



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: **ACTION:** Equivalent Level of Safety of Grob Date: **DEC 29 1994**
G520T EGRETT, Accelerated Stall, Stall
Warning, and Spinning; Finding No. ACE-95-2

From: Manager, Brussels Aircraft Certification Office, AEU-100
Reply to
Attn. of:

To: Manager, Small Airplane Directorate,
Aircraft Certification Service, ACE-100

Background:

Burkhart Grob, Luft-und Raumfahrt, GmbH & Co. KG, manufacturer of the EGRETT Model G520T airplane requested consideration for the compensating factors of a stick shaker/pusher system for demonstrating compliance with the requirements of 14 CFR § 23.221 in accordance with the provisions of § 21.21(b)(1).

The G520T is a dual seat version of the G520, a high aspect ratio, high altitude, pressurized, mid-wing monoplane with tricycle landing gear, which is unique to Part 23 airplanes in that normal operational altitudes extend up to 50,000 feet. The G520T utilizes composite materials for its structure and is powered by a turbopropeller engine. The maximum gross weight is 10,362 pounds.

Applicable Regulations:

The applicable Federal Aviation Regulations (FAR), in effect with the certification basis (amendment 23-34), state in brief:

Section 23.221 requires that a single-engine airplane must demonstrate compliance with a one-turn spin requirement. The airplane must recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn after the controls have been applied for recovery. This should be demonstrated for all configurations.

Applicant's Position:

A rational analysis showed that above approximately Flight Level 250 the operating limits can be expected to be exceeded

during recovery from a spin. Grob proposed to install a stick shaker/pusher system instead of the required spin tests. The system is designed in such a way that a stall, and consequently the entry into a spin, is safely prevented at all attitudes and altitudes. LBA required a margin between aerodynamic stall and stick pusher onset of at least two knots.

Summary:

It is the intent of the Federal Aviation Regulations that only safe aircraft are type certificated. It has been demonstrated by flight tests and rational analysis that the G520T is safe and reliable and meets the intent of the regulatory spin requirements by an equivalent level of safety with a stick shaker/pusher system.

The G520T does not directly meet § 23.221. Instead of the requirements of § 23.221, the G520T is equipped with a stick shaker/pusher system. The system is designed in such a way that a stall, and consequently the entry into a spin, is safely prevented at all attitudes and altitudes. The stick shaker/pusher system offers the following compensating features:

1. Two (Angle-of-Attack) AOA computers are provided working in the fail-safe mode.
2. The Angle-of-Attack (AOA) system provides a failure monitoring output to a warning light if discrepancies in the following circuits exist:
 - AOA potentiometer
 - AOA heater
 - Flap position switch
 - Stick pusher
 - Power input
3. The AOA system is designed in such a way that a single failure would not result in an unwanted operation of the stick pusher at a highly improbable degree.
4. The reliability of the complete AOA system is 10^{-7} (as per NPA 25B-154). A fault tree safety analysis was performed to show compliance with this paragraph. The results of this analysis are contained in the GROB report FA12, "Failure Analysis Stick Pusher System", dated 11 Sept. 1991.
5. A stall warning light and horn is provided.

6. In addition a stick shaker will announce the possibility of a stall with acceptable speed margins.

7. A stick pusher will define the stall speeds with an adequate safety margin above the aerodynamic stall speeds at c.g.'s beyond 24% MAC. The pusher onset is not normally attainable at c.g.'s less than 24% MAC as the stall is characterized by elevator limited minimum speeds. Therefore, entries into an aerodynamic stall would be even more unlikely.

8. A press to test button is provided for both AOA computers. This device activates the stick shaker, the stall warning light and horn when the aircraft is on the ground or in the air and the stick pusher when on the ground only.

9. All warning indications are routed to the aircraft battery bus. This will ensure operation of the stick shaker/pusher system in the event of complete AC/DC loss.

Furthermore,

10. The G520 Pilot's Operating Handbook will give the pilot information about the system and what actions to perform in case of failure indication.

11. The stick pusher system will meet the requirements of DO-160C.

12. The G520T high altitude research airplane may only be flown by qualified and trained pilots having a type rating for this aircraft. The training will include a detailed introduction to the stick pusher system.

13. The stick pusher force was adjusted according to NPA 25B-154 to 60 pounds.

FAA's Position:

The G520T stick shaker/pusher installation is unique because its purpose is not to compensate for unacceptable stall characteristics. The G520T met all stall characteristic requirements without the stick shaker/pusher system. Typically, these systems are installed in airplanes to prevent the pilot from reaching the stall because, in one or more configurations, the airplanes exhibit characteristics that do not meet the Part 23 requirements. Grob chose to use a stick shaker/pusher system only because analysis showed that a spin at altitudes approaching 25,000 feet would result in exceeding structural limits during recovery.

Grob's request is to use the stick pusher to provide relief from the spin requirement in § 23.221 on the basis that the system provides a stall barrier. This is analogous to current airplanes using stick pusher systems to prevent entry into a deep stall or a post stall flight condition that may be unrecoverable. Field experience has justified that stick pushers provide at least the level of safety that the stall requirements provide.

A type rating is considered a prerequisite for safe operation of the G520T. This requirement is based on the specialized training needed to conduct operations for which the G520T was designed. The airplane is essentially a high powered, heavy glider that is already unique for Part 23, but the high altitude capability and numerous complex systems add training concerns/requirements that are best met with a type rating.

A flight test evaluation was conducted to determine if the stick pusher onset rate and force were acceptable. Also, compliance with §§ 23.201, 23.203 and 23.207 was confirmed. Additionally, abused or delayed stalls were evaluated by demonstrations with the airplane in uncoordinated flight, corresponding to one ball width displacement on a slip-skid indicator. It was determined that the pusher operated with sufficient authority that the possibility of a pilot inadvertently holding the controls against the pusher was unlikely. Furthermore, the abused/delayed stall flight test demonstrations exhibited no adverse characteristics likely to promote spin tendencies.

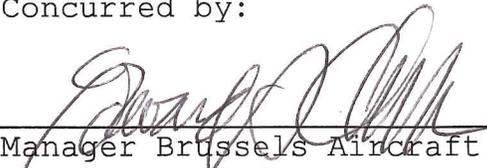
RECOMMENDATION:

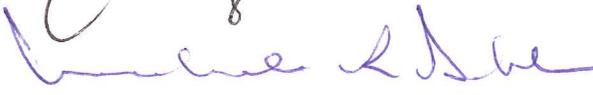
We concur with Grob and LBA that the stick shaker/pusher system is acceptable as a stall barrier for showing an equivalent level of safety for the spin requirement by preventing an inadvertent aerodynamic stall, thus preventing a spin entry.

The stick shaker/pusher installation on the G520T provides an equivalent level of safety to § 23.221 subject to the following item that is in addition to the compensating features 1-13 listed by Grob in this document.

- o In order to prevent inadvertent entry to an aerodynamic stall, the stick shaker/pusher production tolerances must protect the minimum two knots margin between the aerodynamic stall and stick pusher speed.

Concurred by:

 Spring Manager AEU-100 12/21/94
Manager Brussels Aircraft Certification Office, AEU-100 Date

 12/28/94
Manager Standards Office, ACE-110 Date

 12-29-94
for Barry Clements Date
Aircraft Certification Service,
Small Airplane Directorate