

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
KANSAS CITY, MISSOURI 64106

In the matter of the petition of	*	Exemption No. 9549
	*	
EMBRAER AIRCRAFT COMPANY	*	Regulatory Docket
	*	No. FAA-2007-28646
for exemption from Section	*	
23.181(b) of Title 14 of the	*	
Code of Federal Regulations (CFR)	*	

Amendment to GRANT OF EXEMPTION

By letter dated June 14, 2007, Mr. Sergio Augusto Viana de Carvalho, Embraer Aircraft Company, Av. Brig. Faria Lima, 2170, 12227-901, S. Jose dos Campos – SP, petitioned for an exemption from compliance with Section 23.181(b) of Title 14, Code of Federal Regulations (14 CFR) to permit the Embraer Model 500 to be certificated at a reduced level of dynamic lateral-directional stability after a yaw damper system failure.

The petitioner requires relief from the following regulation(s):

Section 23.181(b) of the Federal Aviation Regulations requires that any combined lateral-directional oscillations ("Dutch roll") occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be damped to 1/10 amplitude in 7 cycles with the primary controls - (1) free; and, (2) in a fixed position.

The petitioner proposed these dynamic stability requirements as equivalent:

After a yaw damper system failure, the inherent airframe damping will reduce the Dutch roll to 1/10th amplitude in 13 cycles or less at altitudes above 18,000 feet. The EMB 500 will be flown to demonstrate that it can meet the current requirements of 1/10th amplitude in 7 cycles at altitudes below 18,000 feet.

The petitioner supports the request with the following information:

Equivalency Discussion

14 CFR § 23.181(b) requires a minimum level of Dutch roll damping to ensure that any lateral-directional oscillations, whether from turbulence or from momentary uncoordinated maneuvering, will be rapidly reduced to provide a minimum level of occupant comfort and to ensure that these oscillations do not result in an excessive pilot workload, especially when flying in instrument flight conditions.

In smaller part 23 airplanes, this is normally accomplished by designing the aerodynamic characteristics of the airframe to have the necessary damping. Many part 23 jets, on the other hand, have design features to help operate safely and efficiently at higher altitudes and higher speeds. These design features coupled with less air at the high altitudes tend to reduce the damping inherent in the airframe, so dedicated yaw damper systems are used to increase lateral-directional dynamic stability. Typically the yaw dampers are much more powerful than any natural damping, so the normal level of dynamic stability is much better than the minimum required by § 23.181(b).

In the rare event of a yaw damper system failure, the damping characteristic of the airplane will revert to that naturally provided by the airframe. Embraer, in the event of yaw damper failure, will demonstrate that the inherent damping will reduce the Dutch roll to 1/10th amplitude in 13 cycles or less. This will ensure that, even in the event of yaw damper system failure, enough residual damping will be available to provide for an acceptable crew workload so that a single pilot can easily control the airplane. The EMB 500 also will be shown to meet the requirements of § 23.181(b) (1/10th amplitude in 7 cycles) at altitudes below 18,000 feet.

To design the EMB 500 to meet the requirements of § 23.181(b) after yaw damper system failure is not practical. To provide the necessary damping in the airframe would require the basic airframe design to be modified aerodynamically (decreasing dihedral angle or wing sweep angle and resizing the vertical stabilizer) or by installation of a dual channel yaw damper system (requiring independent system actuation including split rudder surfaces) so that failure of yaw damping is extremely improbable. Both are extremely expensive modifications that provide little increase in safety because they would only be effective after yaw damper system failure and because the current level of damping inherent in the airframe is sufficient to safely fly the airplane system failure.

Public Interest

The granting of this petition is in the public interest. To require the airframe to be modified to inherently provide the required damping would result in a much larger airplane that would not be as fuel efficient as a design that was optimized for the high altitude, high speed environment. To require a less efficient design when the necessary level of safety can otherwise be provided is not in the public interest. Likewise, to require a more complex and expensive yaw damper system design is not in the public interest.

The amount of damping provided following yaw damper system failure will be demonstrated to provide the necessary level of safety to allow the pilot to easily control the airplane with only a minor increase in workload.

Comments on the published exemption:

This exemption was published in the FEDERAL REGISTER as final since the FAA did not receive any comments from the petition summary and we have granted this exemption on at least four previous projects. After publishing the final exemption, Embraer sent a letter to the FAA, dated February 25, 2008, commenting that the FAA had omitted one aspect of Embraer's original petition. This omission did not reflect the latest position that the FAA has taken with another part 23 jet, and Embraer asked for FAA reconsideration. Embraer also asked that the last condition, addressing follow-on flights with a failed yaw damper, be removed since the airplane will be compliant with part 23 or the exemption for their entire flight envelope.

The Federal Aviation Administration's (FAA) revised analysis is as follows:

To obtain an exemption, the petitioner must show, as required by 14 CFR, Part 11, Section 11.81(d) and (e), that: (1) granting the request is in the public interest, and (2) the exemption would not adversely affect safety, or that a level of safety will be provided which is equal to that provided by the rule from which the exemption is sought.

Embraer is correct. The FAA has been working on numerous small jet projects for the past 10 years. Periodically we revise our special conditions and exemptions based on our growing service experience with small jets. In this case, Embraer was granted an exemption from the damping requirements using a previous FAA position. The conditions of that exemption restricted them such that in the event of a yaw damper failure, the pilot would have to descend to an altitude where the airplane would meet the existing damping requirements of 1/10 amplitude in 7 cycles or less. This was an earlier FAA position; however, Embraer commented in their request for reconsideration and FAA experience with recent projects has shown, that it is actually safer to remain at as high an altitude as possible as long as the minimum damping is 1/10 amplitude in 13 cycles or less. Therefore, granting the exemption would not adversely affect safety.

The FAA also accepts Embraer's point that by meeting the current conditions in this amended petition, that the last condition in the original exemption is unnecessary.

In light of the FAA's oversight, the grant of exemption to the Embraer Aircraft Company is amended as follows, replacing the original conditions with the current exemption conditions:

1. All combined lateral-directional oscillations must be damped to 1/10th amplitude in 13 cycles with primary controls free, and in the fixed position. The current standards in § 23.181(b) apply below 18,000 feet.

2. A limitation will be added to the Aircraft Flight Manual for the Embraer Model EMB-500 to restrict operation to altitudes below that altitude where the airplane meets the minimum damping of $1/10^{\text{th}}$ amplitude in 13 cycles if a yaw damper fails.
3. A pilot evaluation must be made to verify that no unsafe condition exists with the airplane's handling characteristics with the yaw damper disabled during landing and takeoff. Also, a pilot evaluation must be made to verify that no unsafe condition exists during the descent from 41,000 feet to the maximum altitude for yaw damper failure as published in the AFM limitations. At least one Aircraft Certification test pilot and at least one Aircraft Evaluation Group (AEG) pilot must conduct these evaluations.

Issued in Kansas City, Missouri on June 12, 2008

s/

Kim Smith
Manager, Small Airplane Directorate
Aircraft Certification Service

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