

UNITED STATES OF AMERICA  
DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION  
RENTON, WASHINGTON 98057-3356

In the matter of the petition of

Alenia Aeronautica

for an exemption from § 25.841(a), (a)(1), and  
(b)(6) of Title 14, Code of Federal Regulations

**Regulatory Docket No. FAA-2008-0496**

**GRANT OF EXEMPTION**

By letter dated March 20, 2008 (letter no. 04/LT/0400/T810E/080148), Mr. Antonio Gandolfo, Alenia Airworthiness Manager, Alenia Aeronautica S.p.A., Strada Malanthero n.17, 10072-Caselle Torinese-Torino, Italy, petitioned to exempt the Model C-27J airplane from the requirements of Title 14, Code of Federal Regulations (14 CFR) 25.841(a), (a)(1), and (b)(6) as amended by Amendment 25-87. This exemption, if granted, would relieve these airplanes from the requirement that:

- cabin-pressure altitude must not exceed 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions
- cabin-pressure altitude must not exceed 15,000 feet after any probable failure condition in the pressurization system, and
- a cabin-pressure-warning indication be provided when the cabin-pressure altitude exceeds 10,000 feet.

**The petitioner requests relief from the following regulations:**

**Section 25.841(a)**, at Amendment 25-87, requires that “Pressurized cabins and compartments to be occupied must be equipped to provide a cabin-pressure altitude of not more than 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions.” In addition, “(1) If certification for operation above 25,000 feet is requested, the airplane must be designed so that occupants will not be exposed to cabin pressure altitudes in excess of 15,000 feet after any probable failure condition in the pressurization system.”

**Section 25.841(b)(6)**, at Amendment 25-87, requires “Warning indication at the pilot or flight engineer station to indicate when the safe or preset pressure differential and cabin pressure altitude limits are exceeded. Appropriate warning markings on the cabin pressure differential indicator meet the warning requirement for pressure differential limits and an aural or visual signal (in addition to cabin altitude indicating means) meets the warning requirement for cabin pressure altitude limits if it warns the flight crew when the cabin pressure altitude exceeds 10,000 feet.”

**The petitioner supports their request with the following information:**

The following is paraphrased from Alenia Aeronautica’s petition and related supporting information.

On March 27, 2006, the European Aviation Safety Agency (EASA) forwarded to the FAA an application from Alenia Aeronautica of Torino, Italy, for U.S. type certification of a twin-engine, commercial transport designated as the Model C-27J. The Alenia C-27J is a twin-turbopropeller, cargo-transport aircraft with a maximum takeoff weight of 30,500 kilograms (67,241 pounds). The Alenia application for FAA type certification, dated March 23, 2006 (letter no. 04/LT/0000/T314/060002), was forwarded by EASA as an attachment to EASA letter EASA D(2006)/WSM/LKE/L7396, dated March 27, 2006. The application identified the Model C-27J as a contender for the U.S. Army/Air Force Joint Cargo Aircraft (JCA) contract. FAA civil type certification was identified by Alenia as a necessary step in the JCA program process.

The Model C-27J is intended to be a derivative of the military G222 airplane which has already been certified by Ente Nazionale per l'Aviazione Civile (ENAC; RAI at that time) under a Restricted Category on March 14, 1997 (Type Certificate N. A348). The Model G222 is certified to operate at a maximum operating altitude of 25,000 feet. By contrast, the Model C-27J aircraft is intended to operate at a maximum cruise altitude of 30,000 feet. The Model C-27J maintains the same environmental control systems with a single air-cycle machine installed in the air-conditioning system. While this design provides an environmental-control system that meets § 25.841 requirements for operation up to 25,000 feet, for flight above 25,000 feet and up to 30,000 feet, the Model C-27J does not comply with § 25.841(a), (a)(1), and (b)(6).

During normal operation, the C-27J environmental-control system can maintain a cabin-pressure altitude of 8,000 feet up to a flight altitude of 25,000 feet. However, at maximum intended cruise altitude of 30,000 feet, the cabin-pressure altitude is 10,075 feet. In addition, for any reasonably probable failure or malfunction in the pressurization system, the cabin-pressure control system is not capable of maintaining a cabin-pressure altitude less than 15,000 feet as required by § 25.841(a).

