AS50881 and AECMA EN3197 for additional guidance. Additionally, wires should be robust enough to withstand the mechanical hazards they may be reasonably subjected to during installation into the aircraft.

d. Mixing of different wire insulation types.

Different wire types installed in the same bundle should withstand the wire-to-wire abrasion they will be subject to. Consideration should be given to the types of insulation mixed within wire bundles, especially if mixing a hard insulation type with a relatively softer type, and particularly when relative motion could occur between the wires. Such relative motion between varying wire insulation types could lead to accelerated abrasion and subsequent wire failure.

e. Tin plated conductors.

Tin plated conductors may be difficult to solder if not treated properly, so preparation of the conductor is necessary to ensure a good connection is made.

(f) Wire gauge selection.

To select the correct size of electrical wire, the following requirements should be considered:

(1) The wire size should be matched with the circuit protective device with regard to the required current.

(2) The wire size should be sufficient to carry the required current without overheating.

(3) The wire size should be sufficient to carry the required current over the required distance without excessive voltage drop (based on system requirements).

(4) Particular attention should be given to the mechanical strength and installation handling of wire sizes smaller than AWG 22 (e.g., consideration of vibration, flexing, and termination.) Use of high-strength alloy conductors should be considered in small gauge wires to increase mechanical strength.

Note: Additional guidance for selecting wires and other EWIS components can be found in SAE AS50881 and EN2853.

g. Wire temperature rating.

Selection of a temperature rating for wire should include consideration of the worst-case requirements of the application. Caution should be used when locating wires in areas where heat is generated, for example where oxygen generators or lighting ballast units are located.

(1) Wires have a specified maximum continuous operating temperature. For many types, this may be reached by any combination of maximum ambient temperature and the temperature rise due to current flow.

(2) In general, it is undesirable to contribute more than 40°C rise to the operating temperature by electrical heating.

(3) Other factors to be considered are altitude de-rating, bundle size de-rating, and use of conduits and other enclosures.

(4) Particular note should be taken of the specified voltage of any wire where higher than normal potentials may be used. Examples are discharge lamp circuits and windscreen heating systems.

h. EWIS components in moisture areas.

(1) Severe wind and moisture problem.

Areas designated as severe wind and moisture problem (SWAMP) areas are different from aircraft to aircraft but they generally are considered to be such areas as wheel wells, wing folds, pylons, areas near wing flaps, and other exterior areas that may have a harsh environment. Wires for these applications should incorporate design features that address these severe environments.

(2) Silver plated conductors.

Many high strength copper alloy conductors and coaxial cables use silver plating. Contamination of silver-plated conductors with glycol (de-icing fluid) can result in electrical fire. Accordingly, you should not use silver plated conductors in areas where de-icing fluid can be present unless suitable protection features are employed. Silver plated conductors and shields can exhibit a corrosive condition (also known as 'Red Plague') if the plating is damaged or of poor quality and is exposed to moisture. Designers should be aware of these conditions.

(3) Fluid contamination of EWIS components.

Fluid contamination of EWIS components should be avoided as far as practicable. But EWIS components should be designed and installed with the appropriate assumptions about fluid contamination, either from the normal environment or from accidental leaks or spills. Industry standards, such as RTCA DO-160/EUROCAE ED-14, contain information regarding typical aircraft fluids. It is particularly important to appreciate that certain contaminants, notably from toilet waste systems, galleys, and fluids containing sugar, such as sweetened drinks, can induce electrical tracking in already degraded electrical wires and unsealed electrical components. The only cleaning fluids that should be used are those recommended by the aeroplane manufacturer in its standard practices manual.

10 EWIS component selection for future modifications

If a TC includes subpart H in its certification basis, future modifiers of those TCs should comply with the subpart H requirements by using the same or equivalent standards / design practices as those used by the TC holder. If modifiers choose to deviate from those standards / design practices, they should have to substantiate compliance independently. The standards / design practices used by the TC holder in order to justify their own choice of components should also be considered.

AMC 25.1707
System separation; EWIS

1 Summary

The continuing safe operation of an aeroplane depends on the safe transfer of electrical energy by the EWIS. If an EWIS failure occurs, its separation from other EWIS and from other systems and structures plays an important role in ensuring that hazardous effects of the failure are mitigated to an acceptable level. CS 25.1707 requires applicants to design EWIS with appropriate separation to minimise the possibility of hazardous conditions that may be caused by an EWIS interfering with other EWIS, other aeroplane systems, or structure. The purpose of separation is to prevent hazards of interference between wires in a single bundle, between two or more bundles, or between an electrical bundle and a non-electrical system or structure. Such interference could take the form of mechanical and or electrical interference (EMI for example). Mechanical interference examples include chafing between electrical cables or pipes or structure and may lead to fluid leakage such as galley water waste systems.

2 Separation by physical distances versus separation by barrier.

CS 25.1707 states that adequate physical separation must be achieved by separation distance or by a barrier that provides protection equivalent to that separation distance. The following should be considered when designing and installing an EWIS:

a. In most cases, physical distance is the preferred method of achieving the required separation. This is because barriers themselves can be the cause of EWIS component damage (e.g., chafing inside of conduits) and can lead to maintenance errors such as barriers removed during maintenance and inadvertently left off. They can also interfere with visual inspections of the EWIS.

b. If a barrier is used to achieve the required separation, CS 25.1707 requires that it provide at least the same level of protection that would be achieved with physical distance. That means that when deciding on the choice of the barrier, factors such as dielectric strength, maximum and minimum operating temperatures, chemical resistivity, and mechanical strength should be taken into account.

c. In addition to the considerations given in paragraph (b) above, when wire bundle sleeving is used to provide separation, applicants should consider that the sleeving itself is susceptible to the same types of damage as wire insulation. The appropriate type of sleeving must be selected for each specific application and design consideration must be given to ensuring that the sleeving is not subjected to damage that would reduce the separation it provides.

3 Determination of separation.

Determining the necessary amount of physical separation distance is essential. But because each system design and aeroplane model can be unique, and because manufacturers have differing design standards and installation techniques, CS 25.1707 does not mandate specific separation distances. Instead it requires that the chosen separation be adequate so that an EWIS component failure will not create a hazardous condition. The following factors should be considered when determining the separation distance:

a. The electrical characteristics, amount of power, and severity of failure condition of the system functions performed by the signals in the EWIS and adjacent EWIS.

b. Installation design features, including the number, type, and location of support devices along the wire path.

c. The maximum amount of slack wire resulting from wire bundle build tolerances and the variability of wire bundle manufacturing

d. Probable variations in the installation of the wiring and adjacent wiring, including position of wire support devices and amount of wire slack possible.

e. The intended operating environment, including amount of deflection or relative movement possible and the effect of failure of a wire support or other separation means.

f. Maintenance practices as defined by the aeroplane manufacturer's standard wiring practices manual and the ICA required by CS 25.1529 and CS 25.1729.

g. The maximum temperature generated by adjacent wire/wire bundles during normal and fault conditions.

h. Possible EMI, HIRF, or induced lightning effects.

4 Cases of inadequate separation.

Some areas of an aeroplane may have localized areas where maintaining the minimum physical separation distance is not feasible. This is especially true in smaller aeroplanes. In those cases, other means of ensuring equivalent minimum physical separation may be acceptable, if testing or analysis demonstrates that safe operation of the aeroplane is not jeopardized. The applicant should substantiate to the Agency that the means to achieve the required separation provides the necessary level of protection for wire related failures. Electro-magnetic interference (EMI) protection must also be verified.

