



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: TRANSPORT CATEGORY AIRPLANES
MODIFIED FOR CARGO SERVICE

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Change:

1. PURPOSE. This Advisory Circular (AC) provides guidance for demonstrating compliance with the Federal Aviation Regulations (FAR) pertaining to transport category passenger airplanes converted for use in all-cargo or combination passenger/cargo (combi) service and the relationship of those regulations to the requirements of Parts 121 and 135 of the FAR. Although it does refer to regulatory requirements that are mandatory, this AC is not, in itself, mandatory. It is for guidance purposes and to acquaint the reader with the provisions of the applicable regulations. This AC is based on the assumption that there are no changes in airspeed, weight or center of gravity limitations, and that there are no major structural changes such as a stretched fuselage or added cargo door. Changes of that nature are beyond the scope of this AC and, unless accomplished in accordance with previously approved type design data, should be referred to the cognizant FAA Aircraft Certification Office.

Section 135.87 of Part 135 permits the carriage of cargo in passenger-configured airplanes provided the cargo is carried under the provisions of § 135.87(c). Such operations are beyond the scope of this AC; however, the section is discussed in this AC because it has been cited incorrectly as a basis for not complying with applicable type certification requirements.

2. RELATED SECTIONS OF THE FAR.

a. Section 21.21 of Part 21 - Issue of type certificate: normal, utility, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers.

b. Section 21.101 of Part 21 - Designation of applicable regulations.

c. Section 25.807 of Part 25 - Emergency exits.

d. Section 25.831 of Part 25 - Ventilation.

e. Section 25.853 of Part 25 - Compartment interiors.

f. Section 25.855 of Part 25 - Cargo or baggage compartments.

g. Section 25.857 of Part 25 - Cargo compartment classification.

h. Section 25.1439 of Part 25 - Protective breathing equipment.

i. Section 25.1557 of Part 25 - Miscellaneous markings and placards.

j. Section 121.314 of Part 121 - Cargo and baggage compartments.

k. Section 135.87 of Part 135 - Carriage of cargo including carry-on baggage.

l. Section 135.169 of Part 135 - Additional Airworthiness requirements.

m. Airworthiness Directive 93-07-15 (58 FR 21243, April 20, 1993) which is applicable to Boeing 707, 727, 737, 747 and 757 series airplanes and McDonnell Douglas DC-8, DC-9 and DC-10 series airplanes.

3. BACKGROUND.

a. The modification of a passenger-carrying airplane to an all-cargo or combi configuration is a change in the type design of that airplane even though the "modification" may be as simple as changing or imposing additional limitations.

(1) Under § 21.101, an applicant for a change in the type design of an airplane must, as a minimum, show that the modified airplane continues to comply with the regulations incorporated by reference in the type certificate. (The "regulations incorporated by reference" are frequently referred to as the "original type certification basis" and are found in the type certificate data sheet for the airplane model involved.)

(2) Under § 21.101(a)(2), an applicant has the option of showing that the modified airplane complies with the regulations in effect on the date of the application for the change (referred to in this AC as "current Part 25"), in lieu of the regulations incorporated by reference.

(3) Unless stated otherwise, regulations cited in this AC are those currently in effect. For airplanes with earlier type certification bases, a regulatory reference includes "or corresponding predecessor regulation."

b. In some instances, the type certification standards of Part 25 go beyond the corresponding requirements of Part 121 or Part 135. Neither Part 121 nor Part 135 provides "relief" in that regard from compliance with the applicable type certification standards. Section 135.87, in particular, has been cited incorrectly as a basis for not complying with type certification requirements concerning flightcrew emergency exits. Conversely, Part 121 or Part 135 may, in some instances, contain additional requirements that go beyond the type certification standards. A Part 121 or Part 135 operator of an airplane modified for cargo service must comply with those requirements in addition to the type certification standards.

c. Section 25.855 provides safety standards applicable to ". . . each cargo or baggage compartment not occupied by crew or passengers." The exception made for compartments ". . . occupied by crew or passengers" does not apply to compartments that may be visited occasionally during flight, such as a Class B cargo or baggage compartment which a crewmember might occupy while fighting a fire. It has also been alleged that the standards of § 25.855 do not apply to certain compartments because the flightcrew "occupy" the compartment while seated

at their duty stations. Regardless of the degree or means of separation provided, the cockpit can not be considered part of the cargo or baggage compartment.

