DHV Safety tests of LTF A- and B- Paragliders, Part 5

The testing team from the DHV's Safety and Technical department chose current LTF-B paragliders available on the market designated as middle to high end gliders by their manufacturers for part 5 of the safety test series.

The following gliders were tested:

Glider	LTF Test number	Weight range
U-Turn Blacklight M	EAPR-GS-7538/12	85-110 kg
Advance Epsilon 7.26	AIRT GS_0683.2013	75-110 kg
Swing Mistral 7.26	EAPR-GS-7662/13	90-110 kg
Nova Mentor 3 M	EAPR-GS-7661/13	85-105 kg

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.

Nova's Mentor 3 had only one weak point: the rear riser is so long that it tends to wrap and twist a little. Its red coloured unsheathed upper gallery lines are relatively easy to sort and check. The Epsilon 7 from Advance needs a little more attention to detail – here its unsheathed yellow gallery lines are more difficult to recognise. Pilots with Swing's Mistral 7 and U-Turn's Blacklight need to concentrate carefully when checking their lines. Swing uses sheathed lines for the front lower gallery, and all the rest are a mixture of unsheather Aramid and Dyneema lines. Uturn fits the Blacklight with a complete set of unsheathed lines in a uniform grey colour, which makes exact line checking very challenging. Both of these gliders only have two sets of lower gallery lines per side. Their risers have no weak points.

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. Pilots who are used to launching high-end B class gliders shouldn't have any problems starting any of the tested gliders, there are however a few differences in the finer details.

Our testers all agreed that Advance's Epsilon 7 had excellent launch characteristics, suitable even or a beginner. During inflation the glider remains a little soft and doesn't give the pilot much feedback, but at the zenith it is easy to stabilise with no tendency to overshoot at all. Nova's Mentor 3 has good balanced launch characteristics: moderate climb to the zenith with good internal pressure and only moderate use of the brakes required to stabilise at the zenith. U-Turn's Blacklight only needs a careful pull to launch it, too much and it overshoots and needs a lot of brake to stabilise it.
The Mistral 7 is a little reluctant to climb, feels rather soft and needs to be actively guided to the zenith. It tends to break out to the side a little at the end of the climb, but doesn't overshoot.

Launch characteristics			
Glider	Delayed	Balanced	Dynamic
Nova Mentor 3 M			
Swing Mistral 7.26			
Advance Epsilon 7.26			
U-Turn Blacklight M			

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 Simon Winkler and Harry Buntz.

Flight stability
What is tested:
Through induced pitch testing a measurement of a gliders pitch stability and pitch-damping 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.

Pitch forward angle				
Glider	< 30°	30-45°	45-60°	> 60°
Advance Epsilon 7.26				
Nova Mentor 3 M				
Swing Mistral 7.26				
U-Turn Blacklight M				

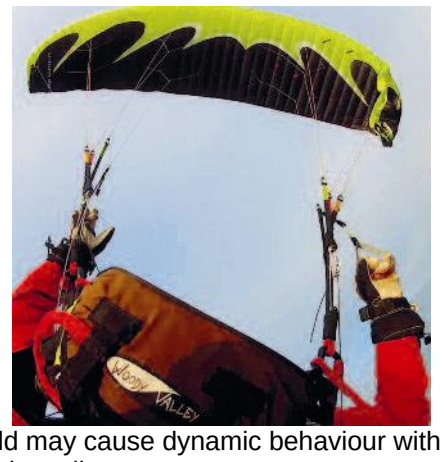
Asymmetric Collapses
What is tested:
Asymmetric collapses are conducted at trim speed and at full speed with no pilot action. Canopies are collapsed to the top limit of the field defined in the LTF airworthiness requirements (visible from the tapes stuck to the lower sail), i.e. the maximum possible 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.
Note: Paragliders in the LTF B certification class are permitted to pitch forward to 45° after collapsing. This test regulation is verified in

LTF testing using only video film shot from the ground and therefore subject to large error margins, as no clear reference points can be used to calibrate the measurements in any way. When a glider collapses assymetrically, the dive experienced is always a combination of pitching forward and rolling to one side. This again makes judging the pitch forward angle from video film very inprecise. The data loggers used by the DHV record pitching and rolling movements separately. It has been determined that only a few gliders in the LTF A and B classes actually fulfill the test requirements of diving forward to less than 45° when measured with the data loggers.

Advance's Epsilon 7 behaves little more dynamically than a low-end LTF-B glider (see examples in DHV-Info 181) but generally very well to assymetric collapses. Even when collapses were conducted at the maximum end of the collapse field, pitch forward rates and angles were still moderate. No cascade collapses on the opposite wing side were noted, just a minimum deflation at the outer wingtip. Turn rates after a collapse begin relatively slowly and give the pilot plenty of time to react.
We compared Nova's Mentor 3 with values recorded in our first serial test series in 2012 from the Mentor 2. Height loss on collapsing is somewhat reduced and we noted no tendencies to cravat on the newer model. The canopy turns through a 180° with high sink rates after self recovering after an assymetric collapse. Massive collapses increased reaction dynamics markedly and caused major cascade collapses on the opposite wing side.