5 Meaning of the term "hazardous condition" as used in CS 25.1707.

The term "hazardous condition" in CS 25.1707 has the same meaning as the one used in CS 25.1309 or CS 25.1709. Unlike CS 25.1309 or CS 25.1709, no probability objectives are required for compliance. The intent of CS 25.1707, is that the applicant must perform a qualitative design assessment of the installed EWIS and the physical separation to guard against hazardous conditions

This assessment involves the use of reasonable engineering and manufacturing judgment and assessment of relevant service history to decide whether an EWIS, system, or structural component could fail in such a way as to create a condition that would affect the aeroplane's ability to continue safe operation. However, the requirements of CS 25.1707 do not preclude the use of valid component failure rates if the applicant chooses to use a probability argument in addition to the design assessment to demonstrate compliance. It also does not preclude the agency from requiring such an analysis if the applicant cannot adequately demonstrate that hazardous conditions will be prevented solely by using the qualitative design assessment.

6 Subparagraph CS 25.1707(a) requires that EWIS associated with any system on the aeroplane be designed and installed so that under normal

conditions and failure conditions, it will not adversely affect the simultaneous operation of any other systems necessary for continued safe flight, landing, and egress. CS 25.1707(a) also requires that adequate physical separation be achieved by separation distance or by a barrier that provides protection equivalent to that separation distance.

7 Subparagraph 25.1707(b) requires that each EWIS be designed and installed to limit electrical interference on the aeroplane.
One type of electrical interference is electromagnetic interferences (EMI). Electromagnetic interference can be introduced into aeroplane systems and wiring by coupling between electrical cables or between cables and coaxial lines or other aeroplane systems. Function of systems should not be affected by EMI generated by adjacent wire. EMI between wiring which is a source of EMI and wire susceptible to EMI increases in proportion to the length of parallel runs and decreases with greater separation. Wiring of sensitive circuits that may be affected by EMI should be routed away from other wiring interference, or provided with sufficient shielding to avoid system malfunctions under operating conditions. EMI should be limited to negligible levels in wiring related to systems necessary for continued safe flight, landing and egress. The following sources of interference should be considered:

a. Conducted and radiated interference caused by electrical noise generation from apparatus connected to the busbars.

b. Coupling between electrical cables or between cables and aerial feeders.

c. Malfunctioning of electrically-powered apparatus.

d. Parasitic currents and voltages in the electrical distribution and grounding systems, including the effects of lightning currents or static discharge.

e. Different frequencies between electrical generating systems and other systems.

8 This paragraph 25.1707(c) contains the wire-related requirements formerly located in CS 25.1353(b). Coverage is expanded beyond wires and cable carrying heavy current to include their associated EWIS components as well. This means that all EWIS components, as defined by CS 25.1701, that are associated with wires and cables carrying heavy current must be installed in the aeroplane so damage to essential circuits will be minimised under fault conditions.

9 Subparagraph 25.1707(d) contains wire-related requirements from CS 25.1351(b)(1) and (b)(2) and introduces additional requirements.

a. Subparagraph (d) requires that EWIS components associated with the generating system receive the same degree of attention as other components of the system, such as the electrical generators.

b. Subparagraph (d)(1) prohibits aeroplane independent electrical power sources from sharing a common ground terminating location. Paragraph (d)(2) prohibits aeroplane static grounds from sharing a common ground terminating location with any aeroplane independent electrical power sources. The reason for these paragraphs is twofold:

(1) to help ensure the independence of separate electrical power sources so that a single ground failure will not disable multiple power sources; and

(2) to prevent introduction of unwanted interference into aeroplane electrical power systems from other aeroplane systems.

10 Subparagraphs 25.1707(e), (f), (g), (h) contain specific separation requirements for the fuel, hydraulic, flight and mechanical control system cables, oxygen, hot bleed air systems, and waste/water systems. They require adequate EWIS separation from those systems except to the extent necessary to provide any required electrical connection to them. EWIS must be designed and installed with adequate separation so a failure of an EWIS component will not create a hazardous condition and any leakage from those systems (i.e., fuel, hydraulic, oxygen, waste/water) onto EWIS components will not create a hazardous situation.

a. Under fault conditions and without adequate EWIS separation a potential catastrophic hazard could occur should an arcing fault ignite a flammable fluid like fuel or hydraulic fluid. Also an arcing fault has the potential to puncture a line associated with those systems if adequate separation is not maintained. If there is leakage from one of those systems and an arcing event occurs, fire or explosion could result. Similarly, leakage from the water/waste system can cause damage to EWIS components and adversely affect their integrity. An EWIS arcing event that punctures a water or waste line could also introduce fluids into other aeroplane systems and create a hazardous condition.

b. In addition to the required separation distance, the use of other protection means such as drip shields should be considered to prevent the potential for fluids to leak onto EWIS.

11 Subparagraph 25.1707(i). To prevent chafing, jamming, or other types of interference, or other failures that may lead to loss of control of the aeroplane, EWIS in general and wiring in particular must be physically separated from flight control or other types of control cables. Mechanical cables have the potential to cause chafing of electrical wire if the two come into contact. This can occur either through vibration of the EWIS and/or mechanical cable or because of cable movement in response to a system command. A mechanical cable could also damage other EWIS components, such as a wire bundle support, in a way that would cause failure of that component. Also, if not properly designed and installed, a wire bundle or other EWIS component could interfere with movement of a mechanical control cable by jamming or otherwise restricting the cable's movement.
Without adequate separation, an arcing fault could damage or sever a control cable. A control cable failure could damage EWIS. Therefore, paragraph (i) requires an adequate separation distance or barrier between EWIS and flight or other mechanical control systems cables and their associated system components. It also requires that failure of an EWIS component must not create a hazardous condition and that the failure of any flight or other mechanical control systems cables or systems components must not damage EWIS and creates a hazardous condition. Clamps for wires routed near moveable flight controls should be attached and spaced so that failure of a single attachment

point cannot interfere with flight controls or their cables, components, or other moveable flight control surfaces or moveable equipment.

12 Subparagraph 25.1707(j) requires that EWIS design and installation provide adequate physical separation between the EWIS components and heated equipment, hot air ducts, and lines. Adequate separation distance is necessary to prevent EWIS damage from extreme temperatures and to prevent an EWIS failure from damaging equipment, ducts, or lines. High temperatures can deteriorate wire insulation and other parts of EWIS components, and if the wire or component type is not carefully selected, this deterioration could lead to wire or component failure. Similarly, should an arcing event occur, the arc could penetrate a hot air duct or line and allow the release of high pressure, high temperature air. Such a release could damage surrounding components associated with various aeroplane systems and potentially lead to a hazardous situation.

13 Subparagraph AMC 25.1707(k). For systems for which redundancy is required either by specific certification requirements, operating rules or by CS 25.1709, each applicable EWIS must be designed and installed with adequate physical separation. To maintain the independence of redundant systems and equipment so that safety functions are maintained, adequate separation and electrical isolation between these systems must be ensured as follows:

a. EWIS of redundant aircraft systems should be routed in separate bundles and through separate connectors to prevent a single fault from disabling multiple redundant systems. Segregation of functionally similar EWIS components is necessary to prevent degradation of their ability to perform their required functions.

b. Power feeders from separate power sources should be routed in bundles separate from each other and from other aircraft wiring in order to prevent a single fault from disabling more than one power source.

c. Wiring that is part of electro-explosive subsystems, such as cartridge-actuated fire extinguishers and emergency jettison devices, should be routed in shielded and jacketed twisted-pair cables, shielded without discontinuities, and kept separate from other wiring at connectors.

14 Subparagraph 25.1707(l) requires that EWIS be designed and installed so they are adequately separated from aircraft structure and protected from sharp edges and corners. This is to minimise the potential for abrasion and chafing, vibration damage, and other types of mechanical damage. This protection is necessary because over time the insulation on a wire that is touching a rigid object, such as an equipment support bracket, will fail and expose bare wire. This can lead to arcing that could destroy that wire and other wires in its bundle. Structural damage could also occur depending on the amount of electrical energy the failed wire carries.

