DHV Safety tests of LTF A- and B-Paragliders, Part 3

This article is a continuation of the safety test series first published in DHV-Info 174 (also available on the internet under www.dhv.de on the Safety and Technical page). Details on test criteria, practical relevance of the test manoeuvres with regard to accident statistics and current LTF airworthiness requirements can be found there.

The testing team from the DHV's Safety and Technical department chose current LTF-A and low end LTF-B paragliders available on the market designated as „suitable for schooling“ by their manufacturers for part 3 of the safety test series.

In the next issue of the DHV-Info and in the near future on our website there will follow a report on current high-end LTF-B gliders from the following manufacturers: Gradient Nevada, U-Turn Blacklight, Icaro Wildcat, Air Design Rise, Mac Para Eden 5, Skywalk Chili 3, Nova Mentor 3, Advance Epsilon 7.

Safety testing was conducted at the top 25% of the weight range for the following gliders:

LTF A	**Certification number**
Icaro Cyber TE M	DHV GS-01-1980-12
Ozone Mojo 4 L	AIRT GS_0557.2012
Independence Pioneer M	EAPR-GS-7502/12
Nova SuSi M	EAPR-GS-7618/12
Niviuk Koyot 2.28	AIRT GS_0525.2012
LTF B Low Level	
Swing Arcus 7.26	DHV GS-01-1986-12
Air Design Vita M	EAPR-GS-7386/11
Sky Paragliders Anakis 2 L	AIRT GS_0498.2011

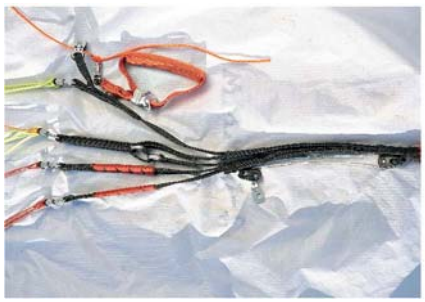
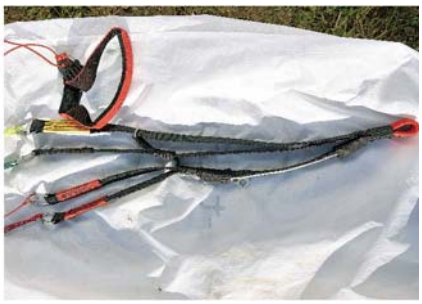
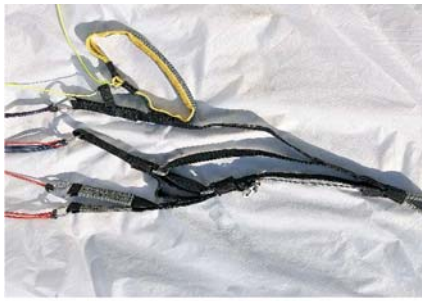
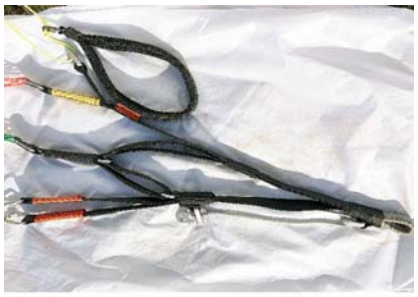
Launch preparations

What is tested:
In particular we look at the risers and line systems, how easy they are to sort, if looping or knots in the lines are easy to see or not and the functionality and ergonomics of the risers.

