Draft Advisory Circular

U.S. Department
of Transportation
Federal Aviation
Administration

Subject: **CLASS B and F CARGO COMPARTMENTS**

Date:

AC No. **25.857-1X**

Initiated by: **ANM-112**

1. PURPOSE. This advisory circular (AC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of the airworthiness standards for transport category airplanes related to the Class B and Class F cargo compartments for transport category airplanes. Like all AC material, this AC is not, in itself, mandatory and does not constitute a regulation. Terms used in this AC, such as "shall" and "must," are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described herein is used. This AC provides guidance with respect to Amendment 25-YY, which became effective [insert date].

2. RELATED FAR SECTIONS. Part 25, §§ 25.851 "Fire extinguishers," 25.855 "Cargo or baggage compartments," 25.857 "Cargo compartment classification," and 25.858 "Cargo compartment fire detection systems."

3. BACKGROUND. Sections 25.857(b) and 25.857(f) provide standards for certification of two classes of cargo compartments; Class B and Class F. A Class B compartment is configured in a manner which allows a crewmember to extinguish or control any fire likely to occur in the compartment using a hand fire extinguisher. While access to the compartment is present, it is not necessary for the person combating the fire to physically enter the compartment. The contents of the compartment may be reached by hand or with the contents of a hand extinguisher, while standing in the entry door. A Class F compartment is similar to a Class C compartment in that there are means to extinguish or control the fire without any requirement for access. Both Class B and Class F compartments have fire or smoke detection systems to alert the crew to the presence of the fire. This AC provides a rational method for demonstrating that the requirements of the related sections of the Federal Aviation Regulations (FAR) are met, and that fires occurring in the compartments can be controlled to ensure that they do not present a hazard to the airplane or its occupants.

4. COMPARTMENT CLASSIFICATION. All cargo compartments must be properly classified in accordance with § 25.857 and meet the requirements of § 25.857 pertaining to the particular class involved. In order to establish appropriate requirements for fire protection, a system for

classification of cargo or baggage compartments was developed and adopted for transport category airplanes on November 1, 1946, as Amendment 04-1 to Part 04 of the Civil Air Regulations (CAR). Classes A, B, and C were initially established; Classes D, E, and F were added later. The classification is based on means by which a fire can be detected, for those classes of compartments, which require detection, and the means available to control the fire.

a. A Class A compartment is one that is located so close to the station of a crewmember that the crewmember would discover the presence of a fire immediately. In addition, each part of the compartment is easily accessible so that the crewmember could quickly extinguish a fire with a portable fire extinguisher. A Class A compartment is not required to have a liner.

(1) Typically, a Class A compartment is a small open compartment in the cockpit area used for storage of crew luggage. A Class A compartment is not, however, limited to such use; it may be located in the passenger cabin and used for other purposes provided it is close to a normally staffed crewmember's station. Typically, the crewmember would be a member of the flightcrew; however, the compartment could be located adjacent to the station of any other crewmember.

(2) Because a Class A compartment does not have a liner, it is absolutely essential that the compartment be small and located close enough to a crewmember that any fire that might occur could be discovered and extinguished immediately. Without a liner to contain it, an undetected or uncontrolled fire could quickly become catastrophic by burning out of the compartment and spreading throughout the airplane. All portions of the compartment must be virtually within arms length of the crewmember in order for any fire to be detected immediately and extinguished in a timely manner. Although there may be some exceptions, such as a 'U-Shaped' compartment for example, a Class A compartment greater than 50 cubic feet in volume would not typically have the accessibility required by § 25.857(a)(2) for fighting a fire.

b. A Class B compartment is one that is more remote than a Class A compartment and must, therefore, incorporate a fire or smoke detection system to give warning at the pilot or flight engineer station. Because a fire could not be detected and extinguished as quickly, a Class B compartment must have a liner in accordance with § 25.855. A Class B cargo or baggage compartment has sufficient access in flight to enable a crewmember to reach any part of the compartment by hand or with the contents of a hand extinguisher when standing at any one access point, without stepping into the compartment. There are means to ensure that, while the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent will enter areas occupied by the crew or passengers.