AMC 25.1709
System safety; EWIS

25.1709 requires applicants to perform a system safety assessment of the EWIS. The analysis required for compliance with CS 25.1709 is based on a qualitative approach to assessing EWIS safety as opposed to numerical, probability-based quantitative analysis. The safety assessment must consider the effects that both physical and functional failures of EWIS would have on aeroplane safety. That safety assessment must show that each EWIS failure considered hazardous is extremely remote. It must show that each EWIS failure considered to be catastrophic is extremely improbable and will not result from a single failure.

1 Objective.

The objective of CS 25.1709 is to use the concepts of CS 25.1309 to provide a thorough and structured analysis of aircraft wiring and its associated components. As in CS 25.1309, the fail-safe design concept applies. Any single failure condition, such as an arc fault, should be assumed to occur regardless of probability.

2 Inadequacies of CS 25.1309 in relation to EWIS safety assessments.

CS 25.1309 requires the applicant to perform system safety assessments. But current CS 25.1309 practice has not led to the type of analysis that fully ensures all EWIS failure conditions affecting aeroplane level safety are considered. This is because wiring for non-required systems is sometimes ignored. Even for systems covered by CS 25.1309(b), the safety analysis requirements have not always been applied to the associated wire. When they are, there is evidence of inadequate and inconsistent application. Traditional thinking about non-required systems, such as IFE, has been that, since they are not required, and the function they provide is not necessary for the safety of the aeroplane, their failure could not affect the safety of the aeroplane. This is not a valid assumption. Failure of an electrical wire, regardless of the system it is associated with, can cause serious physical and functional damage to the aeroplane, resulting in hazardous or even catastrophic failure conditions. An example of this is arcing from a shorted wire cutting through and damaging flight control cables. There are more failure modes than have been addressed with traditional analyses. Some further examples are arcing events that occur without tripping circuit breakers, resulting in complete wire bundle failures and fire; or wire bundle failures that lead to structural damage

3 Integrated nature of EWIS.

The integrated nature of wiring and the potential severity of failures demand a more structured safety analysis approach than that traditionally used under CS 25.1309. CS 25.1309 system safety assessments typically evaluate effects of wire failures on system functions. But they have not considered physical wire failure as a cause of the failure of other wires within the EWIS. Traditional assessments look at external factors like rotor burst, lightning, and hydraulic line rupture, but not at internal factors, like a single wire chafing or arcing event, as the cause of the failure of functions supported by the EWIS. Compliance with CS 25.1709 requires addressing those failure modes at the aeroplane level. This means that EWIS failures need to be analyzed to determine what effect they could have on the safe operation of the aeroplane.

4 Compliance summary.

As specified above, the analysis required for compliance with CS 25.1709 is based on a qualitative approach to assessing EWIS safety as opposed to numerical, probability-based quantitative analysis. The intent is not to examine each individual wire and its relation to other wires. Rather, it is to ensure that there are no combinations of failures that could lead to a hazardous condition. However, in case the “top down” analysis process described in this AMC determines that a failure in a given bundle may lead to a catastrophic failure condition, the mitigation process may lead to performing a complete analysis of each wire in the relevant bundle.

5 Qualitative probability terms.

When using qualitative analyses to determine compliance with CS 25.1709, the following descriptions of the probability terms have become commonly accepted as aids to engineering judgment:

a. Extremely remote failure conditions.

These are failure conditions that are not anticipated to occur to an individual aeroplane during its total life but which may occur a few times when considering the total operational life of all aeroplanes of the type.

b. Extremely improbable failure conditions.

These are failure conditions so unlikely that they are not anticipated to occur during the entire operational life of all aeroplanes of one type.

6 Relationship to CS 25 system safety assessments.

The analysis described may be accomplished in conjunction with the required aircraft system safety assessments of CS 25.1309, 25.671, etc.

7 Classification of failure terms.

The classification of failure conditions is specified in AMC 25.1309.

8 Flowcharts depicting the analysis process.

Flowcharts 1 and 2 outline one method of complying with the requirements of CS 25.1709. The processes in both Flowcharts 1 and 2 identify two aspects of the analysis: physical failures and functional failures. The processes described in both flowcharts begins by using the aircraft level functional hazard analysis developed for demonstrating compliance with CS 25.1309 to identify catastrophic and hazardous failure events. A step-by-step explanation of the analysis depicted in the flowcharts is given in paragraphs 11 (for flowchart 1) and 12 (for Flowchart 2).

a. Flowchart 1.

This flowchart applies to applicants for pre-TC work and for amended TCs, and STCs when the applicant has all data necessary to perform the analysis. If Flowchart 1 is used for post-TC modifications the available data must include identification of the systems in the EWIS under consideration for modification and the system functions associated with that EWIS.

b. Flowchart 2.

This flowchart applies to applicants for post-TC modifications when the applicant cannot identify the systems or systems functions contained in EWIS under consideration for modification.

9 Definitions applicable to CS 25.1709.

For this discussion the following definitions apply:

a. Validation. Determination that requirements for a product are sufficiently correct and complete.

b. Verification. Evaluation to determine that requirements have been met.

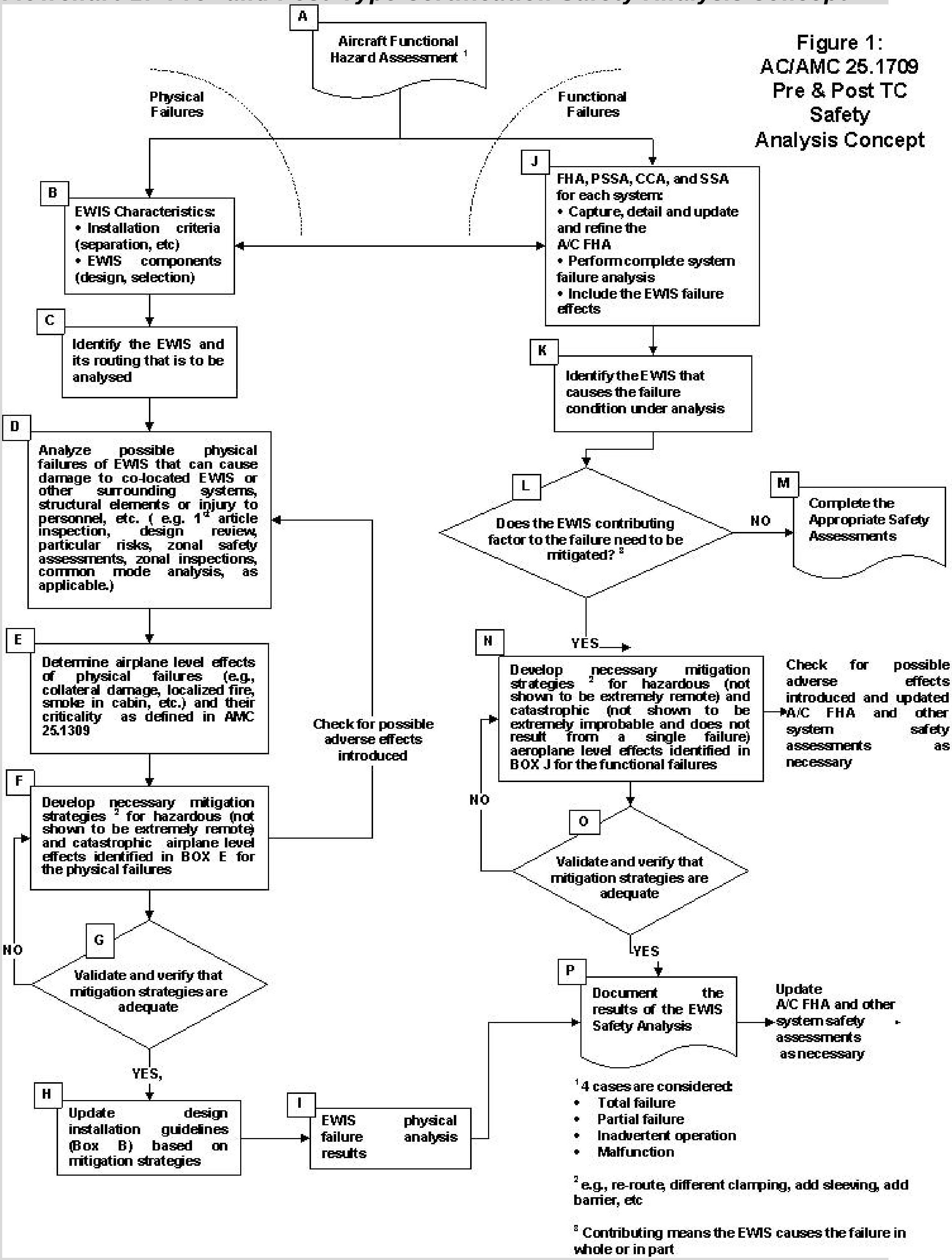
c. Mitigation. Elimination of the hazard entirely or suitable precautions taken to minimize the overall severity to an acceptable level.

