



# Federal Aviation Administration

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## Memorandum

Date: October 15, 2009

To: Manager, Small Airplane Directorate, ACE-100

From: Manager, Project Support Branch, ACE-112

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 2c Glider

ELOS Memo#: ACE-09-09

Regulatory ref: Joint Aviation Regulations (JAR) 22.207

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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."

### **References:**

The proposed ELOS will allow compliance to the regulation to be accomplished based on the inherent quick drop in the indicated airspeed and aerodynamic buffeting, which precedes the stall event. These indicators give the pilot accurate information about the approaching stall.

### **Background:**

The Discus-2c is a single-seat, high-performance sailplane constructed from CFRP and AFRP, in a T-tail configuration. It is a variant of the Discus-2a/-2b, which operates in the U.S. under Federal Aviation Administration (FAA) Type Certificate Data Sheet (TCDS) No. G17CE. 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 TCDS No. A.049, Issue 1, dated September 16, 2005.

Schempp-Hirth has incorporated the following changes to the Discus-2a/-2b type design (TD) to establish the Discus-2c:

- Modified wing planform to include an 18m version
- Lengthened elevator to suit the 18m wings

- Cockpit reinforcement of the canopy frame and sidewalls
- Increased MTOW (18m version)

### **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 paragraph (c) of this regulation.

### **Basis for ELOS:**

#### Schempp-Hirth's Position:

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

Overview of configurations and where an ELOS is used:

<b>Wing span</b>	<b>C.G. Position</b>	<b>22.207(a)</b>	<b>22.207(c)</b>	<b>22.207(d)</b>
18m	Foremost	Not applicable	Not applicable	Is met (page 0.2.171 D2c 18m)
18m	Rearmost	Is met (page 0.2.171 D2c 18m)	ELOS No. 1 (page 0.2.171 D2c 18m)	Not applicable

15m	Foremost	Not applicable	Not applicable	Is met (page 0.2.220 D2c 15m)
15m	Rearmost	Is met (page 0.2.220 D2c 15m)	ELOS No. 3 (page 0.2.220 D2c 15m)	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 and ELOS No. 3. Each ELOS is explained in the following Substantiation Reports:

ELOS No. 1: Substantiation Report page 0.2.171

ELOS No. 3: Substantiation Report page 0.2.220

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

This ELOS is often used in most of our modern gliders. 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 calibrated air speed (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 indicated air speed (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 Air Speed Indicator (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.

Flying with the landing gear extended has no influence on either the stall warning or 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 <math>1,1 \cdot V_{S1}</math> (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 <math>1,1 \cdot V_{S1}</math> (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>

SCHEMP-HIRTH Flugzeugbau GmbH. Kirchheim/Teck	- SUBSTANTIATION REPORT -						Blatt:
	Typ: Discus 2c 18m		Geräte-Nr.: 360				0.2.168
JAR 22.201							
22.201 (continued)							
(f) Stalling speeds							
Weight (kg)	565		359		564		
C.G. aft of datum (mm)	283		433		387		
Airbrakes	re-tracted	ex-tended	re-tracted	ex-tended	re-tracted	ex-tended	
Landing gear	re-tracted	ex-tended	re-tracted	ex-tended	re-tracted	ex-tended	
Stalling speed $V_{S1,IAS}$ * [km/h IAS]	75	80	56	58	67	69	
Start of stall warning $V_{SW,IAS}$ * [km/h IAS]	85	90	65	70	76	82	JAR 22.207 (c)
1,05 $V_{S1}$ [km/h IAS]	79	84	69	61	70	72	
1,10 $V_{S1}$ [km/h IAS]	83	88	62	64	74	76	
<p>* Note 1: IAS-values near the stall drop to a low value and oscillate because pitot pressure is influenced by the wake of the fuselage. Therefore the above stated values are average values of the ASI reading and are averaged over several attempts. Also slight pitching motions with corresponding variations in the airspeed can occur.</p>							
Bearbeiter:	<i>K. Müller</i>			Musterprüfer:			<i>T. Müller</i>
Datum:	77.02.05			Datum:			18.2.2005

