



Federal Aviation Administration

Memorandum

Date: October 8, 2008

From: Manager, Project Support Branch, ACE-112

To: Manager, Small Airplane Directorate, ACE-100

Prepared by: Greg Davison, Aerospace Engineer, ACE-112

Subject: Review and Concurrence, Equivalent Level of Safety (ELOS) to Joint Aviation Regulations (JAR) 22.207, Amendment 4, "Stall Warning" for the Schempp-Hirth Discus 2cT Powered Glider, [ACE-08-17](#)

This memorandum documents concurrence for the subject finding of an ELOS. We request your office to review and concur with the proposed ELOS finding to JAR 22.207(c), Amendment 4, "Stall Warning." The proposed ELOS will allow for the compliance to the regulation to be accomplished based on the inherent quick drop in the indicated airspeed which gives the pilot good information about the approaching stall.

Background:

The Discus-2cT is a single-seat, high performance sailplane constructed from CFRP, GFRP, and AFRP, in a T-tail configuration. It is equipped with a retractable two-stroke SOLO model 2350 engine and fixed pitch, multi-blade propeller. It does not have self-launching capability, nor does the engine have the ability for throttle control. It is a variant of the Discus bT, which is not type-certificated in the U.S. It can be flown in 15m or 18m configurations. It is certificated by the European Aviation Safety Agency (EASA) to operate in the Utility category under EASA Type Certificate Data Sheet (TCDS) number A.050, Issue 1, dated September 16, 2005.

Applicable Regulation:

The applicable regulation is JAR 22.207, Amendment 4, which states:

JAR 22.207: Stall warning

- (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. A visual stall warning alone is not acceptable.
- (c) The stall warning must begin at a speed between $1.05 V_{S1}$ and $1.1 V_{S1}$ 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 has sought an ELOS based on non-compliance with paragraphs (a) and (c) of this regulation.

Basis for ELOS:**Schempp-Hirth's Position:**

In the table below, the various configurations of the Discus-2c/Discus-2cT are summarized.

Overview of configurations and where an ELOS is used:

wing span	State of engine	C.G. Position	22.207 (a)	22.207 (c)	22.207 (d)
18m	retracted	foremost	Not applicable	Not applicable	Is met, (page 0.2.171 D2c 18m)
18m	retracted	rearmost	Is met, (page 0.2.171 D2c 18m)	ELOS No. 1, (page 0.2.171 D2c 18m)	Not applicable
18m	Extended, running	foremost	Not applicable	Not applicable	Is met (page 0.2.137 D2cT 18m)
18m	Extended, running	rearmost	Is met (page 0.2.137 D2cT 18m)	Is met (page 0.2.137 D2cT 18m)	Not applicable
18m	Extended, ignition off	foremost	Not applicable	Not applicable	Is met (in the FTR not explicitly stated only in turning flight stalls on page 0.2.136 D2cT 18m)
18m	Extended, ignition off	rearmost	ELOS No 2, (page 0.2.137 D2cT 18m)	Not applicable	Not applicable
15m	retracted	foremost	Not applicable	Not applicable	Is met, (page 0.2.220 D2c 15m)
15m	retracted	rearmost	Is met, (page 0.2.220 D2c 15m)	ELOS No. 3, (page 0.2.220 D2c 15m)	Not applicable
15m	Extended, running	foremost	Not applicable	Not applicable	Is met, (page 0.2.179 D2cT 15m)
15m	Extended, running	rearmost	Is met (page 0.2.179 D2cT 15m)	Is met (page 0.2.179 D2cT 15m)	Not applicable
15m	Extended, ignition off	foremost	Not applicable	Not applicable	Is met (in the FTR not explicitly stated only in turning flight stalls on page 0.2.178 D2cT 15m)
15m	Extended, ignition off	rearmost	ELOS No.4, (page 0.2.179 D2cT 15m)	Not applicable	Not applicable

Where “Not applicable” is shown, this means if JAR 22.207(d) is met, then JAR 22.207(a) and (c) can be ignored and if JAR 22.207(a) and (c) are met, then JAR 22.207(d) can be ignored.

