Memorandum

U.S. Department
of Transportation

**Federal Aviation
Administration**

Subject: **ACTION**: Equivalent Level of Safety to § 23.145(b)(4); Aero Vodochody Ae 270; Finding No. ACE-05-13

Date: OCT 0 7 2005

From: Manager, Project Support, ACE-112

Reply to
Attn. of:

To: Manager, Small Airplane Directorate, ACE-100

This memorandum requests your office to review and provide concurrence with the proposed finding of equivalent level of safety to the Longitudinal Control requirements of § 23.145(b)(4) of 14 CFR, part 23.

BACKGROUND

The Aero Vodochody Ae 270 is an 8,377-pound single-engine, 10 place, airplane powered by an 850 shaft horsepower (SHP) Pratt &Whitney PT6-66A turboprop engine. Aero Vodochody was not able to meet literal compliance with 14 CFR Part 23, 23.145(b)(4) during the flight-testing of the Ae 270 airplane. Consequently, they have developed a proposed equivalent method of compliance to this regulation that will offer the same level of safety as provided by the rule. Aero Vodochody submitted the procedure to the CAA as a proposed Equivalent Level of Safety (ELOS) to this regulation and requested the Federal Aviation Administration (FAA) to give them credit for the system by accepting it as a safety equivalent to § 23.145(b)(4), Longitudinal Control.

APPLICABLE REGULATIONS

Section 23.145(b) requires that it must "...be possible to carry out the following maneuvers without requiring the application of single-handed control forces exceeding those specified in Sec. 23.143(c). The trimming controls must not be adjusted during the maneuvers." Additionally, § 23.145(b)(4) describes the flight conditions where the airplane must meet the requirements of (b). Those flight conditions are, "With power off, flaps and landing gear retracted and the airplane as nearly as possible in trim at $1.4V_{S1}$, apply takeoff power rapidly while maintaining the same airspeed."

REGULATIONS REQUIRING AN ELOS

In considering the current design, the applicant has requested an ELOS for one specific condition of the *Longitudinal Control* section of 14 CFR Part 23. The FAA has determined that an

appropriate level of safety can be provided by the issuance of an ELOS, in accordance with the provisions of 14 CFR, Part 21, § 21.21(b)(1).

DESCRIPTION OF COMPENSATING FEATURES

The non-compliance consists of exceeding the single-handed limit control forces only in situations when the airplane is loaded towards the forward C.G. position - 21 to 27% approximate.

Section 23.143 defines the limit for temporary pitch forces as 50 pounds. At the most forward C.G position (21%) the Ae 270, if not retrimmed during the maneuver in section 23.145(b)(4), will exceed the force limit by approximately 53% (26.2 lb). By simply retrimming the airplane with one move of the pitch trim handwheel, the control force during the maneuver is reduced below the maximum limit and safely controllable. Aero Vodochody proposes to amend the Aircraft Flight Manual (AFM) to include procedures for trimming the airplane in maneuvers similar to that required in § 23.143(b)(4)

Specific compensating features proposed by Aero Vodochody are:

1. Aero Vodochody proposes the following AFM language:

> ***An aborted descent*** *maneuver using maximum power and maintaining proper airspeed will result in a high nose-up pitch force requiring a strong push on the control wheel. To minimize this push force and allow for single-handed control of the airplane, apply a single nose down rotation of the trim wheel immediately after* ***moving the power control lever to the maximum power setting position.***

2. Aero Vodochody proposes to insert a "CAUTION" statement in the Amplified Procedure section of the AFM. This structure is based on the General Aviation Manufacturers Association (GAMA) 1 requirement (Section 4, Paragraph. 4.5. and / or 4.7.).

3. Additionally, the text introducing the aborted descent maneuver (before item #7) is changed to correspond with the wording of the "CAUTION" statement in the Amplified Procedures section as follows:

POWER-OFF DESCENT

1.	Switches on DE-ICE Panel.....	AS REQUIRED
2.	**PITOT** Switch.....	CHECK **ON**
3.	Propeller Control Lever	**MAX RPM**
4.	Power Control Lever.....	IDLE

5. Airspeed (trimmed)..... 110 – 120 KIAS

6. Cabin Altitude Selector..... Set field elevation + 500 ft
   Cabin Rate Control Selector..... AS REQUIRED

If an aborted descent maneuver while maintaining the same airspeed is required:

7. Power Control Lever..... TAKE-OFF POWER

8. Pitch Trim..... TRIM NOSE DOWN

9. M_K, ITT, n_g, n_p, oil pressure/temperature
(Max. values see Fig. 2-4).....CHECK

After reaching the positive climb gradient:

10. Airplane..... RETRIM

FAA POSITION

The language of the rule requires that the "trimming controls must not be adjusted during the maneuvers." Moreover, based on the preamble from the rule change document, the original intent of the temporary control forces was to allow time for the pilot to trim the forces, so they are manageable with one hand. Limiting the movement of the trim controls in amendment 23-14, for the maneuver in Federal Aviation Regulations (FAR) 23.145(b)(4), was based on the "Study of Control Force Limits for Female Pilots." The focus was on defining a minimum force where female pilots could maintain control the airplane over a sufficient time to trim out the high control forces. The study also points out the time duration that female pilots could hold the temporary forces. These durations were on the order of 30 to 40 seconds for a 50-pound one-hand force.

Historically, high-performance airplanes or airplanes with high horsepower to weight ratios had to be re-trimmed, when going from idle to full throttle to reduce the control forces to a reasonable level for the pilot. The Ae 270, equipped with an 850 shaft horsepower (SHP) turbine engine has the same high control force issue. The FAA observed during validation flight tests of the Ae 270 that control forces can be reduced to within the FAR requirement with a simple 1 to 2 second hand motion. The pilot can easily rotate the trim wheel several inches immediately after the application of maximum power. This small trim-wheel movement results in a pitch force much less than 50-pounds, therefore, allowing one-hand control within the required limits.

We believe that the nominal time the pilot is subjected to the high control forces (less than 10% of the study duration) and the ease at which the airplane can be re-trimmed (a fraction of one turn on the trim wheel), as well as requiring that this procedure be included in the AFM provides an equivalent level of safety to the pilot as intended by the rule.

RECOMMENDATION

The FAA recommends approval of the applicant's proposal.

CONCURRED BY

Manager, Project Support Office, ACE-112	Date 10/5/05
for Manager, Standards Office, ACE-110	Date 10-5-05
for Acting Manager, Small Airplane Directorate, ACE-100	Date 10/7/05