Alenia believes that the FAA should consider the following mitigating factors in granting the petition:

- limited number of occupants (i.e., three trained flightcrew members)
- the airplane is used for cargo-only operation
- quick-donning, full-face-mask oxygen system provided for the flightcrew members
- the cabin-pressure altitude never exceeds 10,400 feet during normal operations

- the airplane design includes an annunciation system that alerts the flightcrew members of cabin-pressurization-system failure events
- during probable system failures, the time it takes the cabin-pressure altitude to increase up to 15,000 feet is much greater than the time it takes the flightcrew members to don oxygen masks, and,
- the quantity of oxygen carried is sufficient for all requirements.

Alenia provided supplemental material in Technical Note G-TNOT-130/070-2130-000 J that the FAA used in evaluating the C-27J design. This material provides detailed substantiation data describing the two different oxygen systems provided on the C-27J airplane. These are:

- a fixed flight-crew oxygen system, fed by a dedicated liquid-oxygen converter, with quick-don oxygen masks available for all crew members, and which can be donned within 5 seconds, and,
- a portable oxygen bottle available for each crew member, for crew mobility.

Note that the available oxygen quantity is sufficient for recovery actions performed by flightcrew members (emergency descent down to 10,000-foot flight altitude). In addition, Alenia’s supplemental material describes the ram-air, emergency-ventilation valve, which is part of the air-conditioning system, and which can be actuated in case of emergency to provide ram air from the exterior of the aircraft.

Alenia noted in their petition that the exemption requested:

- does not adversely affect safety
- improves the efficiency of the C-27J JCA airplane
- tends to reduce air cargo fares for all users
- reduces the cost of the aircraft to US operators

In addition, this petition would provide the public with benefits from a new family of airplanes that incorporate new technology and lessons learned from previous and current production airplanes, and comply with the latest airworthiness standards throughout to provide a safer, more efficient transportation option for cargo airlines.

### **Federal Register Publication:**

A Notice of Petition for Exemption was published in the *Federal Register* on May 23, 2008. No comments were received.

### **The FAA’s analysis:**

The petitioner requests relief from current regulations that require “a cabin pressure altitude of not more than 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions,” and the airplane must be designed so that occupants are not “exposed to cabin pressure altitudes in excess of 15,000 feet after any probable failure condition in the pressurization system.” In addition, the petitioner seeks relief from the requirement for a “Warning indication at the pilot or flight engineer station to indicate when the safe or preset pressure differential and cabin pressure altitude limits are exceeded. Appropriate warning

markings on the cabin pressure differential indicator meet the warning requirement for pressure differential limits and an aural or visual signal (in addition to cabin altitude indicating means) meets the warning requirement for cabin pressure altitude limits if it warns the flight crew when the cabin pressure altitude exceeds 10,000 feet.”

Section 25.841 provides standards for pressurized compartments in transport category airplanes during normal operations and for failure conditions. The FAA has previously granted equivalent level of safety (ELOS) findings, with § 25.841(a) and (b)(6), to other airplane designs with operating characteristics and features that permitted high-altitude airport operations. These airplanes routinely operate at airports with altitudes above 8,000 feet, resulting in the cabin reaching pressure altitudes of up to 14,500 feet. These ELOS findings have been approved because of safeguards on warnings and the short duration of exposure to pressure altitudes above 8,000 feet. Furthermore, the intent of § 25.841(b)(6) is to warn the crew when the safe or preset pressure differential and cabin-pressure altitude limits are exceeded. The rule states that the warning requirement for cabin-pressure altitude limits may be met if the warning is set for 10,000 feet. If an applicant chooses to set the cabin-pressure altitude warning limit above 10,000 feet, the applicant must substantiate that the higher setting provides an acceptable level of safety. As noted previously, the FAA has granted an ELOS to other airplane designs with similar operating characteristics and features; however, most recent transport category airplane ELOS findings required an airplane flight manual (AFM) limitation that one pilot must wear and use an oxygen mask when operating with the cabin high-altitude warning set above 10,000 feet.

The system proposed by Alenia for the Model C-27J is unlike previously certified designs because the environmental-control system includes single components which result in reliability levels that do not meet the latest regulatory requirements. However, like previous designs, the cabin-pressure control-system design itself cannot compensate for the difference in the flight crew’s ability to react to and perform critical functions, at cabin-pressure altitudes above 10,000 feet, the same as they would be expected to react to and perform critical functions at cabin-pressure altitudes of 10,000 feet and below. It should be noted that current FAA operating rules (e.g., 14 CFR 91.211, 121.327, 121.329, and 121.331) permit flight with a cabin-pressure altitude of 10,000 feet for unlimited times without the use of oxygen. Furthermore, if Alenia chooses to operate under 14 CFR part 91 or 121 operating rules, an exemption to those rules may be necessary.

