



Federal Aviation Administration

Memorandum

Date: March 16, 2012

To: Manager, Small Airplane Directorate, ACE-100

From: Manager, Project Support Branch, ACE-112

Prepared by: Jim Rutherford, Aerospace Engineer, Project Support, ACE-112

Subject: Equivalent Level of Safety (ELOS) Finding to JAR 22.207(c), Change 5, for Schempp-Hirth's Model DuoDiscus-xL, FAA Project # AT00366CE-G

ELOS Memo#: ACE-11-14

Regulatory Ref: JAR 22.207(c)

This memorandum requests your office to review and provide concurrence with the proposed finding of an Equivalent Level of Safety (ELOS) for the stall warning initiation regulation of Joint Airworthiness Requirements (JAR) 22.207(c).

Background

The Schempp-Hirth Model "DuoDiscus" is a two-seat, mid-wing, non-powered sailplane certified in the utility category and used for advanced training and cross-country flying. The sailplane is constructed from carbon and glass fiber reinforced plastic (CFRP/GFRP) and features a T-tail with a fixed horizontal stabilizer and moveable elevator. The sales model variant DuoDiscus-xL incorporates Schempp-Hirth Modification Bulletin Number 396-16, which has the following design features:

- Elongation of the front part of the fuselage (approximately 4 inches).
- Redesign of the cockpit area (elongated control rods, modified water ballast valve actuation and lever location, and some cosmetic changes to coverings).
- Installation of battery mounting in the vertical fin to compensate for the nose heavy moment of the forward fuselage elongation.
- Modification to the Schempp-Hirth airbrakes to improve their efficiency (moved forward approximately 2.4 inches and increased height by approximately 0.3 inches)
- Increase maximum weight by 110 lbs. (50 kg) to a total 1,654 lbs. (750 kg).

Schempp-Hirth seeks an ELOS finding based on non-compliance to the stall warning initiation regulation found in Joint Airworthiness Requirements (JAR) 22.207(c), Change 5, effective October 28, 1995. With the Center of Gravity (CG) in the aftmost position, the Model DuoDiscus-xL stall warning speed nearly always begins at a speed higher than the $1.1 V_{SI}$ limit. The European Aviation Safety Agency (EASA) has granted an ELOS Finding to JAR 22.207(c) during its certification. This is documented in the EASA Type Certificate Data Sheet (TCDS) Number A.025.

Applicable regulation

JAR 22.207(c)

Regulation requiring an ELOS finding

The applicable regulation is JAR 22.207, Change 5, which states:

- (a) There must be a clear and distinctive stall warning with air brakes, wing-flaps and landing gear in any normal position, both in straight and in turning flight. In the case of a powered sailplane, compliance with this requirement must also be shown with the engine running in the conditions prescribed in JAR 22.201(f)(5).*
 - (b) The stall warning may be furnished either through the inherent aerodynamic qualities of the sailplane (e.g. buffeting), or by a device that will give clearly distinguishable indications.*
- IEM 22.207(b)*
A visual stall warning alone is not acceptable.
- (c) **The stall warning must begin at a speed between $1.05 V_{SI}$ and $1.1 V_{SI}$ and must continue until the stall occurs.***
 - (d) A sailplane which does not give warning of the approach of the stall may, however, be acceptable provided that when a stall occurs from straight flight:*
 - (1) It is possible to produce and correct roll by using the ailerons, the rudder being held neutral; and*
 - (2) No appreciable wing dropping occurs when both ailerons and rudder are held neutral.*

Schempp-Hirth seeks an ELOS finding based on non-compliance with paragraph (c) of this regulation.

Description of Compensating Design Features

The DuoDiscus-xL glider was flight tested for compliance to the requirements of JAR 22.201 (Wings Level Stall) and JAR 22.207 (Stall Warning) at 1376 lbs. (624 kg) and 1654 lbs. (750 kg) maximum weight and at both forward and aft CG limits. The glider has two pitot systems. There is one set of static ports located on the side of the fuselage aft of the wing. Errors in the indicated airspeed (IAS) caused by pitot/static pressure errors are accounted for in the calibration data provided in the Aircraft Flight Manual. Schempp-Hirth has provided the following analysis as justification for the proposed ELOS.

Indicated airspeed in the speed range of stall warning and the aerodynamic stall can show speed oscillations, because of the high angle of attack at the pitot tube and flow separation around the static ports. Per the rule, the stall warning range for this glider is only about 3 knots wide and the warning is only about 3 knots above the aerodynamic stall. The airspeed indicator scale is readable to the knot, but the needle movement may not be steady. JAR 22.207(d) of the stall warning rule provides for situations, where the stall warning window is not met by requiring easily controllable stall characteristics.

