c. Extinguishing Agent.

In order to effectively extinguish or control a fire in a Class B or F cargo or baggage compartment, sufficient fire extinguishing agent must be allocated. Guidance on this topic is contained in FAA AC 20-42D. This guidance material is accepted by the Agency as addressing how to implement the provisions of CS 25.851(a) that require that at least one hand fire extinguisher be located in the pilot compartment, at least one readily accessible hand fire extinguisher be available for use in each Class A or Class B cargo/baggage compartment and in each accessible Class E or Class F cargo/baggage compartment, and one or more hand fire extinguishers be located in the passenger compartment for aeroplanes with a passenger seating capacity of 7 or more.

d. Fire Control.

"To control a fire" (CS 25.857(f)(2)) implies that the fire does not grow to a state where damage to the aeroplane or harm to the passengers or crew occurs during the time for which the fire protection system is demonstrated to be effective (ie, from the time a fire is detected to the time when an emergency evacuation from the aeroplane can be completed). This in turn implies that critical aeroplane systems and structure are not adversely affected and the temperature and air contaminants in areas occupied by passengers and crew do not reach hazardous levels.

(1) Adequate protection should be provided for cockpit voice and flight data recorder and wiring, windows, primary flight controls (unless it can be shown that a fire cannot cause jamming or loss of control), and other systems and equipment within the compartment that are required for safe flight and landing.

(2) Regardless of a compartment's classification, it must be demonstrated that hazardous quantities of smoke, flames, extinguishing agent, or noxious gases do not enter any compartment occupied by passengers or crewmembers. FAA Advisory Circular 25-9A, Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures, provides guidance concerning smoke penetration testing.

(3) If an aeroplane has one or more Class B cargo compartments, portable protective breathing equipment must be provided for the appropriate crewmembers in accordance with CS 25.1439.

(4) Additional protective breathing equipment or breathing gas supply, and additional fire extinguishers, may be required for Class B cargo compartment operation to ensure that the fire can be controlled for the time the aeroplane is expected to be in the air after onset of a fire.

6. PROCEDURES AND LIMITATIONS

a. To ensure that the contents of Class B and F compartments are either accessible or located such as to allow firefighting, any cargo or baggage loading limitations and any operational limitations or procedures provided must be identified with placards in the compartment. The loading and operational limitations must also be addressed in the appropriate weight and balance or loading document.

b. Any operational limitations or procedures necessary to ensure the effectiveness of the fire protection system for Class B and Class F cargo and baggage compartments should be clearly defined in the AFM. This should include such items as any changes to the ventilation system to prevent the entrance of smoke or gases into occupied areas, use of

hand fire extinguishers, use of protective breathing equipment, use of protective clothing, and use of the FCCs. The certification engineers should work closely with the Agency to ensure that additional training necessary for crewmembers assigned to combat fires is adequately addressed.

c. Any time limit for a cargo or baggage compartment fire protection system, or other conditions or procedures related to combating a fire in a compartment, should be clearly defined in the AFM.

7. AFM CONSIDERATIONS.

a. Crewmember(s) designated to combat a fire in a Class B compartment will need special training. Fires occurring in luggage are difficult to extinguish completely and rekindling may occur. Crewmembers designated to combat fires in Class B compartments should be trained to check periodically to ensure that a fire has not grown back to hazardous proportions.

b. Aeroplane flight manuals should contain instructions to land at the nearest suitable airport following smoke/fire detection, unless it can be positively determined that the fire is extinguished.

c. Any limitations regarding occupancy of Class B and Class F compartments during flight, or during takeoff and landing, should be defined in the AFM.

d. Any loading restrictions associated with access to cargo or baggage or special containers should be clearly identified in the AFM. This would include, but not be limited to, placement of luggage in a Class B compartment or identification of special containers or covers associated with fire protection in a Class F compartment. If covers are used in conjunction with a Class F cargo compartment, they should be easy to install and sufficiently durable to withstand in-service conditions.

[Amdt 25/8]
[Amdt 25/11]
[Amdt 25/12]
[Amdt 25/26]

CS 25.858 Cargo or baggage compartment smoke or fire detection systems

ED Decision 2007/010/R

If certification with cargo or baggage compartment smoke or fire detection provisions is requested, the following must be met for each cargo or baggage compartment with those provisions:

(a) The detection system must provide a visual indication to the flight crew within one minute after the start of a fire.

(b) The system must be capable of detecting a fire at a temperature significantly below that at which the structural integrity of the aeroplane is substantially decreased.

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

(d) The effectiveness of the detection system must be shown for all approved operating configurations and conditions.

