



Federal Aviation Administration

Memorandum

Date: August 25, 2008

From: Manager, Project Support Branch, ACE-112

To: Manager, Small Airplane Directorate, ACE-100

Prepared by: Greg Davison, Glider Project Officer, Project Support Branch, ACE-112

Subject: Equivalent Level of Safety (ELOS) for Schempp-Hirth Duo Discus xT to JAR 22.207(c), Change 5; Finding No. ACE-08-16

This memorandum requests your office review and concur with the proposed finding of equivalent level of safety to Joint Aviation Requirement (JAR) 22.207(c), stall warning initiation requirement.

BACKGROUND:

The Duo Discus xT is a two-seat, mid-wing, non-self launching powered sailplane constructed from carbon, glass, and aramid fiber reinforced plastic; T-tail configuration; two-piece wing with tip extensions; double panel Schempp-Hirth type airbrakes on upper wing surface; water ballast tanks in the wing and (optional) in the fin; retractable main wheel; fixed nose wheel, tail skid, or (optional) tail wheel.

Schempp-Hirth has incorporated the following changes to the Duo Discus T (FAA TC G19CE) type design to establish the Duo Discus-xT:

- Airbrake system
- Winglets
- Retractable landing gear with shock absorber struts and a wheel brake
- Wing construction of carbon fiber reinforced plastic
- Modification of the ventilation system
- Increase maximum take-off weight from 1543 to 1653 lbs (700 to 750 kg)
- Increase maximum weight of non-lifting parts from 1313 to 1340 lbs (490 to 500 kg)

Production of the Duo Discus T with sales name "Duo Discus-xT" will take the place of the Duo Discus T through accomplishment of Schempp-Hirth Modification Bulletin No. 890-6. This bulletin has been accepted by European Aviation Safety Agency (EASA), is identified in the

EASA Type Certificate Data Sheet (TCDS), and will be included in the revised Federal Aviation Administration (FAA) TCDS. An ELOS to JAR 22.207(c), Stall Warning, has been accepted by EASA. The data plate for the sales name Duo Discus-xT will remain as "Duo Discus T". Serial numbers for the Duo Discus-xT are 126, 128 and subsequent. Serial numbers 172 and subsequent have wings that are constructed mainly of carbon fiber reinforced plastic and maximum take-off weight has been increased from 1543 lb (700 kg) to 1654 lb (750 kg). For serial numbers 147, 150, and 151 through 171 (also constructed mainly of carbon fiber reinforced plastic), the increase in take-off weight is optional through Schempp-Hirth Technical Note 890-9.

Comment [CW1]: Technical Note 890-9 ! Modification Bulletin 890-9 doesn't exist yet...

APPLICABLE REGULATIONS:

The applicable regulation is JAR 22.207, Amendment 5, 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.

IEM 22.207(b)

A visual stall warning alone is not acceptable.

- (c) **The stall warning must begin at a speed between $1.05 V_{S1}$ 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.

DISCUSSION:

The Duo Discus xT glider was flight tested for compliance to the requirements of JAR 22.201 (Wings Level Stall) and JAR 22.207 (Stall Warning) at 1543 lb (700 kg) and 1654 lb (750 kg) maximum weight and at both forward and aft CG limits. The glider has two pitot systems. With the engine retracted, the tail mounted pitot is used. With the engine extended, a nose mounted pitot is used. There is one set of static ports located on the side of the fuselage aft of the wing. Both pitot systems comply with the pitot static error requirements and this calibration data is provided in the Aircraft Flight Manual. Engine operation does not influence the pitot system when using the nose pitot.

Indicated airspeed in the speed range of stall warning and the aerodynamic stall can show speed fluctuation and not be smooth and steady because of the high angle of attack at the pitot tube and flow separations 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 needle movement may not be steady. Data from Schempp-Hirth describes this airspeed indicator action that occurs only on certain flight conditions. The stall warning rule JAR 22.207(d) provides for situations where stall warning window is not met by requiring easily controllable stall characteristics.

Data provided by Schempp-Hirth shows that the Duo Discus xT complies with the stall warning requirements of JAR 22.207(c) at most weights and CGs and flight configurations. Additionally, the data indicates that where JAR 22.207(c) is not complied with, that the requirements of 22.207(d) are complied with by satisfactory stall characteristics, thereby meeting all requirements of JAR 22.207. This is also the position of EASA and the LBA. For reference, data from Schempp-Hirth is presented in Attachment 1.

SCHEMPH-HIRTH'S POSITION:

LBA POSITION:

FAA POSITION:

We concur with the findings of the LBA that Schempp-Hirth has established an equivalent level of safety to JAR 22.207(c) Amendment 5, for the Duo Discus xT motorglider.

Concurred by:

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

7-30-08
Date

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

8-25-08
Date

Brian A. Yanez
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8-25-08
Date

ATTACHMENT 1

Data supplied by Schempp-Hirth:

For the 1543 lb (700 kg) version:

1) Stall warning with powerplant retracted:

From Substantiation Report Modification Bulletin 890-6, Blatt (page) 0.2.79, the results from the Duo Discus flight test report (non-powered model) are valid for the Duo Discus xT with the engine retracted.