10 Physical failure analysis.

a. Only single common cause events or failures need to be addressed during the physical failure analysis as described in this AMC and shown on the left hand sides of Flowcharts 1 and 2. Multiple common cause events or failures need not be addressed.

b. In relation to physical effects, it should be assumed that wires are carrying electrical energy and that, in the case of an EWIS failure, this energy may result in hazardous or catastrophic effects directly or when combined with other factors, for example fuel, oxygen, hydraulic fluid, or damage by passengers, These failures may result in fire, smoke, emission of toxic gases, damage to co-located systems and structural elements or injury to personnel. This analysis considers all EWIS from all systems (autopilot, auto throttle, PA system, IFE systems, etc.) regardless of the system criticality.

Flowchart 1: Pre- and Post-Type Certification Safety Analysis Concept



Note: Mitigation as used in this flowchart means to eliminate the hazard entirely or minimise its severity to an acceptable level.

11 Descriptive text for flowchart 1

a. *Box A*: Aircraft functional hazard assessment.

(1) The functional failure analysis assumes that electrical wires are carrying power, signal, or information data. Failure of EWIS under these circumstances may lead to aircraft system degradation effects.

(2) The functional hazard assessment (FHA) referred to in this box is not a stand-alone separate document specifically created to show compliance with CS 25.1709. It is the aircraft level FHA that the applicant will have developed in compliance with CS 25.1309 to help demonstrate acceptability of a design concept, identify potential problem areas or desirable design changes, or determine the need for and scope of any additional analyses (refer to AMC 25.1309)

b. Analysis of Possible Physical Failures

(1) *Box B*: EWIS characteristics.

Use the results of the FHA (BOX A and BOX J) to identify EWIS installation criteria and definitions of component characteristics. Results from BOX B are fed into the preliminary system safety analysis (PSSA) and system safety analysis (SSA) of BOX J.

(2) *Boxes C, D and E*: Validation and verification of installation criteria.

(i) Ensure that the EWIS component qualification satisfies the design requirements and that components are selected, installed, and used according to their qualification characteristics and the aircraft constraints linked to their location (refer to the requirements of CS 25.1703 and CS 25.1707).

(ii) Use available information (digital mock-up, physical mock-up, aeroplane data, historical data) to perform inspections and analyses to validate that design and installation criteria are adequate to the zone/function, including considerations of multi-systems impact. Such inspections and analyses may include a 1st article inspection, design review, particular risk assessment, zonal safety assessment, zonal inspection, and common mode analysis, as applicable. Use such assessments and inspections to ascertain whether design and installation criteria were correctly applied. Special consideration should be given to known problem areas identified by service history and historical data (areas of arcing, smoke, loose clamps, chafing, arc tracking, interference with other systems, etc.). Regardless of probability, any single arcing failure should be assumed for any power-carrying wire. The intensity and consequence of the arc and its mitigation should be substantiated. Give special consideration to cases where new (previously unused) material or technologies are used. In any case CS 25.1703(b) requires that the selection of wires must take into account known characteristics in relation to each installation and application to minimise the risk of wire damage, including any arc tracking phenomena.

(iii) Deviations from installation and component selection criteria identified by these activities should be evaluated. A determination can then be made about their acceptability. Develop alternative mitigation strategies as necessary.

(3) *Boxes F and G*: Development and validation of mitigation strategy.

Identify and develop a mitigation strategy for the physical failures and their adverse effects identified in Boxes D and E. Validation and verification of the mitigation solution should ensure that:

(i) Hazardous failure conditions are extremely remote.

(ii) Catastrophic failure conditions do not result from a single common cause event or failure.

(iii) This mitigation solution does not introduce any new potential failure conditions.

(4) *Box H*: Incorporation of applicable mitigation strategies.

Incorporate newly developed mitigation strategies (BOX F) into guidelines (BOX B) for further design and inspection and analysis processes.

(5) *Box I*: Physical failure analysis results.

From the EWIS physical failure analysis, the following should be documented:

- Physical failures addressed.
- Effects of those physical failures.
- Mitigation strategies developed.

This information should be used to support the final analysis documentation (BOX P).

c. Analysis of Possible Functional Failures

(1) *Box J*: System safety assessments.

The results of the aeroplane level FHA (BOX A) should be used to guide the system level FHA (BOX J). Incorporate EWIS failures identified by CS 25.1709 into the system level and aircraft level FHA, the PSSA, the Common Cause Analyses (CCA), and the SSA. These analyses are performed to satisfy requirements of CS 25.1309. Use results of these analyses to update the EWIS definition (BOX B).

(2) *Boxes K, L and M*: Hazardous and catastrophic failure conditions.

Use the analyses in BOX J to determine if the EWIS associated with the system under analysis can contribute (in whole or in part) to the failure condition under study. Determine whether the EWIS failure needs to be mitigated. If so, develop, validate, and verify a mitigation strategy. If no mitigation is needed, complete the appropriate safety assessment per CS 25.1309, CS 25.671, etc..

