serious hazard such as the examples above. If so, the affected area of the fire zone skin should be fireproof.

(C) For the purpose of the demonstration:

— No credit from external airflow on the cowling/skin should be considered in conjunction with the assumption that the aircraft may be static.

— The engine/APU should be considered to be operative for the first 5 minutes and stopped for the remaining 10 minutes.

— Engine/APU operation — Requirements for ability of cowling/skin in areas subject to flames if a fire starts in an engine or APU fire zone to withstand the effects of fire in ground operating conditions apply with either the engine operating or not operating, whichever is the more critical. The Engine/APU operating conditions shall be justified by the applicant.

(ii) Other areas: For the remaining portions of cowling/skin in areas subject to flames, if a fire starts in an engine or APU fire zone, the degree of fire resistance can be lower than 'fireproof' due to less serious or less probable hazard to the aircraft, crew, passengers and ground personnel under the critical operating conditions. Any burn through of the APU compartment external skin should consider hazards associated with combustion product and possible outgassing and re-ingestion of toxic air into cabin air system.

(A) Fire-resistant cowlings/skins provide adequate fire protection for those areas as they provide sufficient time to stop the aeroplane and evacuate it.

(B) A lower than 'fire-resistant' degree of fire protection may be considered; the following conditions should then be analysed and submitted to the Agency for approval:

— Cowling/skin should have the ability to withstand fire at least equivalent to the ability of a 1 mm (0.040 inch) aluminium sheet in the worst aircraft and engine/APU ground conditions anticipated;

— Applicants must substantiate that this lower fire protection level will not lead to hazardous effects including but not limited to:

— Upon burn through of the lower than 'fire-resistant' area, both the fire-resistant and/or fire-proof areas shall not have their fire withstanding capability affected,

— Liberation of parts that would affect the aeroplane evacuation procedure or reduce the efficiency of fire protection means,

— Reduction in flammable fluid drainage capability such that fire severity would be increased (magnitude, residual presence, propagation to surrounding area),

— Reduction in aeroplane evacuation capability due to proximity to evacuation paths or due to the visibility of the fire hindering the ability of the passengers to evacuate the aeroplane in a rapid and orderly manner,

Note: There is some hazard involving aeroplane evacuation even in the absence of burn through due to such concerns as smoke and flaming liquids exiting from openings. Burn through of nacelle skin should not significantly increase these hazards.

— Reduction in fire detection capability such that the flight crew would not be aware of the fire, especially in a situation involving taxiing prior to take-off,

— Reduction in fire extinguishing capability which could cause or aggravate one of the potential hazards listed above.

— Flammable fluid and/or fire spreading on the aeroplane evacuation path

(f) SPECIFIC CONFIGURATION CONSIDERATIONS

(1) Multiple skin layers: For some specific fire zones, a fire originating in that zone will have to pass through several layers of cowling or skin before burning through the external skin. This may be the case, for example, for the core zone of some turbofan installations. In such cases, credit may be taken for multiple layers, having regard to the location of the fire source and the likely direction of propagation from that location, providing burn through of the inner layer does not produce other hazardous effects and it does not invalidate other certification specifications such as fire extinguishing capability. The corresponding compliance substantiation should take into account particular geometrical configuration with respect to the risk of flame propagation, as well as critical systems or structures.

(2) Inlet skins: For external inlet skins, which enclose fire zones, the guidance provided above for multiple skin layers applies. Inlet ducts should meet CS 25.1103/CS 25J1103 specifications.

(3) Openings: The following considerations are applicable to openings in a fire zone skin whether the openings are of fixed size, variable or controllable size, or normally closed, such as access or inspection doors, or pressure relief doors.

(i) Openings should be located such that flame exiting the opening would not enter any other region where it could cause a hazard in flight or a serious hazard on the ground as per subparagraph (e)(3). Exception is made for covered openings which meet the same criteria for ability to withstand the effects of fire as the surrounding cowl skin, and which are not expected to become open under fire conditions. Since pressure relief doors may open during some fire conditions, they should be located such that flames exiting the door will not cause a hazard. However, doors that will remain closed during most fire conditions, or will tend to re-close following initial opening, have traditionally been assumed to be closed for the purposes of evaluating fire detection and extinguishing.

(ii) Openings should have the same ability to withstand the effects of fire as the adjacent skin with respect to becoming enlarged under fire conditions. Some enlargement, such as burning away of louvers or doublers surrounding the opening or gapping of covered openings, is acceptable provided that the hazard is not significantly increased by a reduction in fire extinguishing or detection capability, increased airflow causing increase in fire size or intensity, or increase in probability of a hazardous spread of fire to other regions.

