



U.S. Department
of Transportation
**Federal Aviation
Administration**

Memorandum

Subject: **ACTION:** Request for Review and Concurrence with Associated Equivalent Level of Safety (ELOS) ACE-00-08_g for the Extra EA-400 Airplane, 14 CFR 23.1143(g) and 23.1147(b)

Date:

From: Extra Project Officer, Project Support Branch, ACE-112

Reply to Karl Schletzbaum
Attn. of: (816) 329-4146

To: Manager, Small Airplane Directorate, ACE-100

This memorandum documents the concurrence for the subject ELOS. We request that your office review and concur with the proposed ELOS finding to the Engine Controls requirement of 14 CFR § 23.1143(g) and Mixture Controls, § 23.1147(b).

Background: The Extra EA-400 airplane is a T-Tail, high wing airplane fabricated almost completely of composite materials. It uses a Teledyne Continental (TCM) TSIOL-550-C reciprocating engine and conventional controls that are subject to the provisions of 14 CFR § 23.1143(g) and § 23.1147(b).

Applicable Regulations: The applicable regulations are 14 CFR § 23.1143(g) and § 23.1147(b), which state:

§ 23.1143(g): For reciprocating single-engine airplanes, each power or thrust control must be designed so that if the control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.

§ 23.1147(b): For reciprocating single-engine airplanes, each manual engine mixture control must be designed so that if the control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.

Applicant's Position:

Extra Flugzeugbau (Extra) desires to show compliance with paragraphs § 23.1143(g) and § 23.1147(b) by an ELOS. New requirements were added to 14 CFR Part 23 with Amendment 43. The intent of these requirements is to prevent accidents and incidents which are caused by the poor reliability of the powerplant control--fuel control unit (FCU) linkage, (see Notice of Proposed Rulemaking (NPRM) 90-23).

After considering the comments to this NPRM, the Federal Aviation Administration (FAA) withdrew requirements for a specific design (such as spring-loaded levers, back-up systems, etc.) as proposed in the NPRM. It also did not require that the power setting must maintain a level flight condition.

The Luftfahrt-Bundesamt of Germany (LBA) has required Extra to establish its position on the (ELOS) item regarding FAR § 23.1143 (g) and § 23.1147 (b). As justification for the (ELOS), a comparison between the proposed system and a spring loaded as well as back up system must be given.

Requirements for a spring loaded or back-up system for power and mixture controls were introduced in Part 23 Amendment 43. There were also discussions concerning similar requirements for Part 33, those however, were never introduced in the requirements. It was not considered possible to have a single acceptable setting, after separation of the control, (for power as well as mixture) to allow continued safe flight and landing, without a full authority digital engine control (FADEC) type system.

In a turbocharged engine on a high performance aircraft as the Extra EA-400, accurate control of both engine power and mixture is of great importance for proper engine operation as well as flight control. A full rich mixture setting does not assure proper engine running under all combinations of altitude and power settings. A full power descent would lead to a high risk of overspeed, with potentially catastrophic consequences. Contrary to a landing with simulated engine failure, a full power landing is not part of normal pilot training. Therefore, a safe landing under a full power condition can't be assumed.

A back-up system causes additional failure modes, greater complexity, increased maintenance effort and danger of incorrect or inadequate maintenance. A potential additional failure could be interference between primary and back-up system that causes jamming of the control with corresponding consequences.

The requirement finds its basis in reported accidents where the cause was a separated control. It is not unreasonable to assume that these were not primarily caused by improper design but due to inadequate maintenance. It is our opinion that a design with inherent safety features which is simple and easy to maintain is to be much preferred over a spring loaded or back-up system.

Inherent safety features of the proposed solution are described below:

<i>Failure mode</i>	<i>Safety feature</i>
Failed rod end ball bearing	Large outer diameter washer prevents control separation
Loose nut	Prevented by cotter pin
Failed cotter pin	Nut prevents control separation
Failed bolt	Bolt dimension such that bolt stress even at high control forces is extremely low.

Maintenance effort has to concentrate on the above items, which are easy to check and replace if necessary. Explicit inspection and replacement criteria will be established and incorporated in the maintenance manual, inspection of the control shall occur after each normal maintenance interval (50 hours). The following text is incorporated in the respective section of the maintenance manual (note that the procedure is not limited to throttle and mixture control, but also includes the propeller speed control):

"Inspect throttle, mixture and propeller governor controls for security, travel and operating conditions. Check bearings for condition, clearance and wear, replace if play more than 0.5 mm. Check cotter pins for security and condition. Replace if damaged or worn."

FAA Position:

The FAA concurs with the applicant's position, which is also the finding of the certifying authority, the Luftfahrt-Bundesamt (LBA) of Germany, and finds that the utilization of compensating features as presented by Extra, provide an ELOS to the requirements of 14 CFR § 23.1143(g) and § 23.1147(b).

Compensating Features: Extra has analyzed the failures associated with the control separation and has provided design features consisting of redundant retention devices, low attachment part stresses and prescribed maintenance, included in the instructions for continued airworthiness, that are considered compensating.

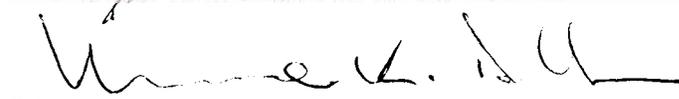
Recommendation: We concur that the Extra EA-400 proposed design of the engine and mixture controls attachments provide an Equivalent Level of Safety (ELOS) to 14 CFR § 23.1143(g) and § 23.1147(b).

Concurred by:



Manager, Project Support Branch, ACE-112

6/28/00
Date



Manager, Standards Office, ACE-110

6-28-00
Date



Manager, Small Airplane Directorate, ACE-100

6/29/00
Date