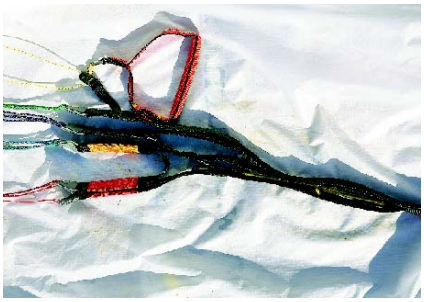
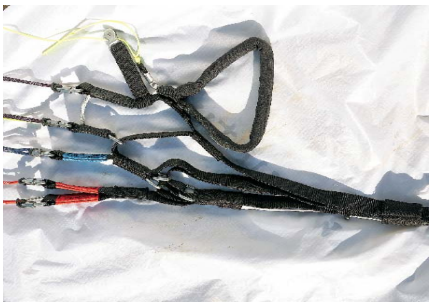
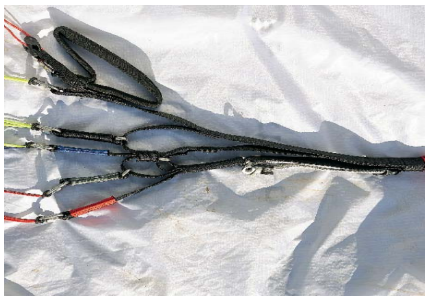
Novas SuSi M set the standards in this test series. No other glider tested here was set up and sorted as quickly and easily as the SuSi. On Independences Pioneer sorting the lines is also very easy due to its effective line geometry. More attention to detail was required on the LTF-A gliders Icaro Cyber TE, Ozone Mojo 4 and Niviuk Koyot 2 due to many thin unsheathed lines un the upper gallery, particularly at the wingtips.

The 3 low end B gliders could also be easily set up and sorted without using any particular tricks. Air Designs Vita has risers which require an extra check and feel somewhat unusual. Also the stabiliser lines require careful checking as on Swings Arcus 7, due to the larger number of attachment points. The soft riser webbing used

on Skys Anakis 2 is kept nice and simple, but does tend to twist in on itself in practice. The thin main lines used also require careful sorting.

Pictures (left to right):
above: Koyot 2, SuSi, Cyber TE,
below: Mojo 4, Pioneer.
Solid and uncomplicated LTF-A risers. The Pioneer webbing is somewhat hard and bulky, its brake handles remind of tramRiser fittings.

Pictures: The Sky Anakis 2 riser (left) is light and uncomplicated but very soft. This makes handling more difficult. Unusual: The Brummel hooks for the speed system is attached to the inside of the A-riser. On the Vita from Air Design (middle) risers are made of thick but soft webbing with a total of 4 metal speed system rings, and need a little getting used to. Swings Arcus 7 has standard risers with nothing unsual about them (left).

In accordance with the LTF airworthiness requirements, lines to stabilisers must be of a differing colour to all other lines on the glider. All gliders with the exception of Independences Pioneer had this important feature (used for recognising to correct line to pull when trying to recover from a cravat). See picture below.

Plastic rods for stiffening the leading edge are now also commonplace in almost all LTF-A and B gliders (Ozone Mojo 4 detail). Only the Anakis 2 from Sky used conventional materials.

Launch preparations			
Glider	Easy	Average	Difficult
Nova SuSi M			
Independence Pioneer M			
Icaro Cyber TE M			
Ozone Mojo 4 L			
Swing Arcus 7.26			
Niviuk Koyot 2.28			
Air Design Vita M			
Sky Paragliders Anakis 2 L			