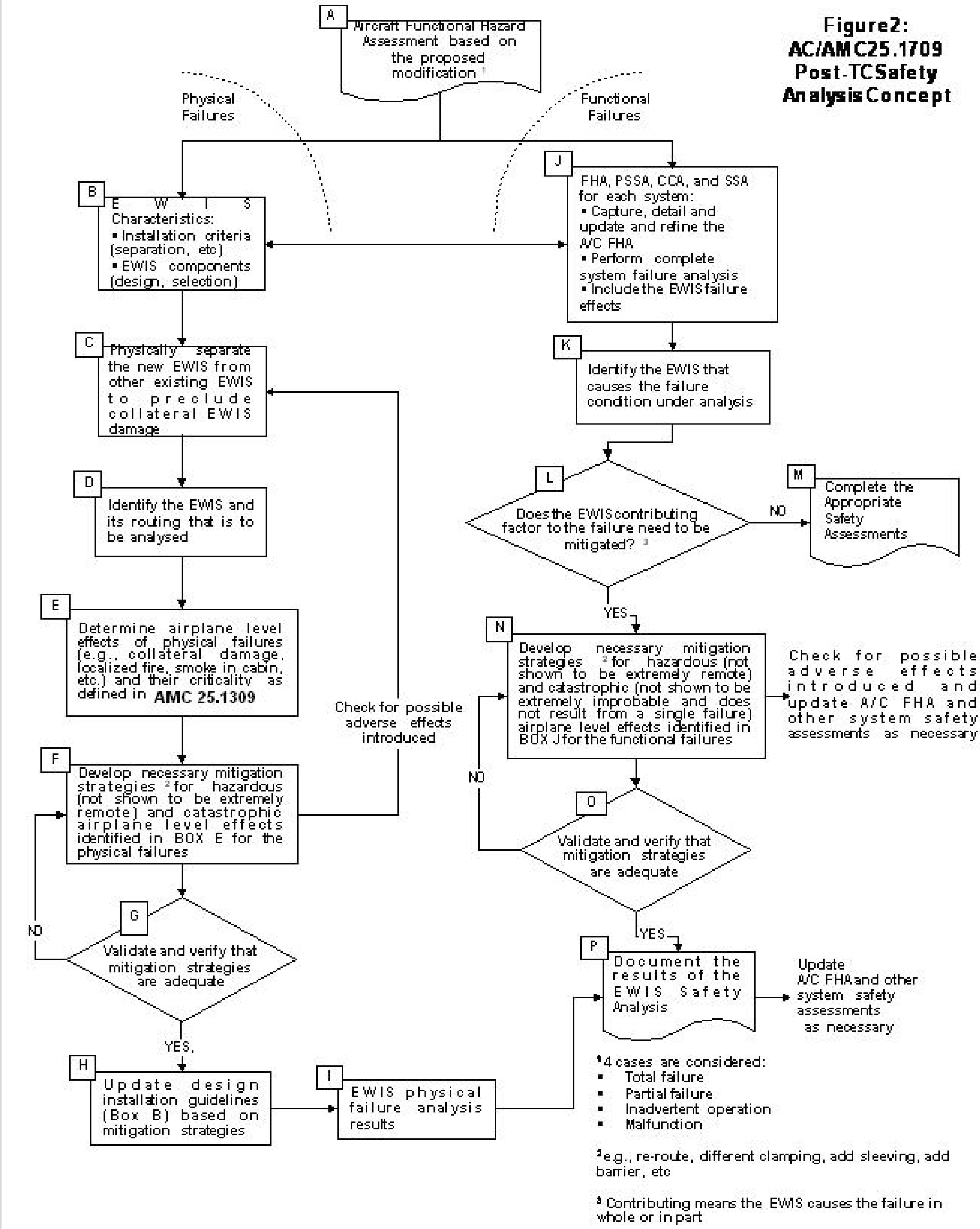
(3) *Boxes N and O*: Development and validation of mitigation strategy.

Identify and develop a mitigation strategy for the functional failures and adverse effects identified in BOX J. Validation and verification of the mitigation solution should determine if initial objective is fully reached; and confirm that this mitigation solution is compatible with existing installations and installation criteria. If the EWIS was the failure cause, the subsequent mitigation strategy developed may introduce new adverse effects not previously identified by the analysis. Check for any new adverse effects and update the aircraft level FHA and other system safety assessments as necessary.

(4) *Box P*: Documentation of EWIS safety analysis results.

After mitigation strategies have been validated and verified, the results of the CS 25.1709 analysis should be documented. Update as necessary the aircraft level FHA that has been developed in support of certification of the proposed modification, in compliance with CS 25.1309 (BOX A).

Flowchart 2: Post-TC Safety Analysis Concept



Note: Mitigation as used in this flowchart means to eliminate the hazard entirely or minimise its severity to an acceptable level.

12 Descriptive text for flowchart 2.

a. Applicants for post-TC modifications should use the analysis depicted in Flowchart 2 when the applicant cannot identify the systems or systems functions contained in existing aircraft EWIS that maybe utilized as part of the modification. An applicant should not add EWIS to an existing EWIS if the systems or systems functions contained in the existing EWIS are unknown. To do so could introduce unacceptable hazards. For example, IFE power wires could inadvertently be routed with aeroplane autoland EWIS.

b. The main objectives are to ensure that the proposed modification will be correctly designed and installed and will not introduce unacceptable hazards either through its own failure or by adversely affecting existing aircraft systems. As far as EWIS is concerned, correct incorporation of the modification should be ensured by both good knowledge of original aircraft manufacturer installation practices and their correct implementation or by adequate separation of the added EWIS from existing EWIS. In either case, physical analyses should be performed (similar to the physical failures part of Flowchart 1).

c. *Box A*: Aircraft functional hazard assessment.

Aircraft level effects must be considered for modified systems or systems added to the aircraft. If the Aircraft level FHA is available, the applicant should examine it to determine the Aircraft level effect of the proposed modification. If the Aircraft level FHA is not available, then the applicant must generate an Aircraft level FHA based on the proposed modification. This Aircraft level FHA would be limited to just those Aircraft systems affected by the proposed modification. If it is determined that no Aircraft level functional effects are introduced, a statement to this effect and the supporting data is sufficient to satisfy BOX A.

d. Analysis of Possible Physical Failures

(1) *Box B*: EWIS characteristics.

Use results of the Aircraft level FHA (BOX A and BOX J) to identify EWIS installation criteria and definitions of component characteristics. Results of BOX B are fed into the PSSA and SSA of BOX J.

(2) *Box C*: Physical separation of new EWIS from existing EWIS.

(i) The EWIS to be added should be separated from existing aeroplane EWIS since the systems or system functions contained in the existing EWIS are unknown. Physical separation between the new and existing EWIS should be established either by separation distance or by an appropriate barrier or other means shown to be at least equivalent to the physical separation distance when allowed by CS 25.1707. Alternative methods given in the advisory material for CS 25.1707 provide an acceptable way to determine adequate separation.

(ii) In cases where separation cannot be maintained because of physical constraints (e.g., terminal strips and connectors), the applicant should accomplish the appropriate analysis to show that no adverse failure conditions result from sharing the common device. This analysis requires knowledge of the systems or system functions sharing the common device (e.g., terminal strips and connectors).

(3) *Box D and E*: Validation and verification of installation criteria.

(i) Ensure that the EWIS component qualification satisfies the design requirements and that components are selected, installed, and used according to their qualification characteristics and the aeroplane constraints linked to their location.

(ii) Use available information (digital mock-up, physical mock-up, aeroplane data, historical data) to perform inspections and analyses to validate that design and installation criteria are adequate to the zone/function, including considerations of multi-systems impact. Such inspections and analyses may include a 1st article inspection, design review, particular risk assessment, zonal safety assessment, zonal inspection, and common mode analysis, as applicable. Use such assessments and inspections to ascertain whether design and installation criteria were correctly applied. Special consideration should be given to known problem areas identified by service history and historical data (areas of arcing, smoke, loose clamps, chafing, arc tracking, interference with other systems, etc.). Regardless of probability, any single arcing failure should be assumed for any power-carrying wire. The intensity and consequence of the arc and its mitigation should be substantiated. Special consideration should be given to cases where new (previously unused) material or technologies are used. Evaluate deviations from installation and component selection criteria identified by these activities and determine their acceptability.

(iii) Alternative mitigation strategies should be developed as necessary.

(4) *Boxes F and G*: Development and validation of mitigation strategy.

Identify and develop a mitigation strategy for the physical failures identified in BOXES D and E and resulting adverse effects. Validation and verification of a mitigation solution should ensure that:

(i) Hazardous failure conditions are extremely remote.

(ii) Catastrophic failure conditions do not result from a single common cause event or failure.

(iii) This mitigation solution does not introduce any new potential failure conditions.

(5) *Box H*: Incorporation of Applicable Mitigation Strategies.

Incorporate newly developed mitigation strategies (BOX F) into guidelines (BOX B) for further design and inspection and analysis process.

(6) *Box I*: Physical failure analysis documentation.

From the EWIS physical failure analysis, the following should be documented:

- Physical failures addressed.
- Effects of those physical failures.

- Mitigation strategies developed.

This information supports the final analysis documentation (BOX P).

e. Analysis of Possible Functional Failures

(1) *Box J*: System safety assessments.