[Amdt 25/3]

CS 25.859 Combustion heater fire protection

ED Decision 2003/2/RM

(a) *Combustion heater fire zones.* The following combustion heater fire zones must be protected from fire in accordance with the applicable provisions of CS 25.1181 to 25.1191 and 25.1195 to 25.1203:

(1) The region surrounding the heater, if this region contains any flammable fluid system components (excluding the heater fuel system) that could –

(i) Be damaged by heater malfunctioning; or

(ii) Allow flammable fluids or vapours to reach the heater in case of leakage.

(2) The region surrounding the heater, if the heater fuel system has fittings that, if they leaked, would allow fuel or vapours to enter this region.

(3) The part of the ventilating air passage that surrounds the combustion chamber. However, no fire extinguishment is required in cabin ventilating air passages.

(b) *Ventilating air ducts.* Each ventilating air duct passing through any fire zone must be fireproof. In addition –

(1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct; and

(2) Each part of any ventilating duct passing through any region having a flammable fluid system must be constructed or isolated from that system so that the malfunctioning of any component of that system cannot introduce flammable fluids or vapours into the ventilating airstream.

(c) *Combustion air ducts*. Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition –

(1) No combustion air duct may have a common opening with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunctioning of the heater or its associated components; and

(2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.

(d) *Heater controls; general*. Provision must be made to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.

(e) *Heater safety controls.* For each combustion heater there must be the following safety control means:

(1) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided, for each heater, to automatically shut off the ignition and fuel supply to that heater at a point remote from that heater when any of the following occurs:

(i) The heat exchanger temperature exceeds safe limits.

(ii) The ventilating air temperature exceeds safe limits.

(iii) The combustion airflow becomes inadequate for safe operation.

(iv) The ventilating airflow becomes inadequate for safe operation.

(2) The means of complying with sub-paragraph (e)(1) of this paragraph for any individual heater must –

(i) Be independent of components serving any other heater whose heat output is essential for safe operation; and

(ii) Keep the heater off until restarted by the crew.

(3) There must be means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means prescribed in sub-paragraph (e)(1) of this paragraph.

(f) *Air intakes*. Each combustion and ventilating air intake must be located so that no flammable fluids or vapours can enter the heater system under any operating condition –

(1) During normal operation; or

(2) As a result of the malfunctioning of any other component.

(g) *Heater exhaust*. Heater exhaust systems must meet the provisions of CS 25.1121 and 25.1123. In addition, there must be provisions in the design of the heater exhaust system to safely expel the products of combustion to prevent the occurrence of –

(1) Fuel leakage from the exhaust to surrounding compartments;

(2) Exhaust gas impingement on surrounding equipment or structure;

(3) Ignition of flammable fluids by the exhaust, if the exhaust is in a compartment containing flammable fluid lines; and

(4) Restriction by the exhaust of the prompt relief of backfires that, if so restricted, could cause heater failure.

(h) *Heater fuel systems*. Each heater fuel system must meet each powerplant fuel system requirement affecting safe heater operation. Each heater fuel system component within the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.

(i) *Drains*. There must be means to safely drain fuel that might accumulate within the combustion chamber or the heater exchanger. In addition –

(1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts; and

(2) Each drain must be protected from hazardous ice accumulation under any operating conditions.

CS 25.863 Flammable fluid fire protection

ED Decision 2016/010/R

(See AMC 25.863)

(a) In each area where flammable fluids or vapours might escape by leakage of a fluid system, there must be means to minimise the probability of ignition of the fluids and vapours, and the resultant hazards if ignition does occur. (See AMC 25.863(a).)

(b) Compliance with sub-paragraph (a) of this paragraph must be shown by analysis or tests, and the following factors must be considered.

(1) Possible sources and paths of fluid leakage, and means of detecting leakage.

(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.

(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.

(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

(5) Ability of aeroplane components that are critical to safety of flight to withstand fire and heat.

(c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.

(d) Each area where flammable fluids or vapours might escape by leakage of a fluid system must be identified and defined.

[Amdt 25/18]

AMC 25.863(a) Flammable fluid fire protection

ED Decision 2003/2/RM

The cooling air supply for any electrical or electronic equipment should be conveyed and discharged so as not to create a hazard following failure of the equipment.

NOTE: Where necessary the cooling duct should be fireproof.

Zones with surfaces which may be exposed to flammable fluids or vapours should be ventilated if the temperature of the surfaces may exceed (under normal or failure conditions) a dangerous value with regard to these fluids or vapours. Unless a higher value can be substantiated, a temperature exceeding 200°C is considered dangerous.

CS 25.865 Fire protection of flight controls, engine mounts, and other flight structure

ED Decision 2003/2/RM

Essential flight controls, engine mounts, and other flight structures located in designated fire zones or in adjacent areas which would be subjected to the effects of fire in the fire zone must be constructed of fireproof material or shielded so that they are capable of withstanding the effects of fire.