An ELOS was introduced for four configurations and these are identified in the table as ELOS No. 1 through 4. Each ELOS is explained in the following Substantiation Reports:

ELOS No. 1: Substantiation Report page 0.2.171
 ELOS No. 2: Substantiation Report page 0.2.137
 ELOS No. 3: Substantiation Report page 0.2.220
 ELOS No. 4: Substantiation Report page 0.2.179.

ELOS No. 1 and ELOS No. 3 for JAR 22.207(c) have exactly the same content because the situation is the same with the 18m and 15m wingspan. ELOS No. 2 and ELOS No. 4 for JAR 22.207(a) have the same content with the 18m and 15m wingspan.

ELOS No. 1 and ELOS No. 3 for JAR 22.207(c):

This ELOS is very often used in most of our modern gliders. The Discus-2cT has two pitot systems. With the engine retracted the tail-mounted pitot is used. With the engine extended, a nose-mounted pitot is used. With the powerplant extended, the pitot pressure must be switched to the probe in the fuselage nose (explained in Flight Manual). Close to the stall, the wake of the fuselage and the wing-fuselage intersection hits the pitot pressure probe in the fin. In this flight condition, there is substantial error in the airspeed indicator. The reading is smaller than the CAS and the indicator is unsteady. Close to the stall, the error is larger than at the beginning of the stall warning. Therefore, if we state the beginning of the stall warning in IAS and reference it to the stall speed in IAS, there will be a lagging factor between the two values (in the case of the Discus-2c, the factor is greater than 1.1) when compared to a procedure where CAS is used for both values.

ELOS No. 1 and No. 3 states that the unsteady ASI near the stall and the substantial drop of the indicator to lower values gives the pilot a good indication about the approaching stall. This indication is in addition to the stall warning described in JAR 22.207(a). All together, this gives a safety level which is even higher than the requirement.

ELOS No. 2 and ELOS No. 4 for JAR 22.207(a):

With the engine extended, the pitot probe located in the fuselage nose is used. In this configuration and with the ignition off, there is a noticeable rocking motion of the airframe due to the extended powerplant in the airstream. This motion is present not only in the range where a stall warning should be present but also at higher airspeeds. The stall warning of the sailplane configuration as described in the corresponding Substantiation Report is superimposed by the rocking motion due to the extended powerplant. Therefore, the stall warning is minimal with the powerplant extended and ignition off (with ignition on, the situation is completely different and the stall warning is noticeable.)

ELOS No. 2 and No. 4 states that this behavior is acceptable because an approach with the powerplant extended is not provided. When the engine is shut down, it is only a short duration

where flight is at relatively low speed with the powerplant still extended and normally, the altitude is high enough that a stall would not be a safety concern. On the other hand, when the engine needs to be started after powerplant extension, the pilot must fly far faster than the stall speed to start the engine by the wing-milling effect (apart from a decompression handle, the engine has no starter device).

It is noted that flying with the landing gear extended has no influence on the stall warning nor the stall behavior.

SCHEMPF-HIRTH Flugzeugbau GmbH. Kirchheim/Teck	- SUBSTANTIATION REPORT -		Blatt:
	Typ: Discus 2c 18m	Geräte-Nr.: 360	0.2.171
JAR 22.207			
<p><u>22.207</u> <u>Stall warning</u></p> <p>(a) In straight and turning flight there is a clear and distinctive stall warning with airbrakes and landing gear in any normal position.</p> <p>(b) The stall warning is produced through the aerodynamic qualities of the sailplane. The stall warning starts with slight vibrations in the airframe and the controls. These vibrations increase when approaching the stalling speed and the ailerons become less responsive.</p> <p>(c) With the C.G. in aftmost position the stall warning begins at a speed higher than $1,1 \cdot V_{S1}$ (IAS) (see JAR 22.201 (f)) because the pitot pressure is influenced by the wake of the fuselage and the IAS-values drop to lower values. The stall warning continues until the stall occurs. With foremost C.G. position mostly the same warning characteristics were found, nevertheless for foremost C.G. position see JAR 22.207 (d). For quantitative results see page 0.2.168.</p> <p><u>Equal level of safety</u> Although the stall warning starts at a speed higher than $1,1 \cdot V_{S1}$ (IAS) this behaviour can be accepted because the IAS-values drop quickly to lower values and give the pilot a very good information about the coming stall.</p> <p>(d) With the C.G. in foremost position and stalling from straight flight: (1) it is possible to produce and correct rolling motions by using the ailerons, the rudder being held neutral. (2) No wing dropping occurs when ailerons and rudder are held neutral. Therefore no stall warning is necessary in this configuration.</p>			
Bearbeiter:	<i>Krauter</i>	Musterprüfer:	<i>T. Weidner</i>
Datum:	<i>17.02.05</i>	Datum:	<i>18.2.2005</i>