Schempp-Hirth provided Table 1, shown in Attachment 1, which is DuoDiscus-xL stall warning data related to JAR 22.207(c) at several weights, C.G.s, and flight configurations. In straight and turning flight there is a clear and distinctive stall warning with airbrakes and landing gear in any normal position. The stall warning is produced through the aerodynamic qualities of the sailplane. It starts with slight vibrations in the airframe and controls. These vibrations increase when approaching the stalling speed and the ailerons become less responsive.

Schempp-Hirth contends that with the C.G. in the aftmost position, the stall warning begins at a speed higher than $1.1 V_{S1}$ IAS, because the pitot pressure is influenced by the wake of the fuselage and the IAS-values drop quickly to lower values. The stall warning continues until the stall occurs. Although the stall warning starts at a speed higher than $1.1 V_{S1}$ IAS, this behavior can be accepted as an ELOS, because the IAS values drop quickly to lower values and gives the pilot a very good indication about the coming stall.

In addition, when the C.G. position is in the foremost position, the stalling from straight flight is covered by JAR 22.207(d). This is due to the fact that it is possible to produce and correct rolling motions by using the ailerons, with the rudder being held neutral. Also, there is no occurrence of wing dropping when both the ailerons and rudder are held neutral. Therefore, no stall warning is necessary in this configuration.

Explanation of Compensating Design Features

The Schempp-Hirth position is that the DuoDiscus-xL complies with the stall warning requirements of JAR 22.207(c) at most weights and C.G.s and flight configurations. For the conditions where the requirements are not met, the glider provides an acceptable indication to the pilot by the quick reduction in the IAS value and by it meeting the requirements of JAR 22.207(d). For these reasons, Schempp-Hirth requests that an ELOS to JAR 22.207(c) be granted.

The EASA (LBA) verified and accepted the noted flight characteristics of the sailplane during certification test flights. Therefore, they concur with the Schempp-Hirth position.

After reviewing the submitted data and analysis, the FAA concurs with the Schempp-Hirth and EASA (LBA) positions on this issue. The basis of this ELOS Memorandum was developed from the FAA Issue Paper F-2 at Stage 4, which documented the agreement with EASA (LBA) and Schempp-Hirth.

FAA Approval of the ELOS Finding

The Small Airplane Directorate concurs with the requested ELOS for the Schempp-Hirth model DuoDiscus-xL sailplane finding to JAR 22.207(c), Change 5, and stall warning initiation regulation.

James E. Jackson

 for Manager, Small Airplane Directorate,
 Aircraft Certification Service

3-16-12

 Date

ELOS Originated by: Project Support: ACE-112	Manager, Project Support Branch: William J. Timberlake	Routing Symbol: ACE-112
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ATTACHMENT 1**Data supplied by Schempp-Hirth:**

Table 1
Model DuoDiscus-xL Stall Speed Data Related to JAR 22.207(c)

Weight	750 kg (1654 lb)		750 (1654 lb)		624 kg (1376 lb)	
C.G. aft of datum	49 mm (1.93 inches)		250 mm (9.84 inches)		250 mm (9.84 inches)	
Airbrakes	Retracted	Extended	Retracted	Extended	Retracted	Extended
Landing Gear	Retracted	Extended	Retracted	Extended	Retracted	Extended
Stalling Speed V_{S1} IAS	72 km/h (39 knots)	72 km/h (39 knots)	60 km/h (32 knots)	61 km/h (33 knots)	55 km/h (30 knots)	55 km/h (30 knots)
Start of Stall Warning V_{SW}	no stall warning		72 km/h (39 knots)	73 km/h (39 knots)	60 km/h (32 knots)	61 km/h (33 knots)
1.05 V_{S1} IAS	76 km/h (41 knots)	76 km/h (42 knots)	63 km/h (34 knots)	64 km/h (35 knots)	58 km/h (31 knots)	58 km/h (32 knots)
1.10 V_{S1} IAS	79 km/h (43 knots)	79 km/h (43 knots)	66 km/h (36 knots)	67 km/h (36 knots)	61 km/h (33 knots)	61 km/h (33 knots)
	Complies to JAR 22.207 d)		ELOS to JAR 22.207 c)		Complies to JAR 22.207 c)	

JAR 22.207(c)

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(MB 396-16)\ELOS Memos\ELOS Memo – F-2 – Stall Warning.doc