Amendment 25-38, published in the Federal Register (41 FR 55454) on December 20, 1976 (effective February 1, 1977), states that the FAA believes pilots have come to rely on the warning at a cabin-pressure altitude of 10,000 feet. However, on the C-27J at maximum cruise-flight altitude, the maximum cabin-pressure altitude is expected to be only 10,075 feet, which is considered a small excursion above 10,000 feet. A cabin high-altitude warning will be annunciated should the cabin-pressure altitude rise above 10,450±250 feet. Therefore, the FAA considers that the maximum cabin-pressure altitude prior to annunciation would be 10,700 feet. The change in physiological threat represented by exposure to this altitude (i.e., 10,700 feet), in lieu of a warning at 10,000 feet, is considered within the accuracy of most physiological evaluations.

The FAA acknowledges that the following cargo-only operation, with three trained crew members, ensures that each crew member is afforded adequate protection from permanent physiological harm from hypoxia experienced during normal operations or failure conditions:

- limited high-altitude operation after failure
- installation of quick-don oxygen masks, and
- inclusion of two different oxygen systems.

Furthermore, adequate system alerts are present to ensure that flightcrew members can detect cabin-pressurization-system failure and that the system warnings permit appropriate recovery actions. In addition, the airplane design includes a ram-air, emergency-ventilation valve as part of the air-conditioning system, and which can be actuated in case of emergency to provide ram air. Appropriate AFM procedures must be available in the event of failures to ensure an adequate emergency descent from maximum cruise to below 10,000 feet flight altitude.

We reviewed databases from our own National Aviation Safety Data Analysis Center, covering 1959 to the present. Since 1959, approximately 3,000 instances of loss of cabin pressure in airplanes have occurred. System failures (e.g., cabin pressurization controller failures and valve failures) have caused the vast majority of these instances, with structural failures (e.g., door seal failures), which typically have been recognized at low altitude within a few minutes after takeoff, as a secondary contributor. Pilot error has also contributed to the number of events. The majority of these events have not subjected the occupants to exposures above 25,000 feet (an altitude considered physiologically significant). The cabin-pressure altitude in most events did not exceed 15,000 feet (the cabin-pressure altitude at which passenger oxygen masks are deployed). Additionally, uncontained engine-rotor-burst failures contribute to incidents of cabin-pressure loss, but tend to be very rare. Calculations show that grouping all engines and transport airplanes together yields an average probability of an uncontained engine failure, at cruise, of approximately  $1 \times 10^{-7}$  per engine hour. We found that no fatalities from hypoxia were due to in-flight, rapid-decompression events as envisioned by Amendment 25-87. The data indicate that decompression is not a significant cause of fatalities. This is in part because these events are so rare that the FAA considers the risk to be acceptable.

However, the FAA remains concerned regarding exposing crew members to a physiological impairment above 15,000 feet cabin-pressure altitude on a probable failure basis. To offset this concern, we believe that it is prudent to require that all occupants of the flight deck don and use their oxygen masks when the airplane operating pressure altitude is above 25,000 feet.

Based upon our evaluation of the Model C-27J design and operational considerations provided by Alenia, we have determined that sufficient justification exists for a grant of exemption from § 25.841(a), (a)(1), and (b)(6), with conditions.

In lieu of § 25.841(a) and as a condition of this exemption, the petitioner must ensure that pressurized cabins and compartments to be occupied are equipped to provide a:

- cabin-pressure altitude of not more than 8,000 feet during flight operating pressure altitude of below 25,000 feet and during normal operations, and
- maximum cabin-pressure altitude not greater than 10,700 feet at airplane maximum cruise operating pressure altitude of 30,000 feet.

In lieu of § 25.841(a)(1) and as a condition of this exemption, the petitioner must ensure that if certification for operation above 25,000 feet is requested, the airplane must be designed so that occupants are not exposed to cabin-pressure altitudes in excess of 25,000 feet after any probable

failure condition in the pressurization system during an emergency descent, initiated at an airplane operating pressure altitude of 30,000 feet.

In addition, the petitioner must include in the AFM limitations section a requirement for all flight-deck occupants to don and use their oxygen masks when the airplane operating pressure altitude is greater than 25,000 feet.