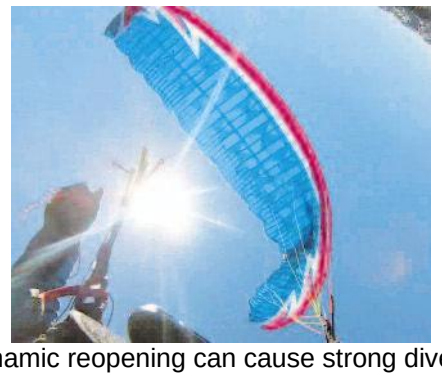
Collapse behaviour for Swing's Mistral 7.26 is similar. The glider collapses steeply and the following dive forward and turning movements are dynamic. Sometimes cascade collapses occur on the opposite wing side, but these did not produce a change in direction or cravat.
U-Turn's Blacklight had the most challenging collapse behaviour in this test series. Collapses to the middle of the test field produced large dives forward and cascade collapses on the opposite wing side. If collapses are performed at the maximum of the test field, then massive dives and cascade collapses result, which are accompanied by course changes and may cravat. Recovering from the cravat is relatively easy by using only the brakes, but must be performed actively. The Blacklight collapses steeply and this is always associated with dynamic glider reactions.


The Blacklight collapses massively.



Collapses at the top limit of the LTF-field may cause dynamic behaviour with collapses on the opposite wing side and small cravats.

The three high-end B gliders Mistral 7, Mentor 3 and Blacklight all have challenging collapse behaviour when collapsed massively. Pilots must be able to recognise and prevent collapses through active flying to reduce the danger of massive forward dives with aggressive cascade collapses and cravats. Advance market their Epsilon 7 as a mid-range class B glider and the differences in dynamics are measurable. The glider is not quite as demanding to fly as its high-end colleages.

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
Advance Epsilon 7.26	30-39 m	-65°	-65°	2,2 G	90°-180°	15-20 m/s	Relatively moderate dynamics and behaviour, height loss under 40 m, relatively low G-Forces.
Nova Mentor 3 M	30-39 m* 50-59 m**	-65° -75°	-75° >75°	2,2 G 2.5 G	90-180° >360°	15-20m/s >20 m/s	Collapsing to the middle* of the test field produces relatively moderate behaviour. Recovery at 180-270° course change followed by 180° turning. Massive** collapses have much increased dynamics with occasional massice cascade collapses but without course change or cravats.
U-Turn Blacklight M	40-49 m* 70-79m**	-75°	>75°	2,4 G	180-360°+	15-20 m/s >20 m/s	Collapsing to the middle* of the test field produces behaviour corresponding to the LTF-B class, but with occasional cascade collapses on the opposite wingtip. Massive** collapses produce severe dives forward, fast course changes, cascade collapses with course changes and cravats and large height loss.
Swing Mistral 7.26	40-49 m	-75°	>75°	2,4G	270-360°	15-20 m/s	This canopy collapses steeply, dives forward markedly and changes course quickly. Cascade collapses without course change or cravat tendencies, course change after recovery 360°


Deep collapses on Mentor 7 with dynamic reopening can cause strong dives forward and cascade collapses but without cravats.


Mistral 7 gets a challenging collapse behaviour with massive collapses: severe dives forward, fast course change and collapses on the other wing side.


Even with collapses over the top limit of the LTF-field, Epsilon 7 behaviour was relatively moderate, with little dives forward and moderate curl of wingtip.

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.

Front collapses

What is tested:
Front collapses are performed at trim speed and at full speed in different configurations: firstly by collapsing to a depth of only 40% of canopy (marked with tapes on the lower sail), and then by collapsing the maximum that the gliders construction presents. Maximum front collapses on full bar generally exceed the LTF certification limits. From accident analysis and diverse video footage, we know that front collapses in practice often effect 100% of the canopy. Many gliders are certified at the minimum 40% limit without looking for construction weaknesses. 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.

In past serial tests, we noted the tendency of some B-class gliders having challenging behaviour to front collapses, which we can also verify in this test series. U-Turn's Blacklight only self recovers from small front collapses. As soon as the collapsed area is increased, the glider enters a stable frontstall with no self recovery. Immediate pilot reaction is required to prevent further twisting, turning and cravating. Similar behaviour was also noted for the Epsilon 7, large front collapses produce a stable horseshoe frontstall with the wingtips back. Rotation tendencies are moderate but sink velocities are high. Both gliders require a short powerful jab on the brakes to start recovery back to normal flight. Nova's Mentor 3 performs better in front collapse testing than earlier models. Recovery is immediate and mostly symetrical, even massive collapses did not indicate any tendency of the glider entering a stable front stall but recovery became less predictable and sometimes assymetric. This was also true for Swing's Mistral 7 in most cases. The glider may remain closed for a few seconds after collapsing, but does self recover in the end.


