U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject:	Action: Review and Concurrence, Equivalent Level of Safety Finding for Embraer Model EMB-135BJ FAA Project Number No. AT5124AT-T	Date:	August 15, 2002
		Reg. Ref:	25.331(c)(2)
From:	Manager, Airframe & Cabin Safety Branch, ANM-115	Reply to Attn of:	Carla Worthey ACE-118 A
To:	Manager, Atlanta ACO, ACE-115 A	ELOS Memo #:	AT5124AT-T-A-5

Background

Embraer proposes to use a recently harmonized set of design criteria for the checked maneuver design load requirement recommended by the Aviation Rulemaking Advisory Committee (ARAC). The FAA intends to publish an NPRM proposing to adopt the standards recommended by ARAC, and outlined in the FAA position below. Embraer has requested an equivalent safety finding to the existing requirements of § 25.331 (c)(2).

Applicable regulation(s)
25.331(c)(2)

Regulation(s) requiring an ELOS
25.331(c)(2) at Amendment 25-91

Description of compensating design features or alternative standards which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

In lieu of paragraph (c)(2) of § 25.331 "Symmetric maneuver loads," the following apply:

Checked maneuver between V_A and V_D. Nose up checked pitching maneuvers must be analyzed in which the positive limit load factor prescribed in § 25.337 is achieved. As a separate condition, nose down checked pitching maneuvers must be analyzed in which a limit load factor of 0g is achieved. In defining the airplane loads, the cockpit pitch control motions described in sub-paragraphs (1), (2), (3) and (4) below must be used:

(1) The airplane is assumed to be flying in steady level flight at any speed between V_A and V_D and the cockpit pitch control is moved in accordance with the following formula:

$\delta(t) = \delta_1 \sin(\omega t)$ for $0 \leq \omega t \leq t_{max}$

where—

δ_1 = the maximum available displacement of the cockpit pitch control in the initial direction, as limited by the control system stops, control surface stops, or by pilot effort in accordance with § 25.397(b);

$\delta(t)$ = the displacement of the cockpit pitch control as a function of time. In the initial direction $\delta(t)$ is limited to δ_1. In the reverse direction, $\delta(t)$ may be truncated at the maximum available displacement of the cockpit pitch control as limited by the control system stops, control surface stops, or by pilot effort in accordance with 25.397(b);

$t_{max} = 3\pi/2\omega$;

ω = the circular frequency (radians/second) of the control deflection taken equal to the undamped natural frequency of the short period rigid mode of the airplane, with active control system effects included where appropriate; but not less than: -

$\omega = \frac{\pi V}{2V_A}$ radians per second;

Where:

V = the speed of the airplane at entry to the maneuver.

V_A = the design maneuvering speed prescribed in § 25.335(c)

(2) For nose-up pitching maneuvers the complete cockpit pitch control displacement history may be scaled down in amplitude to the extent just necessary to ensure that the positive limit load factor prescribed in § 25.337 is not exceeded. For nose-down pitching maneuvers the complete cockpit control displacement history may be scaled down in amplitude to the extent just necessary to ensure that the normal acceleration at the c.g. does not go below 0g.

(3) In addition, for cases where the airplane response to the specified cockpit pitch control motion does not achieve the prescribed limit load factors then the following cockpit pitch control motion must be used:

$\delta(t) = \delta_1 \sin(\omega t)$ for $0 \leq t \leq t_1$

$\delta(t) = \delta_1$ for $t_1 \leq t \leq t_2$

$\delta(t) = \delta_1 \sin(\omega[t + t_1 - t_2])$ for $t_2 \leq t \leq t_{max}$

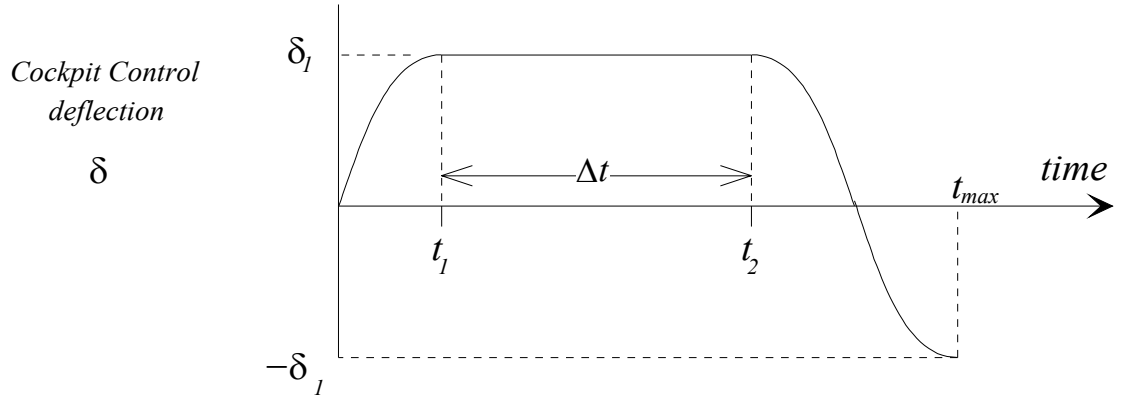
where—

$t_1 = \pi/2\omega$

$t_2 = t_1 + \Delta t$

$t_{max} = t_2 + \pi/\omega$;

Δt = the minimum period of time necessary to allow the prescribed limit load factor to be achieved in the initial direction, but it need not exceed five seconds (see figure below).



(4) In cases where the cockpit pitch control motion may be affected by inputs from systems (for example, by a stick pusher that can operate at high load factor as well as at 1g) then the effects of those systems shall be taken into account.

(5) Airplane loads that occur beyond the following times need not be considered:

(a) For the nose-up pitching maneuver, the time at which the normal acceleration at the c.g. goes below 0g;

(b) For the nose-down pitching maneuver, the time at which the normal acceleration at the c.g. goes above the positive limit load factor prescribed in § 25.337;

(c) t_{max}.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

The ARAC proposal provides a rational pitching maneuver that is related to the natural pitching characteristics of the particular airplane. The existing 25.331(c)(2) (at Amendment 25-91) prescribes fixed pitching accelerations irrespective of the size of the airplane and irrespective of its pitching characteristics. The proposed criteria will provide adequate design loads for the EMB-135BJ that will provide an equivalent or higher level of safety.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned Equivalent Level of Safety Finding in Issue Paper A-5. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number should be listed in the Type Certificate Data Sheet under the Certification Basis section (TC's & ATC's) or on page 3 of the STC Certificate. [E.g. Equivalent Safety Findings have been made for the following regulation(s): 25.331(c)(2) Symmetric maneuvering conditions (documented in TAD ELOS Memo No. AT5124AT-T-A-5)

Original signed by Franklin Tiangsing — 9/18/02

Manager, Airframe & Cabin Safety Branch, ANM-115 — Date

ELOS Originated by Atlanta ACO:	Program Manager: Carla Worthey	Routing Symbol ACE-118 A