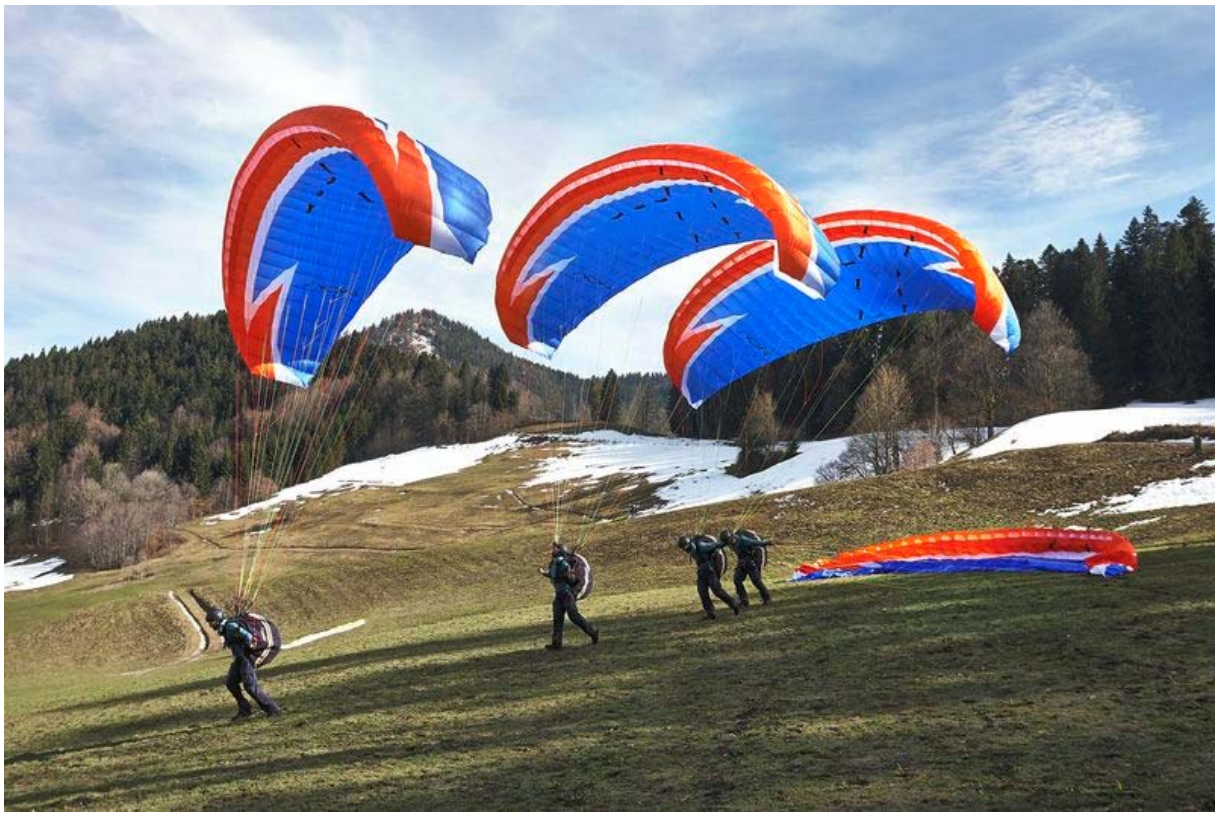
Launch characteristics

What is tested:
Inflation, climb rate, requirements to stabilise and necessary brake inputs.

A team of 4 instructors judged the launch characteristics of the gliders. Special tricks were not required to launch any of the gliders.
Four of the five LTF-A gliders demonstrated good school suitability in terms of launching the glider. For this segment it is particularly important that gliders do not tend to overshoot, as this quickly over-challenges new pilots. Niviuk Koyot 2, Icaro Cyber TE, Nova Susi and Ozone Mojo 4 are all excellent here. Their canopies climb

steadily with comfortable pressure on the A-risers and slow automatically as the reach the zenith. Only moderate brake appliance is necessary to stabilise them. Independences Pioneer is a little more dynamic, this canopy climbs faster and requires more brake appliance to stabilise. Low end B gliders from Swing and Air Design behave very similarly. During inflation these gliders need to be guided a little, but do not hang behind or overshoot at all. Skys Anakis 2 cannot be classed as an overshooter, but it did have the greatest dynamics in the test set. With a relatively gentle impulse on the A-risers the canopy climbs quickly to the zenith where it needs a good jab on the brakes to stabilise it.

Launch characteristics				
Gerät	Delayed	Balanced		Dynamic
Icaro Cyber TE M				
Nova SuSi M				
Ozone Mojo 4 L				
Niviuk Koyot 2.28				
Swing Arcus 7.26				
Air Design Vita M				
Independence Pioneer M				
Sky Paragliders Anakis 2 L				



Particularly for inexperienced pilots, the easy launching characteristics of the SuSi from Nova (LTF-A).