(4) Hinges, Fittings and Latches: These attaching means maintaining the nacelle/cowlings between them or to the aircraft/engine/APU structure may need to have a greater ability to withstand the effect of fire than the surrounding skin. Loss of attaching means may create more severe hazards such as cowling liberation in comparison to a skin burn through. The applicant must justify the required level of fire withstanding capability by test and/or analysis.

(5) Seals: Where seals are used part of the external engine nacelle/cowling or APU compartment boundaries, they should at least comply with the same fire integrity standard as the surrounding cowling/skin.

(g) COMPLIANCE DEMONSTRATION

Compliance should be substantiated per CS 25.1207. Substantiation involving airflow patterns may include analytical methods such as Computational Fluid Dynamics, test methods or other flow visualisation methods or a combination of these methods. Fire testing should be accomplished according to the guidance of ISO 2685 with considerations of applications of representative conditions (airflow, loads, vibrations) and establishment of appropriate pass/fail criteria (burn through, elongation, dislocation).

[Amdt 25/13]

AMC 25.1193(e)(4) and (f) Engine cowling retention

ED Decision 2018/005/R

a. Purpose and scope

CS 25.1193(e)(4) requires design precautions to be taken to minimise the risk of any in-flight opening or loss of an engine cowling that could prevent continued safe flight and landing. CS 25.1193(f) requires the retention system of each removable or openable cowling to have a means, which is demonstrated to be reliable and effective, to verify that the cowling is closed and latched prior to each take-off.

Reported occurrences of engine cowling separations revealed that features like latch handles hanging down, cowling gaps, and detection capabilities offered by walk-arounds and/or checks at the completion stage of maintenance activities, had not been reliable or effective in preventing aeroplanes from taking off with unclosed/unlatched cowlings.

For turbofan engines, these occurrences have concerned fan cowls only. Thrust reverser cowls have shown satisfactory in-service experience with regard to the risk of a cowling separation. Therefore, specifications CS 25.1193(e)(4) and (f) are intended to be applicable to engine fan cowls only.

All dispatch configurations, as permitted by the master minimum equipment list (MMEL) and the configuration deviation list (CDL), should be considered when showing compliance with CS 25.1193(e)(4) and (f).

b. Selection of appropriate design features

The following guidelines are provided to help the applicant in selecting design features appropriate to the engine/nacelle characteristics, and in showing compliance with CS 25.1193(e)(4) and (f).

Human factors

In determining the most appropriate design feature, or combination of design features, to cope with the human-factor aspects that contribute to the risk of an aeroplane being released with unclosed or unlatched cowlings, attention should be placed on the following aspects of cowling latched/unlatched indications:

— Their verification by personnel should not necessitate unusual physical effort (e.g. bending down or kneeling on the ground);

— Their verification by personnel should take into account the variability in the physical capabilities of personnel;

— The provision of these indications should take into account a possible lack of diligence of personnel in conducting walk-arounds and in completing their maintenance activities;

— The combination of indications should draw the attention of personnel without ambiguity (e.g. by paint effects) and should not be rendered ineffective by lighting conditions (night/day), weather conditions, or the operational environment.

Design considerations

The following considerations should be taken into account when selecting design features to mitigate the risk of a cowling separation:

— A wing-mounted engine/nacelle presents a higher risk than a rear-mounted engine/nacelle, therefore it requires more noticeable cowling latched/unlatched indications and/or a combination of them;

— An engine/nacelle with a small ground clearance presents a higher risk than one with a large ground clearance, therefore it requires more noticeable indications and/or a combination of them;

— A hanging heavy/large piece or part on an engine/nacelle with a large ground clearance may draw the attention of personnel;

— A unique indication on the lower part of an engine/nacelle that has a small ground clearance may not be sufficient to draw attention to it;

— The noticeability of a forced gap between the fan cowl and the surrounding structure may be adversely affected by its environment, such as the ambient lighting conditions, external painting or the condition of the surrounding structure, and may not be individually sufficient to draw attention to it;

— A flashing light in an open gap or outside the nacelle skin may draw the attention of personnel. In such cases, the reliability of the flashing light should be investigated and substantiated, taking into account the effects of the engine/nacelle environment;

— A mechanical flag on the outside of the nacelle skin may draw the attention of personnel;

— A latch which is locked by a key equipped with a red flag may draw the attention of personnel, however a duplicate key without a flag could be used, and therefore the use of a flag may not be sufficient;

— A design with a remote indication (i.e. on the flight deck) of the unlatched/unclosed fan cowl condition may effectively draw the attention of the flight crew.