Use the results of the aircraft level FHA (BOX A) to guide the system level FHA (BOX J). Incorporate EWIS failures identified by CS 25.1709 into the system level and aircraft level FHA, the PSSA, the CCA, and the SSA. These analyses are performed to satisfy requirements of CS 25.1309. Use results of these analyses to update the EWIS definition (BOX B).

(2) *Boxes K, L and M*: Hazardous and catastrophic failure conditions.

Use the analyses in BOX J to determine if the EWIS associated with the system under analysis can contribute (in whole or in part) to the failure condition under study. Determine whether the EWIS failure needs to be mitigated. If so, develop, validate, and verify a mitigation strategy. If no mitigation is needed, complete the appropriate safety assessment (e.g., per CS 25.1309, CS 25.671, etc.).

(3) *Boxes N and O*: Development and validation of mitigation strategy.

Identify and develop a mitigation strategy for the functional failures and adverse effects identified in BOX J. Validation and verification of the mitigation solution should determine if initial objective is fully reached and confirm that this mitigation solution is compatible with existing installations and installation criteria. If the EWIS was the failure cause, the subsequent mitigation strategy developed may introduce new adverse effects not previously identified by the analysis. Check for any new adverse effects and update the aircraft level FHA and other system safety assessments as necessary.

(4) *Box P*: Documentation of EWIS safety analysis results.

After mitigation strategies have been validated and verified, document the results of the CS 25.1709 analysis. Update as necessary the aircraft level FHA that has been developed in support of certification of the proposed modification, in compliance with CS 25.1309, (BOX A).

AMC 25.1711
Component identification; EWIS

1 Paragraph 25.1711 requires applicants to identify EWIS components using consistent methods that facilitate easy identification of the component, its function, and its design limitations. For EWIS associated with flight-essential functions where specific certification requirements are met by redundancy, identification of the EWIS must also include separation requirements. This paragraph requires that the identifying markings remain legible throughout the expected service life of the EWIS component, and that the method used to identify components have no adverse affect on their performance.

2 Subparagraph 25.1711(a) requires a consistent method in EWIS identification to avoid confusion and mistakes during aeroplane manufacturing, modification, and maintenance. Aeroplane manufacturers should develop an EWIS identification method that facilitates easy identification of the systems that any specific EWIS component supports and use that identification method in a consistent manner throughout the aeroplane. This consistent identification method must be used for new type certifications and changes to those designs.

3 Subparagraph 25.1711(b): Certain aeroplane systems are installed with redundancy in order to meet the reliability requirements of CS 25.1309 and 25.1709. For EWIS components associated with these systems, paragraph (b) requires specific identification indicating component part number, function, and separation requirement. This is necessary to prevent modifiers from unintentionally introducing unsafe design or installation features on previously certified aeroplanes when they install new or modified systems. Such identification will aid the designers and installers of the new system by alerting them to the presence of these systems. It will allow them to make appropriate design and installation decisions. Component identification will also make those performing maintenance and inspections more aware of what systems are associated with specific EWIS in the areas undergoing maintenance or inspection.

4 Subparagraph 25.1711(c) requires that identifying markings required by CS 25.1711(a) and (b) remain legible throughout the design life of the component. As most wire installations are designed to remain on the aeroplane throughout the aeroplane's service life, this means the identification marks must be able to be read for the life of the aeroplane. The method of marking must take into account the environment in which the EWIS component will be installed. The Society of Automotive Engineers (SAE) documents ARP 5607, "Legibility of Print on Aerospace Wire and Cables," and AS 5942, "Marking of Electrical Insulating Materials," provides guidance on this subject.

5 Subparagraph 25.1711(d) requires that the means used to identify an EWIS component may not have an adverse effect on component performance throughout its design life.

a. Certain wire marking methods have potential to damage wire insulation. Hot-stamp marking is one such method. According to SAE (Society of Automotive Engineers) aerospace information report AIR5575, "Hot Stamp Wire Marking Concerns for Aerospace Vehicle Applications," the hot-stamp marking method is not well suited for today's generation of thin wall aircraft wiring. As noted in that document, wire insulation has become markedly thinner over the years since the procedure was first introduced in the 1940s. Because of this, problems have arisen over wire damage from excessive penetration by the hot stamp process. The document further states: "The frequent need for adjustments in temperature, pressure, and swell time inherent to achieving legible hot stamp wire marking provides many opportunities for error. The controls, methods, and guidance necessary to achieve satisfactory performance with hot stamp marking are often not made available to operators in smaller wire maintenance facilities." In addition it should be established from the wire manufacturer that hot stamp printing is or is not suitable for the particular wire.

b. If damage to the insulation occurs during the marking process, it may fail later in service after exposure to the sometimes-harsh environmental conditions of aircraft use. While CS 25.1711does not prohibit use of hot-stamp marking, its use is discouraged. To comply with this paragraph, if the hot-stamp marking process is used, the guidelines of SAE recommended practice ARP5369, “Guidelines for Wire Identification Marking Using the Hot Stamp Process” or equivalent should be followed.

c. In some cases it may not be practicable to mark an EWIS component directly because of component size or identification requirements. In this case other methods of identification such as a label or sleeve should be used.

6 CS 25.1711(e) requires that EWIS modifications to the type design maintain consistency with the identification scheme of the original type design. It requires that EWIS modifications to the type design take into consideration the identification scheme of the original type design. This is to ensure that the consistency required by CS 25.1711(a) is maintained when a modification is installed. The intent of this requirement is to provide continuity for EWIS identification on a particular model. It is not the intent of the requirement to impose on the modifier the exact wire identification methods of the aeroplane manufacturer. However, since the purpose of CS 25.1711 is to make it easy to identify those aeroplane systems essential to the safe operation of the aeroplane, it is in the best interest of safety that designers of any modifications to the original design consider the approved type design identification methods. For example it would not be appropriate for a modifier to use purple wire to identify a specific flight critical system when the approved type design used the colour green, especially if the type design already uses purple wire to identify non-essential systems. Such a scheme could cause confusion and lead future modifiers or maintainers to believe that the routing of purple wires with green wires (and thus critical systems with non-essential systems) is acceptable. The paragraph does not prescribe a particular method for identification but is meant to ensure that consistent identification is maintained throughout the life of the aeroplane.

7 CS 25.981(b) states that "...visible means to identify critical features of the design must be placed in areas of the aeroplane where maintenance, actions, repairs, or alterations may be apt to violate the critical design configuration limitations (e.g., colour-coding of wire to identify separation limitation)." The design approval holder should define a method of ensuring that this essential information will:

- be communicated by statements in appropriate manuals, such as wiring diagram manuals, and
- be evident to those who may perform and approve such repairs and alterations.

An example of a critical design configuration control limitation that would result in a requirement for visible identification means would be a requirement to maintain wire separation between FQIS (fuel quantity indication system) wiring and other electrical circuits that could introduce unsafe levels of energy into the FQIS wires. Acceptable means of providing visible identification means for this limitation would include color-coding of the wiring or, for retrofit, placement of identification tabs at specific intervals along the wiring.

8 Types of EWIS component identification.

There are at least four types of EWIS component identification, which are accomplished at different stages. They are listed and described below.

a. Component manufacturer part number.

EWIS components should be identified by their manufacturer in accordance with the International Organization for Standardization document ISO 2574, "Aircraft – Electrical Cables – Identification Marking," or similar specifications. This identification comprises product part number, manufacturer identification, and, when possible or specifically required, batch identification or year of manufacture.

This helps ensure:

- Identification and traceability of the component.
- Verification of compliance with the aircraft certification basis.
- Accuracy in manufacture, maintenance, quality control, storage and delivery.
- Verification of the use of approved/qualified sourcing.
- Monitoring of the aircraft configuration during the aircraft life.

(1) EWIS component manufacturer identification.