Test manoeuvres / recovery from instability

All test manoeuvres were filmed with onboard GoPro cameras, ground cameras and documented with the DHVs data loggers. Test manoeuvres were performed by the DHV test pilots Reiner Brunn and Harry Buntz.

Info Data loggers

The pilot data logger is firmly attached to a main suspension strap on the pilots harness.
A second smaller glider logger is attached to a cell wall inside the glider using two strong magnetic plates. The best position for data collection has been determined to be where the C-gallery lines are attached to the canopy at the 70% collapse marker points. Logger data is collected continually from the beginning to the end of the test flight and the two instruments are synchronized with each other via a low-range radio signal. Data sets are transferred from standard micro-SD memory cards to a PC after landing.
The loggers collect the following information:

Pitch, roll and yaw angle,

Pitch roll and yaw acceleration,

Vertical velocity calculated over a 0.5 second window from the barometric altitude sensor,

Velocity: the pilot data logger contains a 5 Hz GPS, from which the velocity over ground is calculated,

G-Force: from the accelerometers contained in the pilot data logger the G-force acting on the pilot is calculated,

Altitude: both the barometric height (recorded at 100Hz) and the GPS height (5Hz) are recorded.

Data processing: the processing software is written to automatically recognize the beginning and end of a test manoeuver. Pilot and glider movements are simulated from the recorded data, and this simulation is synchronized with the video material of the test flight. Test pilots check the synchronized results for plausibility. Data loggers are instruments to assist test pilots and provide additional objective information on parameters which are difficult to judge in the air such as roll and pitch angles, height loss, course changes and durations.

Flight stability

What is tested:
Through induced pitch testing a measurement of a gliders pitch stability can be made. The angle to which a canopy dives forward during pitch testing is a good indicator of the potential dynamics which may develop during such circumstances. Pitch angels were measured after the third pitch cycle during testing.

Nickwinkel				
Gerät	< 30°	30-45°	45-60°	> 60°
Icaro Cyber TE M				
Nova SuSi M				
Independence Pioneer M				
Ozone Mojo 4 L				

Swing Arcus 7.26				
Air Design Vita M				
Niviuk Koyot 2.28				
Sky Paragliders Anakis 2 L				

Asymmetric Collapses

What is tested:
Asymmetric collapses are conducted at trim speed and at full speed with no pilot action. Canopies are collapsed to the top limit of the field defined in the LTF airworthiness requirements (visible from the tapes stuck to the lower sail), i.e. the maximum possible for certified gliders. During LTF testing it is also possible to certify a glider collapsed at the minimum limit of the LTF field, but this generally results in less dynamic behaviour. For this reason we often see differing results here in safety testing, when compared with those of the certification tests.

Novas SuSi M was the least challenging glider tested here: the glider is designed with simplicity and ease of handling in mind with large air intakes and a low aspect ratio and reacts very benignly to asymmetric collapses. Typical for the LTF-A class are the results from Independence (Pioneer M) and Icaro (Cyber TE M). Mojo 4 and Koyot 2 change course to a greater degree and suffer more height loss than the other test gliders.
Behaviour of the low end LTF-B Arcus 7 glider from Swing was generally very similar to average LFT-A class gliders. Air Designs Vita reacts unspectacularly to collapses performed at the minimum limit of the LFT field, however towards the maximum limit, reactions become increasingly dynamic with larger course change angles and associated height loss. Sky Paragliders Anakis 2 behaves very similarly.
None of the tested gliders indicated tendencies to cravat or cascade (e.g. collapse on the opposite side on recovery).