Other guidelines

Furthermore, the following guidelines related to the use of some of the design features should be taken into account by the applicant:

— Procedural control measures may not always be followed as a result of the pressure to dispatch the aeroplane, and because of routine issues;

— Improper Instructions for Continuing Airworthiness may be issued, which may lead to:

  — Improper rigging of the cowls and the associated latches;

  — Poor maintenance of design features intended to prevent aeroplane dispatch with unlatched cowlings, such as bright paint fading over time (or becoming soaked with the dirt accumulated at the bottom of the nacelle), hold-open cowl devices not performing their intended function, etc.;

— Some nacelle painting can defeat the design precautions:

  — Red or orange nacelle colours may negate the visibility of red/dayglow latches;

  — A dark nacelle colour may reduce the noticeability of gaps.

— Specific tools may be improperly defined and maintained (e.g. keys required to open cowls, normally fitted with a red flag, being used without a flag).

In order to address the human factors that contribute to the risk, it might be necessary to conduct an in-service and practical evaluation of the proposed design.

[Amdt 25/21]

CS 25.1195 Fire-extinguisher systems

ED Decision 2016/010/R

(See AMC 25.1195)

(a) Except for combustor, turbine, and tail pipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases for which it is shown that a fire originating in these sections can be controlled, there must be a fire extinguisher system serving each designated fire zone.

(b) The fire-extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. It must be shown by either actual or simulated flight tests that under critical airflow conditions in flight the discharge of the extinguishing agent in each designated fire zone specified in sub-paragraph (a) of this paragraph will provide an agent concentration capable of extinguishing fires in that zone and of minimising the probability of re-ignition. An individual 'one-shot' system may be used for fuel burning heaters, and other combustion equipment. For each other designated fire zone, two discharges must be provided each of which produces adequate agent concentration. (See AMC 25.1195(b).)

(c) The fire-extinguishing system for a nacelle must be able to simultaneously protect each zone of the nacelle for which protection is provided.

[Amdt 25/18]

AMC 25.1195(b) Fire extinguisher systems

ED Decision 2012/008/R

Acceptable methods to establish the adequacy of the fire extinguisher system are laid down in Advisory Circular 20-100. with reference to Halon concentration levels. This AC is not applicable to extinguishing agents alternative to Halon.

[Amdt 25/12]

CS 25.1197 Fire-extinguishing agents

ED Decision 2012/008/R

(See AMC 25.1197.)

(a) Fire-extinguishing agents must –

(1) Be capable of extinguishing flames emanating from any burning of fluids or other combustible materials in the area protected by the fire extinguishing system; and

(2) Have thermal stability over the temperature range likely to be experienced in the compartment in which they are stored.

(b) If any toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid or fluid vapours (from leakage during normal operation of the aeroplane or as a result of discharging the fire extinguisher on the ground or in flight) from entering any personnel compartment, even though a defect may exist in the extinguishing system. This must be shown by test except for built-in carbon dioxide fuselage compartment fire extinguishing systems for which –

(1) 2.3 kg (five pounds) or less of carbon dioxide will be discharged, under established fire control procedures, into any fuselage compartment; or

(2) There is protective breathing equipment for each flight-crew member on flight deck duty.

[Amdt 25/12]

AMC 25.1197 Fire-Extinguishing Agents

ED Decision 2012/008/R

Halon 1301 is no longer an acceptable extinguishing agent, based on EU Law[1], for engine nacelle and APU fire extinction systems to be installed in aircraft types, for which type certification is requested after 31 December 2014. (See AMC 25.851(c) for more information on Halon alternatives.)

[Amdt 25/12]

[1] Commission Regulation (EU) No 744/2010 of 18 August 2010 amending Regulation (EC) No 1005/2009 of the European Parliament and of the Council on substances that deplete the ozone layer, with regard to the critical uses of halon (OJ L 218, 19.8.2010, p. 2).

CS 25.1199 Extinguishing agent containers

ED Decision 2003/2/RM

(a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.

(b) The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent would not damage the aeroplane. The line must also be located or protected to prevent clogging caused by ice or other foreign matter.

(c) There must be a means for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.

(d) The temperature of each container must be maintained, under intended operating conditions, to prevent the pressure in the container from –

(1) Falling below that necessary to provide an adequate rate of discharge; or

(2) Rising high enough to cause premature discharge.

(e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.

CS 25.1201 Fire extinguishing system materials

ED Decision 2003/2/RM

(a) No material in any fire extinguishing system may react chemically with any extinguishing agent so as to create a hazard.

(b) Each system component in an engine compartment must be fireproof.