CS 25.867 Fire protection: other components

ED Decision 2003/2/RM

(a) Surfaces to the rear of the nacelles, within one nacelle diameter of the nacelle centreline, must be constructed of materials at least equivalent in resistance to fire as aluminium alloy in dimensions appropriate for the purpose for which they are used.

(b) Sub-paragraph (a) of this paragraph does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.

CS 25.869 Fire protection: systems

ED Decision 2016/010/R

(See AMC 25.869)

(a) Electrical system components:

(1) Components of the electrical system must meet the applicable fire and smoke protection requirements of CS 25.831(c) and CS 25.863. (See AMC 25.863(a).)

(2) Equipment in designated fire zones, that 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.

(b) Each vacuum air system line and fitting on the discharge side of the pump that might contain flammable vapours or fluids must meet the requirements of CS 25.1183 if the line or fitting is in a designated fire zone. Other vacuum air systems components in designated fire zones must be at least fire resistant.

(c) (See AMC 25.869(c).) Oxygen equipment and lines must –

(1) Not be located in any designated fire zone.

(2) Be protected from heat that may be generated in, or escape from, any designated fire zone, and

(3) Be installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapour accumulations that are present in normal operation or as a result of failure or malfunction of any system.

[Amdt 25/5]
[Amdt 25/18]

AMC 25.869(a)(1) Electrical System Fire and Smoke Protection

ED Decision 2003/2/RM

These requirements, and those of CS 25.863 applicable to electrical equipment, may be satisfied by the following:

1 Electrical components in regions immediately behind firewalls and in engine pod attachment structures should be of such materials and 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.

2 Electrical equipment should be so constructed and/or installed that in the event of failure, no hazardous quantities of toxic or noxious (e.g. smoke) products will be distributed in the crew or passenger compartments.

3 Electrical equipment, which may come into contact with flammable vapours should be so designed and installed as to minimise the risk of the vapours exploding under both normal and fault conditions. This can be satisfied by meeting the Explosion Proofness Standards of RTCA DO-160/EUROCAE ED-14.

AMC 25.869(c) Fire Protection for Oxygen Equipment

ED Decision 2003/2/RM

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

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

3 The compartments in which high-pressure system components, including source(s) are located should have adequate ventilation to ensure the rapid dilution of leaked oxygen. Such compartments should also provide adequate protection against contamination by liquids and other products which could result in the risk of fire.

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

5 The installation of the system should be such that components and pipe lines –

a. Are adequately separated from electrical and fluid systems,

b. Are routed so as to minimise joints and sharp bends,

c. Are clear of moving controls and other mechanisms,

d. Are protected against grease or other lubricants, and are protected against the effects of vibration.

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

6 Where the oxygen is supplied from chemical generators, the effects of heat emission, during both normal and inadvertent operation, on both the installation and other adjacent equipment, should be taken into account.

MISCELLANEOUS

CS 25.871 Levelling means

ED Decision 2003/2/RM

There must be means for determining when the aeroplane is in a level position on the ground.

CS 25.875 Reinforcement near propellers

ED Decision 2003/2/RM

(a) Each part of the aeroplane near the propeller tips must be strong and stiff enough to withstand the effects of the induced vibration and of ice thrown from the propeller.

(b) No window may be near the propeller tips unless it can withstand the most severe ice impact likely to occur.

CS 25.899 Electrical bonding and protection against static electricity

ED Decision 2003/2/RM

(See AMC 25.899)

(a) Electrical bonding and protection against static electricity must be designed to minimise accumulation of electrostatic charge, which would cause:

(1) Human injury from electrical shock,

(2) Ignition of flammable vapours, or

(3) Interference with installed electrical / electronic equipment.

(b) Compliance with sub-paragraph (a) of this paragraph may be shown by

(1) Bonding the components properly to the airframe or

(2) Incorporating other acceptable means to dissipate the static charge so as not to endanger the aeroplane, personnel or operation of the installed electrical/electronic systems.

AMC 25.899 Electrical bonding and protection against static electricity

ED Decision 2020/024/R

1 Protection against Lightning Discharges.

Refer to CS 25.581; 25.954; 25.1316 and associated Acceptable Means of Compliance.

2 Characteristics of Lightning Discharges.

Industry standards.

Refer to EUROCAE document ED-84 (including Amendment N°1 dated 06/09/99) titled: Aircraft Lightning Environment and Related Test Waveforms; or the equivalent SAE ARP5412 document.

The following documents may be used when showing compliance with CS 25.899:

— EUROCAE document ED-84A dated July 2013 (Aircraft Lightning Environment and Related Test Waveforms) or the equivalent SAE ARP5412B.