SCHEMP-HIRTH Flugzeugbau GmbH, Kirchheim/Teck	- SUBSTANTIATION REPORT -		Blatt:
	Typ: <b>Discus 2c.15m</b>	Geräte-Nr.: <b>360</b>	<b>0.2.220</b>
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 sometimes at a speed higher than <math>1,1 \cdot V_{st}</math> (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 <del>0.2.216</del> 0.2.217</p> <p><u>Equal level of safety</u> Although the stall warning starts at a speed higher than <math>1,1 \cdot V_{st}</math> (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 drooping occurs when ailerons and rudder are held neutral. Therefore no stall warning is necessary in this configuration.</p>			
Bearbeiter:	<i>K. Winkler</i>	Musterprüfer:	<i>T. ...</i>
Datum:	<i>30.03.05</i>	Datum:	<i>30.03.2005</i>

SCHEMP-P-HIRTH Flugzeugbau GmbH. Kirchheim/Teck	- SUBSTANTIATION REPORT -					Blatt: <b>0.2.217</b>
	Typ: <b>Discus 2c 15m</b>		Geräte-Nr.: <b>360</b>			
JAR 22.201						
<u>22.201</u> (continued)						
(f) Stalling speeds						
Weight (kg)	525	350		525		
C.G. aft of datum (mm)	283	431		379		
Airbrakes	re-tracted	re-tracted	ex-tended	re-tracted	ex-tended	
Landing gear	re-tracted	re-tracted	ex-tended	re-tracted	ex-tended	
Stalling speed $V_{S1,IAS}$ * [km/h IAS]	78	56	60	70	74	
Start of stall warning $V_{SW,IAS}$ * [km/h IAS]	84	66	70	78	81	JAR 22.207 (c)
1,05 $V_{S1}$ [km/h IAS]	81,0	59	63	74	78	
1,10 $V_{S1}$ [km/h IAS]	85,8	62	66	77	81	
<p>* Note 1: IAS-values near the stall drop to a low value and oscillate because pitot pressure is influenced by the wake of the fuselage. Therefore the above stated values are average values of the ASI reading and are averaged over several attempts. Also slight pitching motions with corresponding variations in the airspeed can occur.</p>						
Bearbeiter:	<i>Krauth</i>			Musterprüfer:		<i>Trecher</i>
Datum:	<i>30.03.05</i>			Datum:		<i>30.03.2005</i>

Schempp-Hirth's Position:

Schempp-Hirth concurs with this position.

LBA's Position:

FAA's Position:

Concurred by:

\_\_\_\_\_  
Manager, Project Support Branch, ACE-112

\_\_\_\_\_  
Date

\_\_\_\_\_  
Acting Manager, Standards Office, ACE-110

\_\_\_\_\_  
Date

\_\_\_\_\_  
Manager, Small Airplane Directorate, ACE-100

\_\_\_\_\_  
Date

Schempp-Hirth  
Flight Instructor  
Post No. 1443  
N73222 N73222  
DE.219.0022

Schempp-Hirth's Position:

LBA's Position:

The LBA accepted during the certification process that the Discus 2c Glider fulfils the most requirements of JAR22.207(a) and (e) and for the not complied requirements, an equivalent level of safety was accepted by the fulfilled requirements of JAR22.207(d) and differently.

FAA's Position:



Concurred by:

\_\_\_\_\_  
Manager, Project Support Branch, ACE-112

\_\_\_\_\_  
Date

\_\_\_\_\_  
Acting Manager, Standards Office, ACE-110

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Date

\_\_\_\_\_  
Manager, Small Airplane Directorate, ACE-100

\_\_\_\_\_  
Date

FAA's Position:

We agree with the LBA's finding for an equivalent level of safety to JAR 22.207(c), Change 4, and that this finding is within the requirement of 14 CFR, part 21, § 21.17(b).

Kim Smith  
Manager, Small Airplane Directorate  
Aircraft Certification Service

10-15-09  
Date

ELOS Originated by Small Airplane Directorate:	William J. Timberlake Manager, Project Support Branch	Routing Symbol ACE-112
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