c. A Class C compartment differs from a Class B compartment in that it is not required to be accessible in flight and must, therefore, have a built-in fire extinguishing system to suppress or control any fire occurring therein. A Class C compartment must have a liner and a fire or smoke detection system in accordance with §§ 25.855 and 25.857. There must also be means to exclude hazardous quantities of extinguishant and products of combustion from occupied areas.

d. A Class E compartment is found on an all-cargo airplane. Typically, a Class E compartment is the entire cabin of an all-cargo airplane; however, other compartments of such airplanes may be classified as Class E compartments. A fire in a Class E compartment is controlled by shutting off the ventilating airflow to or within the compartment. A Class E compartment must have a liner and a fire or smoke detection system installed in accordance with § 25.857(e); however, it is not required to have a built-in fire suppression system.

e. A Class F compartment is one in which there are means to control or extinguish a fire without requiring a crewmember to enter the compartment. Allowing access by a crewmember in the presence of a fire warning is not envisioned. The Class F compartment must have a fire or smoke detection system installed in accordance with § 25.857(f). Unless there are other means of containing the fire and protecting critical systems and structure, a Class F compartment must have a liner meeting the requirements of part III of Appendix F, or other approved equivalent methods.

5. FIRE PROTECTION FEATURES. The fire protection features required for the class of compartment involved, e.g., liners, fire or smoke detection systems, hand-held fire extinguishers, and built-in fire suppression systems, must be provided, and they must be shown to meet the standards established by the original type certification basis for the airplane or later part 25 standards.

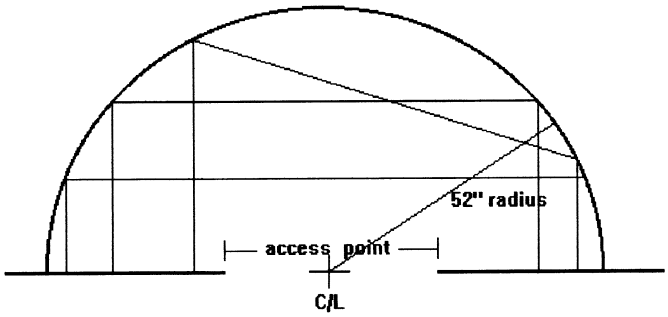
a. The primary purpose of a liner is to prevent a fire originating in a cargo compartment from spreading to other parts of the airplane before it can be brought under control. For Class B compartments, it is assumed that the fire will be quickly extinguished. Therefore, the liner need not be qualified to Part III of Appendix F requirements. For Class F cargo compartments, the fire might have grown larger prior to being suppressed, and therefore, better protection is needed to prevent damage to surrounding systems and structure. Insofar as that purpose is concerned, the liner does not need to serve as the compartment seal. It should be noted, however, that the liner is frequently used to perform the secondary functions of containing discharged extinguishing agent and controlling the flow of oxygen into the compartment. If other means, such as compartment walls, are not capable of performing those functions, the liner must be sufficiently airtight to perform them.

b. The liner must have sufficient fire integrity to prevent flames from burning through the liner before the fire can be brought under control and the heat from the fire is sufficiently dissipated. As noted in Part III of Appendix F, in addition to the basic liner material, the term "liner" includes any design feature, such as a joint or fastener, that would affect the capability of the liner to safely contain a fire.

c. In the case of a Class B compartment as defined in Amendment 25-YY, there must be sufficient accessibility to enable a crewmember to reach the contents of the compartment by hand or with the contents of a hand extinguisher without physically entering the compartment. This requirement, by its nature, tends to limit the size and shape of the compartment. Additionally, the access provisions should be sufficiently large to enable the crewmember to visually determine that a fire has been extinguished.

(1) "To reach any part of the compartment" means that the crewmember should be able to open the door or hatch and, standing in the opening, reach by hand anywhere in the compartment where cargo or baggage can be located. The extension of the crewmember's reach through the use of fire extinguisher wands, etc., should not be considered in determining reach.

(2) Based on the estimated reach of a 95 percentile male, the outline of any compartment, viewed from above, should fit within a vertical cylinder of radius 52 inches measured from the centerline of the access door or hatch (see Figure 1). This dimension assumes the above male can reach a one foot square box located anywhere within the compartment. It is understood that access by a smaller crewmember to reach the same area within the compartment could require that the crewmember move laterally within the access door or hatch opening, while not physically entering the compartment.