4. STRUCTURAL REQUIREMENTS.

a. The cabin floor (or bottom of the compartment if it is not located on the floor) and any structure used to support or restrain the compartment and its contents must be shown to meet the applicable requirements of the original type certification basis or current Part 25 for structural strength. Note that this involves a damage-tolerance evaluation as well as an assessment static strength if the certification basis of the airplanes includes § 25.571 as amended by Amendment 25-45. Among the changes to primary structure that must be evaluated are modified load paths, additional holes, existing holes loaded in a different manner, cut-outs, etc. Particular attention should be given in this regard to pressurized airplanes due to the possibility of a catastrophic decompression. Appropriate floor-loading limitations must be established and displayed in prominent placards. If the airplane is the subject of a Supplemental Structural Inspection Program, the effects of the changes on that program must also be evaluated.

b. The cargo restraint system, i.e., nets, straps, chains, tie downs, etc., must not only have sufficient strength to safely restrain the cargo, but must also ensure that cargo will not shift and block or reduce access to emergency exits and any other required equipment. As required by § 25.685(a), the restraint system must be designed and installed so that there is no possibility that either cargo or the restraint system itself could interfere with cables or other components of the control system.

c. Normally, the modification of a passenger airplane for cargo service would not result in a significant change in the mass distribution of the airplane. If, however, there is a significant change in mass distribution, it would be necessary to investigate the effect of that change on structural strength, flutter characteristics and aircraft handling characteristics.

5. COMPARTMENT CLASSIFICATION. The compartment 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 and E were added later. The classification is based on the means by which a fire could be detected and the means available to fight 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 cabin and used for other purposes provided it is close to a 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. There is no specific limit on the volume; however, 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. Typically, Class B compartments are the cargo portions of combi airplanes; however, they are sometimes found in other airplanes, such as business jets. There has not previously been any limitation on the size of a Class B compartment. Due, however, to recent adverse service experience, the FAA has determined that larger Class B compartments constitute an unsafe condition unless certain additional fire precautions are taken.

(1) Boeing 707, 727, 737, 747 and 757 series airplanes and McDonnell Douglas DC-8, DC-9 and DC-10 series airplanes must comply with the provisions of Airworthiness Directive (AD) 93-07-15 (58 FR 21243, April 20, 1993).

(2) The Cargo Standards Harmonization Working Group of the Aviation Rulemaking Advisory Committee (ARAC) has been assigned the task of determining acceptable standards for Class B, including the maximum compartment volume that does not constitute an unsafe condition. On completion of that task, it is anticipated that an additional AD will be adopted to address the Class B compartments installed in models other than those shown in AD 93-07-15. In the meantime, any proposed installation of a Class B compartment in any transport category airplane model not addressed by AD 93-07-15 should be coordinated with the FAA Transport Airplane Directorate in order to preclude a finding that an unsafe condition exists and denial of approval under the provisions of § 21.21(b)(2).

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. A Class C compartment must have a liner and a fire or smoke detection system in accordance with §§ 25.855 and 25.857.

d. A Class D compartment differs from a Class C compartment in that the ventilating air flow is carefully controlled so that any fire which might develop is deprived of the oxygen needed for combustion. Neither fire or smoke detectors nor a fire extinguishing system is required; however, a Class D compartment must have a liner in accordance with § 25.855. Section 25.857(d) was amended by Amendment 25-60 to limit the total volume of a Class D compartment to 1,000 cubic feet.

e. 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 extinguishing system.

6. 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 extinguishing systems, must be provided; and they must be shown to meet the standards established by the original type certification basis or current 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. Insofar as that purpose is concerned, the liner does not need to serve as the compartment seal. If it is not airtight, flame arresters must be provided as necessary to ensure that no flames can pass to any other part of the airplane; and there must be nothing adjacent to the compartment that could be ignited by the heat flux. 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 the 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. 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. Section 25.855, as amended by Amendment 25-60, and part III of Appendix F to Part 25 contain more stringent test standards applicable to the ceiling and sidewall liners of Class C and D compartments.

d. For airplanes operated under the provisions of Part 121 or Part 135, §§ 121.314 and 135.169(d) require each Class C or D compartment greater than 200 cubic feet to meet flammability standards similar to those of § 25.853 after March 20, 1991, regardless of whether the original type certification basis of the airplane includes Amendment 25-60. (Sections 121.314 and 135.169(d) do not contain the 1,000 cubic feet volume limitation of § 25.853 for Class D compartments.)

e. In the case of a Class A or B compartment, there must be sufficient accessibility to enable a crewmember to effectively reach any part of the compartment with the contents of a hand-held fire extinguisher.

(1) "Effectively reach any part of the compartment" basically means that the crewmember should be able to get close enough to fight a fire anywhere in the compartment without having to move or crawl over cargo. How close the crewmember would have to be to the fire would depend on the range and other characteristics of the fire extinguisher used, and the shape of the compartment. (It must be assumed that the compartment would be fully loaded.) Class A compartments are especially critical in this regard because they do not have liners. As noted above, a fire that is not extinguished immediately could quickly become catastrophic by burning out of a Class A compartment and spreading throughout the airplane.

(2) No compartment in an airplane approved for single-pilot operation could be classified as a Class A or B compartment because the pilot would not have the accessibility required by § 25.857(a) or (b) while remaining at the controls of the airplane.

(3) As noted above, a compartment greater than 50 cubic feet in volume could not typically be classed as a Class A compartment because it would not have the accessibility to all parts needed to fight fires, as required by § 25.857(a).

f. In the case of a Class E compartment, there must be means to shut off the ventilating airflow to, or within, the compartment in accordance with § 25.857(e)(3). Those means must be accessible to the flightcrew in the crew compartment.

g. A smoke detection system, if required by the compartment classification, must be shown to detect a smoldering fire producing a small amount of smoke.