Table 1 (from Schempp-Hirth Modification Bulletin 396-15, page 0.2.110)

Weight	700 kg (1543 lb)		700 (1543 lb)		624 kg (1376 lb)		
C.G. aft of datum	49 mm (1.93 inches)		257 mm (10.12 inches)		262 mm (10.31 inches)		
Airbrakes	Retracted	Extended	Retracted	Extended	Retracted	Extended	
Landing Gear	Retracted	Extended	Retracted	Extended	Retracted	Extended	
Stalling V _{S1} IAS	70 km/h (38 knots)	70 km/h (38 knots)	58 km/h (31 knots)	58 km/h (31 knots)	55 km/h (30 knots)	55 km/h (30 knots)	
Start of warning IAS	70 km/h (38 knots)	70 km/h (38 knots)	70 km/h (38 knots)	70 km/h (38 knots)	60 km/h (32 knots)	60 km/h (32 knots)	JAR 22.207(c)
1.05 V _{S1}	74 km/h (40 knots)	74 km/h (40 knots)	61 km/h (33 knots)	61 km/h (33 knots)	58 km/h (31 knots)	58 km/h (31 knots)	
1.10 V _{S1}	77 km/h (42 knots)	77 km/h (42 knots)	64 km/h (35 knots)	64 km/h (35 knots)	61 km/h (33 knots)	61 km/h (33 knots)	

2) Stall warning with powerplant extended:

a) With the engine running (no throttle control, full power is only option):

From Substantiation Report Modification Bulletin 890-6, page 0.2.79, the results from the Duo Discus T flight test report are applicable for the Duo Discus xT. The stall speeds are shown in Table 2.

Table 2 (from Schempp-Hirth Substantiation Report 890, page 0.2.31)

Weight	536 kg (1182 lb)				700 kg (1543 lb)			
C.G. aft of datum	264 mm (10.4 inches)				47 mm (1.9 inches)			
Engine	Ext ign. off	Ext ign. off	Max. power	Max. power	Ext ign. off	Ext ign. off	Max. power	Max. power
Airbrakes	Retr	Ext	Retr	Ext	Ret	Ext	Retr	Ext
Landing Gear	Retr	Ext	Retr	Ext	Ret	Ext	Retr	Ext
Stalling V _{S1} IAS	61 km/h 33 knots	63 km/h 34 knots	61 km/h 33 knots	63 km/h 34 knots	67 km/h 36 knots	80 km/h 43 knots	67 km/h 36 knots	78 km/h 42 knots
Start of warning 1.05 IAS	66 km/h 36 knots	66 km/h 36 knots	65 km/h 35 knots	69 km/h 37 knots	67 km/h 36 knots	80 km/h 43 knots	67 km/h 36 knots	78 km/h 42 knots
1.05 V _{S1}	64 km/h 35 knots	66 km/h 36 knots	64 km/h 35 knots	66 km/h 36 knots	70 km/h 38 knots	84 km/h 45 knots	70 km/h 38 knots	82 km/h 44 knots
1.10 V _{S1}	67 km/h 36 knots	69 km/h 37 knots	67 km/h 36 knots	69 km/h 37 knots	74 km/h 40 knots	88 km/h 48 knots	74 km/h 40 knots	86 km/h 46 knots

JAR 22.207(c)

For the 1543 lb (750 kg) version:

3) Stall warning with powerplant retracted:

From Substantiation Report Modification Bulletin 890-6, Blatt (page) 0.2.33-750, the results from the Duo Discus (non-powered model) are valid for the Duo Discus xT with the engine retracted. Refer to Table 1 for stall speed data.

4) Stall warning with powerplant extended:

a) With the engine running (no throttle control, full power is only option):

From Substantiation Report Modification Bulletin 890-6, Blatt (page) 0.2.33-750, the results of Substantiation Report 890, Blatt (page) 0.2.34 (see Table 2) are applicable for the 1543 lb (750 kg) version.

Nevertheless further test flights with aft most C.G. and a weight of 674 kg were conducted. The results of these test flights were converted to the maximum weight of 750 kg. See Table 3 below:

Table 3:

Weight	674 kg (1486 lb)				750 kg (1653 lb)			
C.G. aft of datum	251 mm (9.9 inches)				251 mm (9.9 inches)			
Engine	Ext ign. off	Ext ign. off	Max. power	Max. power	Ext ign. off	Ext ign. off	Max. power	Max. power
Airbrakes	Retr	Ext	Retr	Ext	Ret	Ext	Retr	Ext
Landing Gear	Retr	Ext	Retr	Ext	Ret	Ext	Retr	Ext
Stalling V_{S1} IAS	72 km/h 39 knots	73 km/h 39 knots	72 km/h 39 knots	73 km/h 39 knots	76 km/h 41 knots	77 km/h 42 knots	76 km/h 41 knots	77 km/h 42 knots
Start of warning 1.05 IAS	76 km/h 41 knots	77 km/h 42 knots	76 km/h 41 knots	77 km/h 42 knots	80 km/h 43 knots	81 km/h 44 knots	80 km/h 43 knots	81 km/h 44 knots
1.05 V_{S1}	76 km/h 41 knots	77 km/h 42 knots	76 km/h 41 knots	77 km/h 42 knots	80 km/h 43 knots	81 km/h 44 knots	80 km/h 43 knots	81 km/h 44 knots
1.10 V_{S1}	79 km/h 43 knots	80 km/h 43 knots	79 km/h 43 knots	80 km/h 43 knots	83 km/h 45 knots	84 km/h 45 knots	83 km/h 45 knots	84 km/h 45 knots

JAR 22.207(c)

When comparing the results shown in Table 3 with the data shown in Table 2, there are small differences. These differences are founded in the natural scatter of the tests and the different test pilots.

With the C.G. in aft-most position and weight of 1653 lbs (750 kg), 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. Compliance to JAR 22.207(c) is met.

With the C.G. in the most forward position and weight of 1653 lbs (750 kg), the stall warning does not comply with JAR 22.207(c); no warning is given of the approaching stall. Therefore, JAR 22.207(d) is applicable to achieve compliance.

END