Collapse Anakis

Collapse Arcus

Collapse Cyber TE

Collapse Koyot 2

Collapse Mojo

Collapse Pioneer

Collapse SuSi

Collapse Vita

Asymmetric Collapses							
Glider	Height-loss in m	Pitch-angle in °	Pitch change rate in °/sec	G-Force in G	Course-change angle in °	V/sink maximum in m/s	Notes
LTF A							
Nova SuSi M	20-29m	-45°	-55°	2,0 G	90-180°	10-15 m/s	Very moderate reactions, low dynamics, relatively low height loss
Icaro Cyber TE M	30-39 m	-65°	-75°	2,3 G	90-180°	15-20m/s	Relatively moderate reactions, moderate dynamics, height loss < 40m
Independence Pioneer M	30-39 m	-65°	-75°	2,3 G	90-180°	15-20m/s	
Ozone Mojo 4 L	40-49 m	-65°	-75°	2,3 G	-270°	15-20m/s	Greater height loss and course change angles than other moderate LTF-A gliders
Niviuk Koyot 2.28	40-49 m	-65°	-75°	2,2 G	-270°	15-20m/s	Greater height loss and course change angles than other moderate LTF-A gliders
LTF B Low Level							
Swing Arcus 7.26	30-39 m	-55°	-65°	2,0 G	90-180°	15-20m/s	Relatively moderate reactions, moderate dynamics, height loss < 40m
Air Design Vita M	40-49 m	-65°	-75°	2,2 G	90-270°	15-20 m/s	Very moderate reactions to collapses at the minimum of the LTF field. Slow course change < 90° For collapses over the entire LTF field this glider reacts with greater height loss, greater course change angles and generally more dynamically than other LTF-A gliders. Collapses need active pilot recovery actions.
Sky Anakis 2 L	40-49 m	-65°	-75°	2,4 G	180-270°	15-20 m/s	Greater height loss and course change angles than other moderate LTF-A gliders

Front collapses

What is tested:
Front collapses are performed at trim speed and at full speed in two different configurations: firstly by collapsing only 40% of the leading edge, and then by collapsing as much as possible of the gliders leading edge. Many gliders are certified at the minimum 40% limit. We often see large deviations to certification behaviour when gliders are tested at the upper limit.
Pilot action to recover is only performed when the glider does not self-recover.

Novas SuSi rarely needs more than 25 m to recover from even the hardest „destroyer“ front collapse. The canopy opens very quickly and regains normal speed without delay but with a tendency to dive somewhat. Icaros Cyber TE opens with a slight to moderate delay, sometimes asymmetrically which then results in a course change. This behaviour is moreso with the Independence Pioneer, course change and height loss are greater. Ozones Mojo 4 opens first in the middle, but the ears stay closed with sink velocities of about 5 m/s for a period before recovering completely. Sink rates are relatively low for the Mojo 4 even for large collapses. Swings Arcus 7 stands out from the others that its height loss on large collapses does not differ significantly from smaller ones. The reason for this: on smaller collapses the canopy ears tend to stay closed which delays recovery to normal flight. On larger collapses recovery is usually immediate.

Niviuks Koyot 2 reacts as expected for an LTF-A glider for front collapses up to 40%. For a maximum possible leading edge collapse the canopy tends to remain in a stable closed position for several seconds. Air intakes are not filled, and the canopy then horseshoes to the rear with long recovery delays. Air Designs Vita M is unspectacular and returns quickly to normal flight on small front collapses. Things look different on large collapses – here behaviour is chaotic and opening may be fast, symmetric and with a large dive or remain in a stable closed state. When this happens the canopy then enters a horseshoe and begins to rotate. Recovery does eventually happen without pilot reaction, but with large delays and severe height loss.

Novas SuSi LTF-A (right) and the low-end LTF-B Swing Arcus 7 (left) recovered from massive front collapses with the lowest height loss.


Ozone Mojo 4 (right) recovers delayed after a front collapse, Sky Paragliders Anakis 2 (left) recovers very quickly.


These gliders tend to fold in the middle on a hard front collapse and may recover asymmetrically: Independence Pioneer (right). Reduced tendency on the Icaro Cyber TE (left).


