

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

**EMBRAER Empresa Brasileira de
Aeronáutica S/A**

Section 25.841(a)(2)(i) and (ii), Amendment
25-87 of Title 14, Code of Federal Regulations

Regulatory Docket No. FAA-2004-19937

GRANT OF EXEMPTION

By letter dated December 6, 2004 (GEM74912004), Mr. Paulo C. Olenski, Certification Manager, EMBRAER Empresa Brasileira de Aeronáutica S.A., Av. Brigadeiro Faria Lima 2170, 12227-901 – São José Dos Campos, SP, Brazil, petitioned for an exemption from the requirements of § 25.841(a)(2)(ii), Amendment 25-87 of Title 14, Code of Federal Regulations (14 CFR), to permit EMBRAER, for the Model ERJ 190 series airplanes, to be relieved of the requirement that during a decompression the airplane cabin altitude not exceed 40,000 feet for any duration. In a subsequent letter dated March 4, 2005 (GEC-0915/2005), Mr. Olenski asked that the petition for exemption be expanded to include exemption from the requirements of § 25.841(a)(2)(i), Amendment 25-87, to permit EMBRAER, for the Model ERJ 190 series airplanes, to be relieved of the requirement that during a decompression the airplane cabin altitude not exceed 25,000 feet for more than 2 minutes.

Sections of the Federal Aviation Regulations (FAR) affected:

Section 25.841(a)(2)(i), at Amendment 25-87, requires that the airplane must be designed so that occupants will not be exposed to a cabin pressure altitude that exceeds 25,000 feet for more than 2 minutes after decompression from any failure condition not shown to be extremely improbable.

Section 25.841(a)(2)(ii), at Amendment 25-87, requires that the airplane must be designed so that occupants will not be exposed to a cabin pressure altitude that exceeds 40,000 feet for any duration after decompression from any failure condition not shown to be extremely improbable.

The petitioner's supporting information is as follows:

As required by 14 CFR §11.25, Embraer provided information in support of its petition for exemption. An excerpt of that information is as follows:

“Amendment 25-87 implemented restrictions on the maximum allowable cabin altitude that could result from certain failures including system, structural, and engine failures, unless those failures could be shown to be extremely improbable. Because it is not possible for the current state-of-the-art to ensure that certain engine failures, specifically engine rotorburst, are extremely improbable, Amendment 25-87 effectively prevents airplanes with wing-mounted engines from having maximum altitudes above 40,000 feet, because an engine rotorburst could potentially strike the pressurized fuselage. Embraer notes that neither the Joint Airworthiness Authorities nor the European Aviation Safety Administration have implemented similar requirements.

“Embraer will ensure that an adequate level of safety is demonstrated. It is important to note that very few decompression incidents, if any, have exposed an aircraft cabin to pressure altitude profiles with risk of injury to passengers. Industry history reveals that few cases of catastrophic decompressions at high altitude have occurred and those that have occurred have typically involved small business jets. The FAA has cited few cases of rotor burst in cruise. In one such instance, a DC-10 crossing New Mexico reported several cases of initial decompression sickness, apparently with no permanent injuries. However, the rotor burst in that case was believed to have been induced by crew action.

“There have been six known cases of disk or spacer departure in cruise in the industry-wide high bypass turbofan fleet. (Data from CAAM committee report and from SAE reports AIR4770, AIR4003 and AIR1537, together with personal communications with safety representatives of each major engine manufacturer.) These six cases were all on first-generation high bypass engines, on the 747, L1011 or DC10 airplanes. This fleet (747, L1011, DC10) has accrued 81 million airplane flight hours (287 million engine hours to date). (Data source: Boeing). Approximately 70% of this time is spent in cruise, for this fleet (mean flight of 3.5 hours). The first generation high bypass disk burst rate in cruise is therefore $1E-7$ /airplane hour, or $3E-8$ /engine hour.

“The second-generation fleet has an uncontained failure rate much lower than that of the first generation. For all fragment types grouped together, the second-generation rate is 23% of the first generation rate (AIR4770 section 4.2.3). Applying the ratio of 23% to the first generation cruise disk burst rate results in an estimated second generation cruise disk burst rate of $7E-9$ /engine hour. This gives a rotor burst risk for two engines in cruise of $1.4E-8$ per flight hour. Using this failure probability results in a probability of a fuselage strike due to engine rotorburst of $1.5 E-9$ per flight hour in a typical airplane with wing mounted, second-generation engines. This is very close to the extremely improbable requirement of Amendment 25-87 ($1.0 E-9$ per flight hour).

“In summary, the probability of fuselage strike due to engine rotorburst is very low, [but] the state-of-the-art of today’s engine design will not result in rotorburst probability being extremely improbable. The design of the ERJ 190 provides a very high level of protection against exposure to high cabin altitude. The descent capability of the airplane provides additional protection in the extremely unlikely event of cabin decompression.”

The Petitioner’s Statement of Public Interest follows:

“The EMBRAER ERJ 190 aircraft fully complies with 14 CFR 25.841, Amendment 25-87, except in regard to the narrow exemption requested herein. All possible threat minimizations for cabin occupants have been taken into consideration for the aircraft. This new aircraft, therefore, offers a significantly higher level of safety than previously certified transport category aircraft under FAR 25.

“As previously discussed, the likelihood of a sudden decompression from engine rotorburst is extremely unlikely. The general increase in level of safety provided by the ERJ 190 is clearly in the public interest, and denying certification due to the narrow inability to comply completely with Amendment 25-87 would deny the traveling public this safety benefit. As described above, all protections feasible given the current state of the art have been implemented, and the narrow exemption requested herein will not adversely affect safety of the occupants.