Schempp-Hirth Flugzeugbau GmbH Kirchheim/Teck	- SUBSTANTIATION REPORT -		Blatt:
	Typ: Discus 2cT	Geräte-Nr.: 863	0.2.137
JAR 22.207			
<p><u>22.207</u> <u>Stall warning</u></p> <p style="text-align: center;"><u>Power plant retracted</u></p> <p>(a)-(d) The results of FTR Discus-2c page 0.2.168 and 0.2.171 are applicable.</p> <p style="text-align: center;"><u>Power plant extended and engine running</u></p> <p>(a) The stall warning of the sailplane configuration by vibrations in the controls is superimposed from the engine vibrations and the propeller wake on the tail of the powered sailplane. With the C.G. in aftmost position the noise and vibrations of the power plant (at maximum power) increase with the beginning of the stall. The ailerons become spongy and continue spongy until the stall.</p> <p>(b) The stall warning is produced through the aerodynamic qualities of the powered sailplane and the power plant.</p> <p>(c) With the C.G. in aftmost position (see JAR 22.201 (f)) the stall warning begins at a speed between $1,05 \cdot V_{S1}$ and $1,1 \cdot V_{S1}$. The stall warning continues until the stall occurs. With the C.G. in foremost position this requirement is not met. Therefore refer to 22.207 (d).</p> <p>(d) With the C.G. in foremost position and stalling from straight flight:</p> <p>(1) It is possible to produce and correct rolling motions by using the ailerons, the rudder being held neutral.</p> <p>(2) No wing drooping occurs when ailerons and rudder are held neutral.</p> <p>Therefore this behaviour is acceptable.</p> <p><u>Note: Equal level of safety:</u> <u>Power plant extended and ignition off:</u> With extended power plant and ignition off the beginning stall warning of the sailplane configuration is superimposed by the rocking due to the extended power plant in the airstream. Therefore with extended power plant JAR 22.207 is only met with engine running. In this case additional adequate vibrations and noise start in the required speed range, see JAR 22.201(f) page 0.2.38. Therefore approach with extended power plant is not provided. It is only an emergency procedure.</p>			
Bearbeiter:	<i>Krauter</i>	Musterprüfer:	<i>Freitag</i>
Datum:	<i>08.04.05</i>	Datum:	<i>8.04.2005</i>