It is common practice to use the five-digit/letter C.A.G.E. code (Government and Commercial Entity Code), for manufacturer identification, particularly for wires. Alternatively, for small components whose size may make it difficult to use other forms of clear identification, a logo may be used.

(2) Identification intervals.

Wires and cables should be identified at intervals of not more than 38 cm (15 inches). This interval is different than the interval used by airframe manufacturers to prevent the possibility of two identifications overlapping over the entire length of the run, which could render both identifications illegible.

(3) Types of wire manufacturer markings.

Wire manufacturer markings should generally be green to differentiate them from the black marking typically used by the aeroplane manufacturer, but other contrasting colors are also acceptable. The preferred marking process is the "ink transfer" or "ink jet" type, with post curing to increase resistance to mechanical or chemical wear. As stated above, hot stamp marking method has the potential to damage wire insulation and its use is discouraged.–

(4) The component technical specification should include methods used for identification and legibility during the design life of the component.

b. Airframe manufacturer component function identification number.

In addition to the type identification imprinted by the original wire manufacturer, aircraft wire should also contain a unique circuit identification coding that is accomplished at time of harness assembly. This allows existing installed wire to be identified as to its performance capabilities when considering replacement. Inadvertent use of a lower performance and unsuitable replacement wire can thus be avoided. Identification of EWIS components by the airframe manufacturer helps ensure:

- Identification and inspection of cable runs.
- Accuracy of manufacture, maintenance, quality control, storage and delivery.
- Verification of the system to which the component belongs.
- Identification of components related to systems required for safe flight, landing, or egress or that have the potential to impact the flight crew's ability to cope with adverse operating conditions.

Identification of EWIS components should clearly correspond to aircraft wiring manuals.

c. Airframe manufacturer routing identification and modification.

Electrical drawings should describe wire routings through the entire aeroplane (for example: incompatibility between routes, minimum distance between routes, absolute ban of combining bundles) and be available in the maintenance documentation as required by Appendix H to CS 25. This information ensures that modification designers and maintenance personnel are aware of the defined physical segregation of the different routes of the aircraft model they are working on. Coding for identification of routes or bundles used on aircraft should be displayed by adequate means such as labels, tags, placards, coloured ties, bar-codes. This type of component identification helps ensure:

- Identification and inspection of bundles.
- Accuracy of manufacture, maintenance, quality control, storage and delivery.
- Determination of the type of route, or route function, (feeder power, radio etc.).
- Clear identification of systems that require physical segregation (i.e. to detect the possible mix of different routes/bundles, the misrouting of a system in an area, etc).
- Identification of routes taken by systems that are required for safe flight, landing, egress, or have the potential to impact the ability of the flight crew to cope with adverse operating conditions.

(1) Means used for this identification should be appropriate for the component type. The identification process used should not cause degradation of the characteristics of any of the wire cables or other EWIS components in the harness.

(2) Modification and repairs identification, in a form that helps ensure the original aeroplane manufacturer's identification scheme, should be maintained throughout the service life of the aeroplane.

(3) Wires and cables should be identified at intervals of preferably not more than 46 cm (18 inches) and should not obscure the identification markings of the EWIS component manufacturer or airframe manufacturer component function identification number. This identification interval is different than the interval used by wire manufacturers to prevent the possibility of two identifications overlapping over the entire length of the run, which could render both identifications illegible. Also, exceptions can be made for short runs of wires or cables or when the majority of the wire or cable is installed in a manner that facilitates easy reading of the identification markings

d. Identification of user EWIS modification or repair – (operator's identification coding).

Repairs or modifications to EWIS should follow the identification guidance given in the above paragraphs for aeroplane manufacturers. This helps ensure that the original aeroplane manufacturer's identification scheme is not compromised by future modifications or repairs and is maintained throughout the service life of the aeroplane.

AMC 25.1713
Fire protection: EWIS

The intent of CS 25.1713 is to ensure that the EWIS does not fail in such a way as to propagate fire and produce hazardous quantities of smoke and toxic fumes.

1 Subparagraph 25.1713(a) requires that all EWIS components meet the applicable fire and smoke protection requirements of CS 25.831(c). After reasonably probable failures or malfunctions, EWIS components should not cause harmful or hazardous concentrations of gases or vapours in excess of the levels prescribed in CS 25.831(b)(1) and (2).

2 Subparagraph 25.1713(b) requires that EWIS components located in designated fire zones and are used during emergency procedures must be at least fire resistant. This requirement is intended to help ensure that emergency services on the aeroplane are available in the event of a fire. EWIS components in regions immediately behind firewalls and in engine pod attachment structures should be made of such materials and installed at such a distance from the firewall that they will not suffer damage that could hazard the aeroplane if the surface of the firewall adjacent to the fire is heated to 1100° C for 15 minutes.

3 Subparagraph 25.1713(c) requires that insulation on electrical wire and electrical cable installed anywhere in the aeroplane be self-extinguishing when tested in accordance with the applicable portions of part I of Appendix F of CS 25.
In addition, to protect against propagation of a fire, EWIS components other than wire and cable should be designed using non-flammable and self-extinguishing materials as tested to meet the intent of Part I of Appendix F.

AMC 25.1715
Electrical bonding and protection against static electricity: EWIS

1 The build-up and subsequent discharge of static electricity has the potential to create hazardous conditions for both aeroplane systems and the aeroplane occupants. Static can cause physical injury, interfere with installed electrical/electronic equipment, and cause ignition of flammable vapours. All EWIS components used for bonding and protection against static electricity play a vital role in ensuring the integrity of the bonds.

2 CS 25.1715(a) requires that EWIS used for electrical bonding and protection against static electricity meet the requirements of CS 25.899. To minimise the hazardous effects of static discharge, EWIS components should be selected, designed, and installed so that the cross-sectional area of bonding paths used for primary and secondary bonding ensure that an appropriately low electrical impedance is obtained and maintained throughout the expected service life of the components. The maximum resistance for electrical bonds varies depending on the type of bond, e.g., ground stud, between connector shell and structure.

3 CS 25.1715(b) requires that EWIS components used for any electrical bonding purposes (not just those used for protection against static electricity) provide an adequate electrical return path under both normal and fault conditions. EWIS components should be selected, designed, and installed so that the cross-sectional area of bonding paths used for primary and secondary bonding paths ensure that appropriately low electrical impedance is obtained and maintained throughout the expected service life of the components.

AMC 25.1717
Circuit protective devices: EWIS

CS 25.1717 requires that all applicable EWIS components (for example wires, connector pins, terminal blocks, relays, splices) be compatible with the circuit protective devices required by CS 25.1357. This means that when selecting the EWIS components to be used for a specific application, care must be taken to ensure that the proper type and rating of the circuit protective device (e.g., circuit breaker) is selected so that the wire and cables are adequately protected from over-current situations.

AMC 25.1719
Accessibility provisions: EWIS

CS 25.1719 requires that means be provided to allow for inspection of EWIS and replacement of their components as necessary for continued airworthiness.

1 The intent of CS 25.1719 is to ensure that EWIS components are installed so that inspections, tests, repairs, and replacements can be undertaken with a minimum of aircraft disassembly. When adjacent structures and aircraft systems

components must be removed to allow access to wire installations, new possibilities for contamination, chafing, and other types of damage are introduced.

2 As far as practicable, EWIS components should be installed so that inspections, tests, repair, and replacements can be done without undue disturbance to the EWIS installation or to surrounding aircraft systems. During the design phase, consider minimizing the amount of aircraft disassembly required to perform such tasks. For example, wiring inside conduit may incur damage from chafing against the sides of the conduit. If failure of wiring inside a conduit can lead to an unsafe condition, a means should be provided for inspection of those wires. Inspection may be by testing or other means acceptable to the Agency and should be included in the maintenance requirements that are part of the Instructions for Continued Airworthiness.

AMC 25.1721
Protection of EWIS.