— EUROCAE document ED-91A (Aircraft Lightning Zoning) or the equivalent SAE ARP5414B.

— EUROCAE document ED-105A (Aircraft Lightning Test Methods) or the equivalent SAE ARP 5416A.

— EUROCAE document ED-113 (Aircraft Lightning Direct Effects Certification) or the equivalent SAE ARP 5577.

3 *Protection against the Accumulation of Static Charges*

3.1 *General*. All items, which by the accumulation and discharge of static charges may cause a danger of electrical shock, ignition of flammable vapours or interference with essential equipment (e.g. radio communications and navigational aids) should be adequately bonded to the main earth systems.

3.2 *Intermittent Contact.* The design should be such as to ensure that no fortuitous intermittent contact can occur between metallic and/or metallized parts.

3.3 *High Pressure Refuelling and Fuel Transfer.* Where provision is made for high pressure refuelling and/or for high rates of fuel transfer it should be established, by test, or by consultation with the appropriate fuel manufacturers, that dangerously high voltages will not be induced within the fuel system. If compliance with this requirement involves any restriction on the types of fuel to be used or on the use of additives, this should be established.

3.3.1 With standard refuelling equipment and standard aircraft turbine fuels, voltages high enough to cause sparking may be induced between the surface of the fuel and the metal parts of the tank at refuelling flow velocities above approximately 7 meters/second (23 feet/second). These induced voltages may be increased by the presence of additives and contaminants (e.g. anti-corrosion inhibitors, lubricating oil, free water), and by splashing or spraying of the fuel in the tank.

3.3.2 The static charge can be reduced as follows:

a. By means taken in the refuelling equipment such as increasing the diameter of refuelling lines and designing filters to give the minimum of electrostatic charging, or

b. By changing the electrical properties of the fuel by the use of anti-static additives and thus reducing the accumulation of static charge in the tank to negligible amount.

3.3.3 The critical refuelling rates are related to the aeroplane refuelling installations, and the designer should seek the advice of fuel suppliers on this problem.

4 Primary and Secondary Bonding Paths.

(Reference : CS 25.581; 25.899, 25.954; 25.1316; 25.1353; 25.1360.)

4.1 Primary bonding paths are those paths which are required to carry lightning discharge currents. These paths should be of as low an electrical impedance as is practicable. Secondary bonding paths are those paths provided for other forms of bonding.

4.2 Where additional conductors are required to provide or supplement the inherent primary bonding paths provided by the structure or equipment, then the cross-sectional area of such primary conductors made from copper should be not less than 3 mm^2 except that, where a single conductor is likely to carry the whole discharge from an isolated section,

the cross-sectional area would be not less than 6 mm^2. Aluminium primary conductors should have a cross-sectional area giving an equivalent surge carrying capacity.

4.3 Primary bonding paths should be used for –

a. Connecting together the main earths of separable major components which may carry lightning discharges,

b. Connecting engines to the main earth,

c. Connecting to the main earth all metal parts presenting a surface on or outside of the external surface of the aeroplane, and

d. Conductors on external non-metallic parts.

4.4 Where additional conductors are required to provide or supplement the inherent secondary bonding paths provided by the structure or equipment then the cross-sectional area of such secondary conductors made from copper should be not less than 1 mm^2. Where a single wire is used its size should be not less than 1·2 mm diameter.

5 *Resistance and Continuity Measurements*. Measurements should be made to determine the efficacy of the bonding and connection between at least the following:

5.1 Primary Bonding Paths

5.1.1 The extremities of the fixed portions of the aeroplane and such fixed external panels and components where the method of construction and/or assembly leads to doubt as to the repeatability of the bond, e.g. removable panels.

5.1.2 The engines and the main aeroplane earth.

5.1.3 External movable metal surfaces or components and the main aeroplane earth.

5.1.4 The bonding conductors of external non-metallic parts and the main aeroplane earth.

5.1.5 Internal components for which a primary bond is specified and the main aeroplane earth.

5.2 Secondary Bonding Paths

5.2.1 Metallic parts, normally in contact with flammable fluids, and the main aeroplane earth.

5.2.2 Isolated conducting parts subject to appreciable electrostatic charging and the main aeroplane earth.

5.2.3 Electrical panels and other equipment accessible to the occupants of the aeroplane and the main aeroplane earth.

5.2.4 Earth connections, which normally carry the main electrical supply and the main aeroplane earth. The test on these connections should be such as to ensure that the connections can carry, without risk of fire or damage to the bond, or excessive volt drop, such continuous normal currents and intermittent fault currents as are applicable.

5.2.5 Electrical and electronic equipment and the aeroplane main earth, where applicable, and as specified by the aeroplane constructor.

5.2.6 Static discharger wicks and the main aeroplane structure.