SCHEMPP-HIRTH Flugzeugbau GmbH. Kirchheim/Teck	- SUBSTANTIATION REPORT -		Blatt: 0.2.220
	Typ: Discus 2c 15m	Geräte-Nr.: 360	
JAR 22.207			
<p><u>22.207</u> Stall warning</p> <p>(a) In straight and turning flight there is a clear and distinctive stall warning with airbrakes and landing gear in any normal position.</p> <p>(b) The stall warning is produced through the aerodynamic qualities of the sailplane. The stall warning starts with slight vibrations in the airframe and the controls. These vibrations increase when approaching the stalling speed and the ailerons become less responsive.</p> <p>(c) With the C.G. in aftmost position the stall warning begins sometimes at a speed higher than $1,1 \cdot V_{S1}$ (IAS) (see JAR 22.201 (f)) because the pitot pressure is influenced by the wake of the fuselage and the IAS-values drop to lower values. The stall warning continues until the stall occurs. With foremost C.G. position similar warning characteristics were found, nevertheless for foremost C.G. position see JAR 22.207 (d). For quantitative results see page 0.2.218.</p> <p><u>Equal level of safety</u> Although the stall warning starts at a speed higher than $1,1 \cdot V_{S1}$ (IAS) this behaviour can be accepted because the IAS-values drop quickly to lower values and give the pilot a very good information about the coming stall.</p> <p>(d) With the C.G. in foremost position and stalling from straight flight: (1) It is possible to produce and correct rolling motions by using the ailerons, the rudder being held neutral. (2) No wing dropping occurs when ailerons and rudder are held neutral. Therefore no stall warning is necessary in this configuration.</p>			
Bearbeiter:	<i>Krauder</i>	Musterprüfer:	<i>T. ...</i>
Datum:	<i>30.03.05</i>	Datum:	<i>30.03.2005</i>

Schempp-Hirth Flugzeugbau GmbH Kirchheim/Teck	- SUBSTANTIATION REPORT -		Blatt:
	Typ: Discus 2cT 15m	Geräte-Nr.: 863	0.2.196 473
JAR 22.207			
<p>22.207 <u>Stall warning</u></p> <p style="padding-left: 40px;"><u>Power plant retracted</u></p> <p>(a)-(d) The results of FTR Discus-2c 15m page 0.2.220 and 0.2.217 are applicable.</p> <p style="padding-left: 40px;"><u>Power plant extended and engine running</u></p> <p>(a) The stall warning of the sailplane configuration by vibrations in the controls is superimposed from the engine vibrations and the propeller wake on the tail of the powered sailplane. With the C.G. in aftmost position the noise and vibrations of the power plant (at maximum power) increase with the beginning of the stall. The ailerons become spongy and continue spongy until the stall.</p> <p>(b) The stall warning is produced through the aerodynamic qualities of the powered sailplane and the power plant.</p> <p>(c) With the C.G. in aftmost position (see JAR 22.201 (f)) the stall warning begins at a speed between $1,05 * V_{S1}$ and $1,1 * V_{S1}$. The stall warning continues until the stall occurs. With the C.G. in foremost position this requirement is not met. Therefore refer to 22.207 (d).</p> <p>(d) With the C.G. in foremost position and stalling from straight flight:</p> <p>(1) It is possible to produce and correct rolling motions by using the ailerons, the rudder being held neutral.</p> <p>(2) No wing dropping occurs when ailerons and rudder are held neutral. Therefore this behaviour is acceptable.</p> <p>Note: <u>Equal level of safety.</u> <u>Power plant extended and ignition off.</u> With extended power plant and ignition off the beginning stall warning of the sailplane configuration is superimposed by the rocking due to the extended power plant in the airstream. Therefore with extended power plant JAR 22.207 is only met with engine running. In this case additional adequate vibrations and noise start in the required speed range, see JAR 22.201(f) page 0.2.38, 197. Therefore approach with extended power plant is not provided. It is only an emergency procedure.</p>			
Bearbeiter:	<i>Wander</i>	Musterprüfer:	<i>T. Weber</i>
Datum:	<i>19.04.05</i>	Datum:	<i>19.04.2005</i>

Schempp-Hirth's Position:

See attached duplicate page 9 which has been signed by Schempp-Hirth.

LBA's Position:

See attached duplicate page 10 which has been signed by the LBA.

FAA's Position:

We concur with the findings of the LBA that Schempp-Hirth has established an ELOS to JAR 22.207(a) and (c) for the Discus-2cT motorglider.

Concurred by:

William J. Timberlake
Manager, Project Support Branch, ACE-112

9-16-08
Date

Patrick R. Mullen for
Acting Manager, Standards Office, ACE-110

10-7-08
Date

Kim Smith
Manager, Small Airplane Directorate, ACE-100

10-7-08
Date