“Authorization for flight at 41,000 feet will enable to this new aircraft to fly at one additional flight level without adversely affecting the safety of the passengers. The reduced airspace congestion and reduced probability of midair collision is in the public interest. The ability to cruise at more fuel-efficient altitudes reduces fuel consumption and engine emissions, both of which are in the public interest.

“The grant of this exemption request will also enable the ERJ 190 to compete fairly with other existing aircraft that are subject to older amendments without causing any adverse effects to the passengers which is in the public interest. Lastly, the public interest will also be served by the use of the new generation engines in the market, as they offer low operational cost and higher fuel efficiency.”

Notice and Opportunity for Public Comment

A Notice of Petition for Exemption; Summary of Petition Received was published in the Federal Register on January 13, 2005 (70 FR 2453). Two comments were received. One expressed opposition to a grant of exemption but supplied no supporting information. The other supported a grant of exemption to Embraer, noting that the petition “is congruent with the conclusions of the Mechanical Systems Harmonization Working Group (MSHWG) in its report that was approved by the FAA’s Transport Airplane and Engine Issues Group (TAEIG) and submitted to the FAA Associated Administrator for Regulation and Certification on October 21, 2003.” (Copies of both comments may be found in the Department of Transportation’s Docket Management System at <http://dms.dot.gov/> in Docket FAA-2005-19937.)

The FAA’s Analysis of the Petition

The petitioner is requesting relief from § 25.841(a)(2)(ii) which specifies that cabin pressure altitude may not exceed 40,000 feet for any duration after decompression from any failure condition not shown to be extremely improbable. A grant of exemption from this regulation would allow the Model ERJ 190 to operate up to 41,000 feet.

In addition, the petitioner is requesting relief from § 25.841(a)(2)(i) which specifies that cabin pressure altitude may not exceed 25,000 feet for more than two minutes after decompression from any failure condition not shown to be extremely improbable. A grant of exemption from this regulation would allow the Model ERJ 190 to take slightly longer than 2 minutes to descend from 41,000 feet to 25,000 feet after such decompression.

Embraer's petition included a review of available research on physiological effects of increases in cabin pressure altitude and an analysis of such effects. The analytical methodology involves calculation of a Depressurization Exposure Integral (DEI), which provides a quantitative means to estimate the oxygen deprivation and thus the severity of the exposure. The petitioner also provided information on design and operational features of the ERJ 190—including descent profiles—which would mitigate the effects of a slight increase in cabin pressure altitude. The data indicate that the ERJ 190 can descend rapidly from an altitude of 41,000 feet to below 25,000 feet. The slight increase in cabin altitude above 40,000 feet and the slight increase in time spent above 25,000 feet would not cause unacceptable increase in the risk of physiological effects.

The FAA reviewed this petition in the context of our Draft Interim Policy on Amendment 25-87 Requirements (Policy Statement No. ANM-03-112-16) published in the Federal Register on May 30, 2005 (68 FR 32570). (A copy of ANM-03-112-16 may be obtained from the FAA website, under Regulations & Policies, Policy & Guidance, Policy Statements, Proposed, Closed to Public Comment, Part 25, at http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgPolicy.nsf/). Our review indicates that the methodology used by Embraer is the same as that recommended in our draft policy. Based on comments received, this draft policy has been revised and is currently under review within the FAA. Embraer's methodology is also consistent with these revisions. The FAA believes that this methodology is conservative in the sense that it assumes a lower partial pressure of oxygen than would actually be present during decompression at 41,000 feet.

Ultimately, occupant survival during a decompression event depends upon a swift descent to a lower altitude. In its review of the petitioner's airplane descent profile, the FAA noted that the petitioner used a conservative value for the rate of descent. The petitioner had data from wind tunnel studies showing that the actual maximum rate of descent is greater than that used to evaluate physiological response to decompression.

The petitioner also provided data on the likelihood of occurrence of the worst-case failure (i.e., uncontained engine rotor failure). While the FAA concurs with the petitioner that uncontained engine failures are rare events, this consideration did not have a major bearing on the granting of the exemption.

The grant of this exemption also has the potential for reducing operators' costs, thereby benefiting the traveling public while also providing increased flexibility to the manufacturer.

The Grant of Exemption

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, the petition of EMBRAER Empresa Brasileira de Aeronáutica S/A, for an exemption from the requirements of 14 CFR 25.841(a)(2)(i), and 25.841(a)(2)(ii), both as amended by Amendment 25-87. The exemption from § 25.841(a)(2)(ii) will permit the cabin pressure altitude to exceed 40,000 feet (but not to exceed 41,000 feet) after decompression from any failure condition not shown to be extremely improbable. The exemption from § 25.841(a)(2)(i) will permit the cabin pressure altitude to exceed 25,000 feet for more than 2 minutes (but not more than 3 minutes) after decompression from any failure condition not shown to be extremely improbable, allowing time for the airplane to descend from an altitude of 41,000 feet to 25,000 feet.

This exemption is subject to the following conditions:

1. The petitioner must validate by means of flight test the descent profiles used in the analysis.
2. The Airplane Flight Manual for the ERJ 190 must state that the maximum operating pressure altitude is 41,000 feet.

Issued in Renton, Washington, on August 23, 2005.

/s/ Ali Bahrami
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service