CS 25.1203 Fire-detector system

ED Decision 2008/006/R

(a) There must be approved, quick acting fire or overheat detectors in each designated fire zone, and in the combustion, turbine, and tailpipe sections of turbine engine installations, in numbers and locations ensuring prompt detection of fire in those zones.

(b) Each fire detector system must be constructed and installed so that –

(1) It will withstand the vibration, inertia, and other loads to which it may be subjected in operation;

(2) There is a means to warn the crew in the event that the sensor or associated wiring within a designated fire zone is severed at one point, unless the system continues to function as a satisfactory detection system after the severing; and

(3) There is a means to warn the crew in the event of a short circuit in the sensor or associated wiring within a designated fire zone, unless the system continues to function as a satisfactory detection system after the short circuit.

(c) No fire or overheat detector may be affected by any oil, water, other fluids, or fumes that might be present.

(d) There must be means to allow the crew to check, in flight, the functioning of each fire or overheat detector electric circuit.

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

(f) No fire or overheat detector system component 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.

(g) Each fire detector system must be constructed so that when it is in the configuration for installation it will not exceed the alarm activation time approved for the detectors using the response time criteria specified in the appropriate European Technical Standard Order for the detector.

(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.

[Amdt 25/5]

CS 25.1207 Compliance

ED Decision 2003/2/RM

Unless otherwise specified, compliance with the requirements of CS 25.1181 to 25.1203 must be shown by a full scale fire test or by one or more of the following methods:

(a) Tests of similar powerplant configurations;

(b) Tests of components;

(c) Service experience of aeroplanes with similar powerplant configurations;

(d) Analysis.

SUBPART F – EQUIPMENT

GENERAL

CS 25.1301 Function and installation

ED Decision 2008/006/R

(See AMC 25.1301)

(a) Each item of installed equipment must –

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

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

(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.

[Amdt 25/2]
[Amdt 25/5]

AMC 25.1301(a)(2) Function and installation

ED Decision 2008/006/R

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.

[Amdt 25/5]

CS 25.1302 Installed systems and equipment for use by the flight crew

ED Decision 2007/010/R

(See AMC 25.1302.)

This paragraph applies to installed equipment intended for flight-crew members' use in the operation of the aeroplane from their normally seated positions on the flight deck. This installed equipment must be shown, individually and in combination with other such equipment, to be designed so that qualified flight-crew members trained in its use can safely perform their tasks associated with its intended function by meeting the following requirements:

(a) Flight deck controls must be installed to allow accomplishment of these tasks and information necessary to accomplish these tasks must be provided.

(b) Flight deck controls and information intended for flight crew use must:

(1) Be presented in a clear and unambiguous form, at resolution and precision appropriate to the task.

(2) Be accessible and usable by the flight crew in a manner consistent with the urgency, frequency, and duration of their tasks, and

(3) Enable flight crew awareness, if awareness is required for safe operation, of the effects on the aeroplane or systems resulting from flight crew actions.

(c) Operationally-relevant behaviour of the installed equipment must be:

(1) Predictable and unambiguous, and

(2) Designed to enable the flight crew to intervene in a manner appropriate to the task.

(d) To the extent practicable, installed equipment must enable the flight crew to manage errors resulting from the kinds of flight crew interactions with the equipment that can be reasonably expected in service, assuming the flight crew is acting in good faith. This sub-paragraph (d) does not apply to skill-related errors associated with manual control of the aeroplane.

[Amdt 25/3]

AMC 25.1302 Installed Systems and Equipment for Use by the Flight Crew

ED Decision 2007/010/R

Table of content

1. PURPOSE

This Acceptable Means of Compliance (AMC) provides guidance material for demonstrating compliance with the requirements of CS 25.1302 and several other paragraphs in CS-25 that relate to the installed equipment used by the flight crew in the operation of an aeroplane. In particular, this AMC addresses the design and approval of installed equipment intended for the use of flight-crew members from their normally seated positions on the flight deck. This AMC also provides recommendations for the design and evaluation of controls, displays, system behaviour, and system integration, as well as design guidance for error management.

Applicants should use Paragraphs 4, 5 and 6 of this AMC together to constitute an acceptable means of compliance. Paragraph 4 “Certification Planning”, describes the activities and communication between the applicant and the Agency for certification planning. Paragraph 5 “Design Considerations and Guidance”, is organised in accordance with the sub-paragraphs of CS 25.1302 and identifies HF related design issues that should be addressed to show compliance with CS 25.1302 and other relevant rules. Paragraph 6 “Means of Compliance” describes general means of compliance and how they may be used.