Small collapses are unspectacular on Niviuks Koyot 2 whereas larger ones display a tendency to severely delayed recovery.

Similar behaviour for the Air Design Vita: the closed leading edge prevents quick recovery, recovery does occur without pilot input but with severe height loss.

Front Collapse						
Glider	Height-loss in m	Pitch-angle in °	Pitch change rate in °/sec	Rotation, G-Force in G	Course-change angle in °	V/sink maximum in m/s
LTF A						
Nova SuSi M						
40% collapse	< 20 m	-30°	30-45°	no	-10 m/s	Low pitch back, moderate pitch forward, immediate recovery, no course change, low sink rates
Maximum possible leading edge collapse	20-29 m	30-45°	45-55°	no	-10 m/s	Moderate pitch back, marked pitch forward, fast recovery, no course change, low sink rates
Icaro Cyber TE M						
40% collapse	30-39 m	-30°	-30°	no	-10 m/s	Low pitch back, low pitch forward, slight delayed recovery, no course change, low sink rates
Maximum possible leading edge collapse	30-39 m	30-45°	45-55°	Yes, < 90°	10-14 m/s	Moderate pitch back, marked pitch forward, slight delayed recovery, slight course change <90°
Independence Pioneer M						
40% collapse	30-39 m	-30°	-30°	no	-10 m/s	Low pitch back, low pitch forward, slight delayed recovery, no course change, low sink rates
Maximum possible leading edge collapse	40-49 m	30-45°	30-45°	Yes, 90-180°	10-14 m/s	Moderate pitch back, moderate pitch forward, delayed recovery, asymmetric opening course change 90-180°
Ozone Mojo 4 L						
40% collapse	30-39 m	-30°	-30°	no	-10 m/s	Low pitch back, low pitch forward, slight delayed recovery, no course change, low sink rates
Maximum possible leading edge collapse	40-49 m	-30°	30-45°	no	-10 m/s	Low pitch back, marked pitch forward, delayed recovery (ears remain closed), no course change, low sink rates
Niviuk Koyot 2.28						
40% collapse	30-39 m	-30	30-45°	no	-10 m/s	Low pitch back, moderate pitch forward, slight delayed recovery, no course change, low sink rates
Maximum possible leading edge collapse	50- >60 m	-30	30-45°	Yes	10-14 m/s	Low pitch back, moderate pitch forward. Leading edge may remain closed, if so the canopy enters a horseshoe. Severely delayed recovery, strong course change tendency.

LTF B Low Level						
Swing Arcus 7.26						
40% collapse	*30-39 m **40-49 m	-30°	30-45°	no	-10 m/s	Low pitch back, moderate pitch forward, *immediate recovery or **delayed recovery with closed ears, low sink rates
Maximum possible leading edge collapse	30-39 m	45-55°	30-45°	no	10-14 m/s	Marked pitch back, moderate pitch forward, immediate recovery to normal flight, no course change
Air Design Vita M						
40% collapse	30-39 m	30-45°	30-45°	no	-10 m/s	Moderate pitch back, moderate pitch forward, fast recovery, no course change, low sink rates
Maximum possible leading edge collapse	*30-39 m **70-79m	*30-45° **-30°	*55-65° **-30°	*no **Yes > 360°	10-14 m/s	Glider has two different reactions: *fast recovery with high pitch forward angles, **front horseshoe with rotation >360°, large height loss, severely delayed recovery with low pitch forward.
Sky Paragliders Anakis 2 L						
40% collapse	30-39 m	30-45°	30-45°	no no	-10 m/s	Moderate pitch back, moderate pitch forward, immediate recovery, no course change, low sink rates
Maximum possible leading edge collapse	40-49 m	45-55°	45-55°		10-14 m/s	Marked pitch back, marked pitch forward, immediate recovery to normal flight, no course change.