Examples of possible cargo compartment shapes within 52" reach from access point centerline.

FIGURE 1.

d. In the case of a Class F compartment, a means must be provided to control or extinguish a fire without a crewmember entering the compartment.

(1) One means might be to design the compartment to Class C requirements but without having a built in fire suppression system. One suppression method might be to utilize a plumbing and nozzle distribution system within the compartment that would provide acceptable suppression capability throughout the volume of the compartment. The source for such a system could be hand-held fire extinguishers, which interface with the distribution system through a suitable interface nozzle. This reduces the complexity and costs associated with a built-in suppression system and could be suitable for smaller compartments. For certification purposes, the extinguishing agent concentration should be measured in flight, following airplane flight manual (AFM) procedures, and the length of protection time afforded by the system recorded. This time of protection should be used to establish flight manual limitations for cargo or baggage compartment fire protection times. These times could then be used by the operator for route planning. For Halon 1301 fire extinguishing agent, a five percent concentration by volume is

considered adequate for initial knock-down of a fire, and a three percent concentration by volume is considered the minimum for controlling a fire after it is knocked down. The use of this option requires the use of a liner, if needed, as noted in § 25.855(c).

(2) Another means to provide fire protection in a Class F compartment might be the use of cargo containers or covers shown to be capable of containing a fire. Because the fire is controlled or extinguished within the compartment but is isolated from the actual compartment boundaries, the liner requirements of § 25.855(c) would not apply. However, the effects of the heat generated by the covered fire should be evaluated to ensure that adjacent systems and structure are not adversely affected.

(3) It is recognized that other means of controlling or extinguishing fires in Class F compartments may be developed in the future. It is not the intent of this AC to limit the choices available for meeting the requirements to those discussed above.

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

e. Whether a compartment is classified as Class B or Class F, it must be demonstrated that hazardous quantities of smoke, flames, extinguishing agent, or noxious gasses do not enter any compartment occupied by passengers or crewmembers. Advisory Circular 25-9A, Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures, provides guidance concerning smoke penetration testing.

f. If an airplane has one or more Class B cargo compartments, portable protective breathing equipment must be provided for the appropriate crewmembers in accordance with § 25.1439. If the airplane is operated under part 121, the protective breathing equipment must meet the more stringent standards of § 121.337.

g. "To control a fire" (§ 25.857(f)(1)) implies that the fire does not grow to a state where damage to the airplane or harm to the passengers or crew occurs during the time for which the fire protection system is demonstrated to be effective. This in turn implies that critical airplane 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. 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. If protective covers are used, they must be constructed of materials that meet the Flame Penetration Resistance requirements of part 25, Appendix F, Part III (Amendment 25-60).

6. PROCEDURES AND LIMITATIONS.

a. The cargo or baggage loading limitations and any operational limitations or procedures provided to ensure that the contents of a Class B compartment are accessible to combat a fire

must be identified with placards in the compartment and 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 gasses into occupied areas, use of hand-held fire extinguishers, use of protective breathing equipment, use of protective clothing, etc. The certification engineers should work closely with the FAA Flight Standards organization (Aircraft Evaluation Group) to ensure that additional training necessary for crewmembers assigned to combat fires is adequately addressed.

c. Any limitations regarding the 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. AIRPLANE FLIGHT MANUAL CONSIDERATIONS

a. For Class B compartments, it is important to note that special training is needed for the crewmember(s) designated to combat a fire in the compartment. The certification office should work with the appropriate organization to ensure that training in the use protective breathing equipment, fire extinguishers, protective gloves and clothing, is provided. Fires occurring in luggage are difficult to extinguish completely. Rekindling is not unlikely. Crewmembers designated to combat fires in Class B compartments should be trained to check periodically to ensure that any fire that has occurred has not grown back to hazardous proportions.

b. Airplane 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.

12-13-00: Incorporate Mahinder's changes
1-23-01: Revised per NS changes
4-02-01 Revised by M. Wahi per Perry Eskridge/ANM-7