1 The requirements of this paragraph are intended to prevent damage to EWIS by passengers, crew members, baggage or cargo handlers, or maintenance and service personnel. CS 25.1721(a) is applicable to EWIS located in cargo or baggage compartments, and CS 25.1721(b) and (c) apply to EWIS located elsewhere in the aeroplane.

2 CS 25.1721(a), specifies that EWIS cannot be located in cargo or baggage compartments if its damage or failure may affect safe operation unless it cannot be damaged by movement of cargo or baggage in the compartment, or its breakage or failure will not create a fire hazard. This means that any EWIS located in a cargo or baggage compartment must be protected against damage. EWIS in general and wiring in particular should be installed so the structure affords protection against its use as a handhold and damage from cargo. Wires and wire bundles should be routed or otherwise protected to minimise the potential for maintenance personnel stepping, walking, or climbing on them. Wire bundles should be routed along heavier structural members whenever possible. If the structure does not afford adequate protection, other protection means such as a mechanical guard should be provided. When EWIS is close to sharp metal edges, the edges should be protected to prevent chafing. Additionally, wires should not be routed between aircraft skin and fuel lines in the same plane.

3 Subparagraph 25.1721(b) requires that EWIS be designed and installed to minimise the risk of damage by movement of people in the aeroplane during all phases of flight, or during maintenance, and servicing. Some examples of areas of concern are the flight deck, passenger compartment, crew rest area, wheel wells, and wing leading and trailing edges.

a. Special consideration should be given to EWIS that are routed to, around, and on passenger seats. It should be protected so that passengers cannot damage it with their feet or access it with their hands.

b. EWIS located in the lavatories should not be readily accessible by passengers or aircraft cleaners. It should be designed and installed so that it cannot be damaged by the removal and replacement of items such as rubbish containers.

c. EWIS located in the galleys should not be readily accessible by cabin crew, aircraft cleaners, or passengers. EWIS should be designed and installed so that galley equipment, including galley carts, cannot come into contact with it and cause damage.

d. As with EWIS located in baggage and cargo compartments, EWIS in areas such as landing gear bays, the APU compartment, and electrical and electronic bays should be designed and installed to minimise potential for maintenance personnel stepping, walking, or climbing on them. Where the structure does not afford adequate protection, other protection such as a mechanical guard should be provided.

AMC 25.1723
Flammable fluid protection: EWIS

CS 25.1723 requires that EWIS located in areas where flammable fluid or vapours might escape must be considered to be a potential ignition source. As a result, these EWIS components must meet the requirements of CS 25.863. CS 25.863 requires that efforts be made to minimise the probability of ignition of fluids and vapours, and the hazards if ignition does occur. See CS 25.1707 for the separation requirements between EWIS and flammable fluids.

EWIS components located in fuel vapour zones should be qualified as explosion proof, where appropriate, in accordance with Section 9 of EUROCAE ED-14 / RTCA Document DO160 or other equivalent approved industry standard. The possibility of contamination with flammable fluids due to spillage during maintenance action should also be considered.

23. Insert the following new AMCs to AMC - Appendices

AMC to Appendix H, H25.4(a)(3)
Mandatory replacement time of EWIS components as defined in CS 25.1701

In accordance with subparagraph H 25.4(a)(3) applicants are required to include in the Airworthiness Limitations section of the Instructions for Continued Airworthiness any mandatory replacement times for EWIS components. EWIS components are those defined by CS 25.1701. Generally, EWIS components are designed and selected to last for the service life of the aeroplane. Any EWIS component that must be replaced at regular intervals to maintain the airworthiness of the associated system or aeroplane must be specified, with its required replacement interval, in the Airworthiness Limitations section of the ICA.

AMC to Appendix H, H25.5
Instructions for Continued Airworthiness applicable to EWIS.

In accordance with subparagraph H 25.5 the applicant must prepare Instructions for Continued Airworthiness (ICA) applicable to EWIS as defined by 25.1701 that should include the following:

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

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.

2 Acceptable EWIS maintenance practices in a standard format:

Applicants should document EWIS maintenance practices in a standard format. This is typically accomplished with publication of a standard wiring practices manual (SWPM). The rule is not intended to require that every manufacturer's SWPM is identical. The intent is to enable people performing EWIS maintenance and repairs to find information in the SWPM more quickly and easily, regardless of what aeroplane model they are currently working on. Standard wiring practices include procedures and practices for the installation, repair, and removal of EWIS components, including information about wire splices, methods of bundle attachment, connectors and electrical terminal connections, bonding, and grounding. A SWPM is not a design manual, and designers of EWIS modifications for specific aeroplane models should not use it as such. But it does provide the designer with insight into the types of EWIS components used by the TC holder and the procedures recommended by the manufacturer for maintenance or repair that supports continued airworthiness of the components. AMC 20-23 "Development of Standard Wiring Practices Documentation," provides guidance on how to comply.

3 Wire separation requirements as determined under 25.1707:

Applicants should include EWIS separation requirements in the ICA. EWIS separation guidelines are important for maintaining the safe operation of the aeroplane. Maintenance personnel need to be aware of the type certificate holder's separation requirements so they do not compromise separation in previously certified systems.

Determination of EWIS separation requirements is required by 25.1707. To comply with H25.5, the applicant should develop a way to convey these separation requirements and place them in the ICA. For example, if an aeroplane has a fly-by-wire flight control system and a minimum of 2 inches of physical separation is needed between the EWIS associated with the flight control system and other EWIS, this information should be available in the ICA.

Similarly, the separation of certain wires in fuel tank systems may be critical design configuration control items and therefore qualify as an airworthiness limitation. Maintenance personnel need these guidelines and limitations because many times wire bundles must be moved or removed to perform maintenance.

The separation data included in the ICA can take many forms. If a particular aeroplane model has fly-by-wire flight controls, the manufacturer may designate the EWIS associated with the flight control systems by a certain identification scheme (as required by 25.1711), and in the ICA state that EWIS so designated must be maintained with XX amount of separation from all other EWIS and YY amount of separation from other aeroplane systems and structure. The manufacturer can then repeat this information for other EWIS associated with other aeroplane systems. The ICA could indicate how EWIS associated with IFE and other passenger convenience systems is identified, and that this EWIS must be maintained XX inches from other categories of EWIS or structure.

It is not the intent of the regulation to require a type design holder or an applicant to divulge proprietary information in order to comply. Certain information, however, needs to be made available to modifiers and maintainers to ensure that future modifications and repairs do not invalidate previously certified designs.

4 Information explaining the EWIS identification method and requirements for identifying any changes to EWIS under CS 25.1711. This paragraph requires that the ICA contain information explaining the EWIS identification method and requirements for identifying any changes to EWIS. This requirement is intended to ensure that future modifications that add EWIS, identify the added EWIS with the same type of identification scheme used by the original aeroplane manufacturer. This information will help modification designers and modification personnel avoid improper modification and repair of existing EWIS or improper installation of new EWIS. These personnel need to review the applicable standard wiring practices, EWIS identification requirements, and electrical load data for the aeroplane they are modifying.

5 Electrical load data and instructions for updating that data. The ICA should contain electrical load data and instructions for updating that data. Electrical load data and the instructions for updating that data are necessary to help ensure that future modifications or additions of equipment that consume

electrical power do not exceed the generating capacity of the onboard electrical generation and distribution system. Maintaining a record of actual airplane electrical loads is important to ensure that modifications to the original design do not impose electrical loads on the electrical generating system in excess of the system's capability to provide the necessary power and maintain necessary margins. To comply with the requirements of this paragraph applicants need to provide:

a. Electrical generating capacity of each source of normal electrical power generation.

b. Electrical generating capacity of each source of emergency power generation.

c. Electrical load capacity of each of electrical bus.

d. Actual electrical loading of each electrical bus.

6 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.