In lieu of § 25.841(b)(6) and as a condition of this exemption, the petitioner must ensure that a warning indication is provided at the pilot or flight-engineer station to indicate when the safe or preset pressure differential and cabin-pressure altitude limits are exceeded. Appropriate warning markings on the cabin-pressure differential indicator meet the warning requirement for pressure-differential limits, and an aural or visual signal (in addition to cabin-pressure-altitude indicating means) meets the warning-requirement condition of this exemption for cabin-pressure-altitude limits if it warns the flight crew when the cabin-pressure altitude exceeds 10,450±250 feet.

The petitioner must submit certification flight-test data to show that:

- after a simulated probable failure event, the cabin-pressure altitude does not exceed 25,000 feet during an emergency descent initiated at an airplane operating pressure altitude of 30,000 feet
- for a simulated decompression at an airplane operating pressure altitude of 30,000 feet, the cabin-pressure altitude does not exceed 25,000 feet for more than 3 minutes during the emergency descent.

This grant of exemption is predicated and/or premised on:

- successfully demonstrating compliance to §§ 25.1441, 25.1443, 25.1445, 25.1447, and 25.1449.
- the condition that, prior to each flight the availability and proper functioning of the ram air emergency ventilation valve and both the fixed-oxygen and portable-oxygen systems is confirmed. Confirmation may be provided, as appropriate, by means of either:
  - Flight crew action, as defined in the Limitations section of the AFM, or
  - Maintenance action, as defined in the Certification Maintenance Requirements (CMR)

While the FAA does not envision approval of any similar petition which would include exposure of passengers to the same potential of hypoxic threat, all of the crew members of this airplane are trained crew members who have received physiological training and understand the dangers of hypoxia. In addition, they understand the use and limitations of the oxygen systems installed on the Model C-27J airplane. Our decision on this grant of exemption is predicated on the crew members having this knowledge of the risk of hypoxia and the means of mitigation.

This grant of exemption does not relieve compliance to any part or subsection of § 25.841 other than those indicated in this exemption. This grant of exemption does not relieve compliance to any part or subsection of 14 CFR part 91 or 121.

### **The FAA's Decision**

In consideration of the foregoing, I find that a grant of exemption is in the public interest regarding § 25.841(a), (a)(1), and (b)(6) as amended by Amendment 25-87. Therefore, pursuant

to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, the petition of Alenia for an exemption from the requirement of § 25.841(a), (a)(1), and (b)(6) as amended by Amendment 25-87, is granted, for Alenia Aeronautica's Model C-27J airplanes.

This grant of exemption is subject to the following conditions:

1. Operation of the C-27J is limited to all-cargo (i.e., freighter) operation only.
2. Occupancy of the C-27J is limited to a maximum of three trained (i.e., have received physiological training and understand the dangers of hypoxia, and are knowledgeable of the operation of the oxygen systems) crew members who meet the appropriate medical standards.
3. The petitioner must demonstrate that the Model C-27J cabin-pressure altitude does not exceed 8,000 feet during flight-operating-pressure altitude of below 25,000 feet and that the maximum cabin-pressure altitude does not exceed 10,700 feet at airplane maximum cruise-operating-pressure altitude of 30,000 feet.
4. The petitioner must demonstrate that after a simulated probable-failure event, the cabin-pressure altitude does not exceed 25,000 feet during an emergency descent initiated at an airplane indicated operating-pressure altitude of 30,000 feet.
5. The petitioner must demonstrate that after a simulated decompression at an airplane operating pressure altitude of 30,000 feet, the cabin-pressure altitude does not exceed 25,000 feet for more than 3 minutes during the emergency descent.
6. The petitioner must demonstrate that the warning indication, provided at the pilot station to indicate when the cabin-pressure altitude limit is exceeded, activates at no greater than 10,700 (i.e., 10,450±250) feet.
7. Appropriate AFM procedures must be provided:
  - a. to ensure an emergency descent will be performed to below 10,000 feet indicated-operating-pressure altitude, following any depressurization or decompression occurrence at higher altitudes; and,
  - b. to ensure that all crew members don and use their oxygen masks at and above 25,000 feet flight indicated-operating-pressure altitude.
8. Prior to each flight, it must be confirmed that both the fixed-oxygen and portable-oxygen systems have an adequate quantity of oxygen (e.g., sufficient quantity for normal operations above 25,000 feet indicated-operating-pressure altitude, plus for emergency/non-normal procedures) to meet all regulatory requirements, and are functional.

9. Prior to each flight, it must be confirmed that a ram-air, emergency-ventilation valve is available as part of the air-conditioning system and functions properly in the event of an emergency.

Issued in Renton, Washington, on December 31, 2009.

/s/

Ali Bahrami  
Manager, Transport Airplane Directorate  
Aircraft Certification Service