Spiral dive

What is tested:
Spirals are flown such that after at least 5 seconds and before the 540° point the canopy is fully locked in the rotation. The testpilot then keeps the glider in the spiral using the brakes for a further 2 turns (720°) before releasing the inside brake to start recovery.

The spiral test provided no great surprises. All gliders behaved in accordance with their LTF classifications. Swings Arcus 7 tends to remain longer in the spiral when recovering from fast spirals before going nose up and self-exiting. Due to this the height loss was the greatest under the tested gliders. Similar, when not quite as severe, was the behaviour from Novas SuSi.

Spiral dives							
	Vsink after 360°, 720°, max.	G-Force after 360°, 720°, max.	Height loss after 360°, 720°, max.	Height loss from brake release to regaining normal flight	Time to 360° 720° Total	Action after brake release	Notes
LTF A							
Nova SuSi M	7 m/s 13 m/s 17 m/s	1,9 G 2,7 G 2,9 G	20m 60m	70m	0-10 s 10-15 s	Acceleration from 13 m/s to 17 m/s in the next 90° constant sink for 270°, then automatic exit	Recovery relatively challenging as the glider continues to spiral and automatic exiting is delayed. Relatively low G-forces.

						and recovery in the next 90°	
Icaro Cyber TE M	5 m/s 12 m/s 22 m/s	1,8 G 2,9 G 3,3 G	20 m 60m	60 m	0-10 s 10-15 s	Acceleration from 17m/s to 22 m/s in the next 180°, then automatic exit and recovery in the next 180°	Entry simple. Exiting more challenging than class average due to acceleration for 180°
Independence Pioneer M	7 m/s 15 m/s 15 m/s	2,0 G 2,9 G 2,9 G	30 m 80 m	50 m	0-9s 9-13s	Vsink remains at 15 m/s for 180°, then automatic exit and recovery in the next 270°	Dynamic transition from entry to spiral. Glider collapses on outer ear at 15 m/s which resists further acceleration. Relatively low G-forces.
Ozone Mojo 4 L	7 m/s 17m/s 20m/s	2,0 G 2,8 G 3,8 G	30 m 80 m	50 m	0-7s 7-11s	Acceleration from 17 m/s to 20 m/s in the next 90°, then automatic exit and recovery in the next 180°	Relatively dynamic transition from entry to spiral, with rapid increase in sink rate and G-force. Exit relatively simple.
Niviuk Koyot 2.28	7 m/s 17m/s 17 m/s	2,1 G 3,2 G 3,3 G	30 m 80 m	40 m	0-7s 7-11s	Vsink remains at 17 m/s for 180°, then automatic exit and recovery in the next 180°	Relatively dynamic transition from entry to spiral, with rapid increase in sink rate and G-force. Exit relatively simple. Glider collapses on outer ear at 17 m/s which resists further acceleration.
LTF B Low Level							
Swing Arcus 7.26	6 m/s 12 m/s 23 m/s	2,0 G 3,1 G 3,9 G	20 m 60 m	90 m	0-9s 9-13 s	Acceleration from 17m/s to 23 m/s in the next 90°, Vsink > 20 m/s for 360°, then automatic exit and recovery in the next 180°	Simple entry. Challenging exit behaviour with maintained high sink rates for 360°. Relatively high height loss on exiting.
Air Design Vita M	7m/s 14m/s 20m/s	1,9 G 3,1 G 3,5 G	30 m 70 m	40 m	0-9s 9-13s	Acceleration from 14m/s to 20 m/s in the next 90°, then automatic exit and recovery in the next 180°	Impulse required for correct entry, relatively dynamic transition from entry to spiral. Simple exit.
Sky Anakis 2 L	6m/s 13m/s 19m/s	1,9 G 2,9 G 3,3 G	30 m 80 m		0-8 8-12	Acceleration from 13m/s to 19 m/s in the next 90°, then automatic exit and recovery in the next 180°	Simple entry and exit.