7. EMERGENCY EGRESS. Accessible emergency exits must be provided in accordance with the original type certification basis or the applicable operating rules, whichever is more stringent.

a. Bulletin 7A and Part 4a of the Civil Air Regulations (CAR) contain no specific requirements for flightcrew exits; however, § 135.87(c)(7) of the FAR requires that the flightcrew of an airplane operated under Part 135 have access to at least one emergency or regular exit. (Section 135.87 actually pertains to the carriage of cargo in passenger-configured airplanes rather than those converted for the carriage of cargo; however, it has been incorrectly cited as a basis for not complying with applicable type certification requirements.) Even though Bulletin 7A contains no such requirements, a Douglas DC-3 certificated under Bulletin 7A and operated under Part 135, for example, must have access to at least one exit under the more stringent provisions of Part 135. In a crash landing, there is always the possibility that an exit on one side of the airplane may be unusable because of an external fire on that side of the airplane or because the fuselage has rolled over on that side. Applicants are, therefore, strongly urged to provide at least one exit on each side of the airplane even though § 135.87(c)(1) requires only one exit for the whole airplane.

b. Prior to December 20, 1951, Part 4b of the CAR required at least one exit in the pilot compartment. For an airplane type certificated under Part 4b of this vintage, such as a Douglas DC-6, there must be at least one emergency exit in the pilot compartment, the provisions of § 135.87(c)(7) permitting the use of a passenger exit notwithstanding. Again, applicants are strongly urged to provide an exit on each side of the airplane.

c. The current requirements of § 25.807(f) of the FAR became effective on December 20, 1951, (Part 4b effective July 20, 1950, as amended by Amendment 4b-4). Both § 25.807(f) and its predecessor, § 4b.362 of the CAR, require a flightcrew emergency exit on each side of the airplane or a top hatch in the flightcrew area, unless the airplane has a passenger capacity of 20 or fewer. For airplanes with 20 or fewer passengers, a passenger emergency exit may be used in lieu of an exit located in the flightcrew area in the same side of the fuselage provided it is convenient and readily accessible to the flightcrew. (The number of passengers refers to the number of passenger seats in the airplane as modified to an all-cargo or combi configuration. The number of passenger seats installed in the original passenger configuration is no longer relevant.) Regardless of whether it is a passenger emergency exit or a dedicated flight crew exit, a transport category airplane with an original type certification basis later than January 19, 1951, and without a top hatch in the flightcrew area, must have at least one exit in each side of the airplane that is convenient and accessible to the flightcrew, the provisions of § 135.87(c)(7) specifying an exit on only one side notwithstanding.

d. When passenger emergency exits are used in lieu of exits located in the flightcrew area, there must be appropriate design features or loading limitations to ensure that access to the exits will not be compromised by improperly loaded or shifted cargo.

e. Normally, passenger emergency exits must be provided if any persons other than crewmembers are carried. Exemptions have been granted in certain specific instances, however, to permit the carriage of a limited number of additional occupants with only crewmember emergency exits provided. Unless an exemption has been granted for the specific airplane being modified, passenger emergency exits meeting the requirements of § 25.807 must be provided if additional persons, such as supernumerary crewmembers, cargo handlers or company personnel, are carried.

8. VENTILATION.

a. Means must be provided to exclude hazardous quantities of smoke, flames, extinguishing agent or noxious gases from any compartment occupied by crew or passengers in accordance with § 25.857. Compliance must be shown by flight test as required by § 25.855.

b. Procedures for evacuation of smoke from the cockpit must be developed and shown to be satisfactory in accordance with § 25.831(d).

c. Advisory Circular 25-9 provides guidance concerning smoke detection, penetration, evacuation tests and related flight manual emergency procedures. Note that the adequacy of the smoke detection system, the means provided to prevent penetration of smoke into occupied areas, and the procedures for

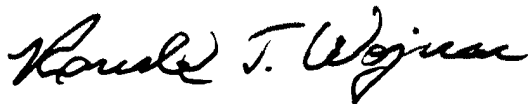
evacuating smoke must be shown by flight test rather than analysis if there is any substantial change which affects the air flow between compartments or smoke penetration characteristics.

d. Either fixed or portable protective breathing equipment (PBE) must be provided for the flightcrew in accordance with § 25.1439. If the airplane has a Class A, B or E compartment, portable PBE must be provided for the appropriate crewmembers. If the airplane is operated under Part 121, the PBE must also meet the more stringent standards of § 121.337.

9. PROCEDURES AND LIMITATIONS.

a. The cargo loading schedules and operational limitations provided in accordance with § 25.1557(a) must reflect the required accessibility to cargo for fire-fighting and to emergency exits, as well as weight and balance considerations.

b. A flight manual supplement or revision showing any limitations, conditions or procedures which are added or changed due to the modification of the airplane for the carriage of cargo must be prepared in accordance with § 25.1581.



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