B-Stall

What is tested:
Pitch back behaviour on entry, pitch forward behaviour on exiting and sink velocities. In particular we look at the canopy stability and tendencies to deform on longer B-Stalls (>10s) and any recovery problems.

The LTF-A gliders Nova SuSi, Icaro Cyber TE, Ozone Mojo 4, Niviuk Koyot and the low end LTF-B Swing Arcus 7 and Air Design Vita displayed good behaviour in B-stalls. No deformation tendencies, stable sink phase with good sink rates and no recovery or deep stall problems on exiting. Independences Pioneer displayed a slight tendency to deform on longer B-stalls. Skys Anakis 2 enters a short deep stall on exiting from a B-stall but self recovers from this within the next 3 seconds with a marked pitch forward.

B-Stall					
Glider		Sink rate in stable B-stall. Deformation tendencies Rotation	Pitch back on entry / pitch forward on exit	Height loss on exit	Notes
LTF-A					
Nova SuSi M		8 m/s no no	15°-30° 30°-45°	-20 m	Large entry force, very stable sink phase
Icaro Cyber TE M		7 m/s no no	15°-30° -15°	-20 m	Very stable sink phase, low pitch forward on exit
Independence Pioneer M		8 m/s slight no	15°-30° 30°-45°	- 20 m	Slight deformation tendency in Canopy middle
Ozone Mojo 4 L		8 m/s no slight <90°	15°-30° -15°	- 20 m	Very stable sink phase, low pitch forward on exit
Niviuk Koyot 2.28		7 m/s no slight	15°-30° 15°-30°	- 20 m	Very stable sink phase, slight rotation tendency
LTF-B Low Level					
Swing Arcus 7.26		7 m/s no no	15°-30° 15°-30°	-20 m	Very stable sink phase
Sky Anakis 2 L		8 m/s no no	15°-30° > 45°	-40 m	Very stable sink phase, short deep stall on exiting.
Air Design Vita M		8 m/s no no	15°-30° 15°-30°	-20m	Very stable sink phase

Big Ears

What is tested:
Big ears at trim speed and at full speed. Glider sink and speed is measured. Any entry difficulties or deep stall tendencies on exiting from trim speed big ears are noted.

Performing big ears on all of the tested gliders was unproblematic. Icaros Cyber TE tends to flap its ears and snake a little in straight flight at full speed. This behaviour is note noted at trim speed.

Big Ears					
Glider	Entry	Exit	Vsink (trim) Vsink (full)	Speed difference trim - full	Notes
LTF A					
Nova SuSi M	simple	automatic	2, 5 m/s 3,5 m/s	approx.3- 5 km/h less than trim speed approx. 3-5 km/h more than trim speed	
Icaro Cyber TE M	simple	automatic	3 m/s 4 m/s	approx. 5-8 km/h less than trim speed approx. trim speed	Ears flap at full speed
Independence Pioneer M	simple	automatic, marked delay	3 m/s 4 m/s	approx. 5 km/h less than trim speed approx. 5 km/h more than trim speed	Delayed recovery
Ozone Mojo 4 L	simple	automatic	2,5 m/s 4 m/s	approx. 5 km/h less than trim speed approx. 5 km/h more than trim speed	
Niviuk Koyot 2.28	simple	automatic	2, 5 m/s 3,5 m/s	approx.3- 5 km/h less than trim speed approx. 3-5 km/h more than trim speed	
LTF B Low Level					
Swing Arcus 7.26	simple	automatic delayed	3 m/s 4 m/s	approx. 5 km/h less than trim speed approx. 5-8 km/h more than trim speed	
Sky Anakis 2 L	simple	automatic, marked delay	3 m/s 4 m/s	approx. 5 km/h less than trim speed approx. 7 km/h more than trim speed	Delayed recovery
Air Design Vita M	simple	automatic delayed	2, 5 m/s 3,5 m/s	approx. 5-8 km/h less than trim speed approx. 5-8 km/h more than trim speed	