Nova Mentor 3 has no tendency to stable front stalls. It opens relatively quick, sometimes asymmetric.



Mistral 7 may open relatively quickly even with maximum front collapses, but may also have the tendency to remain closed with delayed recovery.


Smaller front collapses at the Blacklight open a bit delayed with rolled in wingtips. Massive front stalls stay stable and require fast pilot action and brake handling to prevent cravats and twist.


Variable: With smaller front collapses Epsilon 7 may recover fast as well as delayed.
Massive front collapses causes Advance's intermediate as well to stable deformation and require pilot reaction.
Unlike the Blacklight the course change tendency is low.

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
Advance Epsilon 7.26						
40% collapse	30-39 m	30-45°	-30°	no	10-14 m/s	Moderate pitch back, recovery times vary between fast and delyed with closed wingtips return to normal flight with low dive forward, no course change
Maximum collapse presented by construction	>60 m	30-45°	45-55°	Yes, >90°	15-20 m/s	Moderate pitch back. Stable frontstall with low course change tendency. No self recovery, pilot action required. Marked dive forward on pilot recovery. High sink rate.
Nova Mentor 3 M						
40% collapse	20-29 m	30-45°	30-45°	no	10-14 m/s	Moderate pitch back, moderate pitch forward, immediate recovery, no course change
Maximum collapse presented by construction	40-49 m	45-55°	45-55°	Yes, <90°	10-14 m/s	Marked pitch back, marked pitch forward, immediate recovery usually slightly assymetric, course change <90°
U-Turn Blacklight M						
40% collapse	20-29 m	30-45°	30-45°	no	10-14 m/s	Moderate pitch back, moderate pitch forward, immediate recovery and rapid return to normal flight, no course change
Maximum collapse presented by construction	Pilot action required to recover after approx. 60 m height loss	30-45°	45-55°	Yes, >180°	15-20 m/s	Moderate pitch back, stable front stall with high tendency to twist and turn. Pilot action required to prevent twists and cravats. Marked dive forward on recovery. High sink rate
Gradient Nevada 28						
40% collapse	20-29 m	30-45°	30-45°	no	10-14 m/s	Moderate pitch back, moderate pitch forward, immediate recovery, no course change
Maximum collapse presented by construction	30-39 m	45-55°	30-45°	Yes, <90°	10-14 m/s	Marked pitch back, moderate pitch forward, slight delayed assymetric recovery
Swing Mistral 7.26						
40% collapse	30-39 m	30-45°	-30°	no	10m/s	Moderate pitch back, low pitch forward, slight delayed recovery, no course change, low sink rate
Maximum collapse presented by construction	40-49m	45-55°	45-55°	no	10-14 m/s	Marked pitch back, marked pitch forward, usually slightly assymetric immediate recovery, slight tendency to remain closed with delayed recovery.

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 Epsilon 7 and Blacklight both had no problems with B-stalls. These canopies did not deform when stalled, and regained normal flight immediately on recovery. Swing's Mistral 7 begins to deform after about 5 seconds in a stable B-stall with sink rates of 8 m/s. The wingtips begin to bend to the front and signal to the pilot that recovery is necessary. Releasing the B-risers to recover prevents the danger of a cravat in this situation. On the Mentor 3 this behaviour occurs even faster, and the glider handbook makes a clear statement about it. For both gliders it is better to cross the B-stall off the list of flyable descent manoeuvers.



Without difficulty: B-Stall with Epsilon 7 and Blacklight.



Mistral 7: Short stable sink phase and marked deformation tendency.


Spares the stable sink phase and deforms immediately on entry: Nova Mentor 3.

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
Advance Epsilon 7.26		8 m/s no slight	15°-30° 30°-45°	-20 m	stable sink phase
Swing Mistral 7.26		8 m/s yes yes	15°-30° 30°-45°	-20 m	Short stable sink phase, marked deformation tendency
U-Turn Blacklight M		8 m/s no no	15°-30° 30°-45°	-20 m	stable sink phase
Nova Mentor 3 M					Not recommended, canopy deforms immediately on entry

Spiral dives

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.

U-Turn's Blacklight collapses on the outer wingtip when entering a spiral dive which prevents the glider from accelerating further into the dive. On brake release the glider quickly self recovers back to normal flight. The Epsilon 7 reaches higher sink velocities but recovers to normal flight after a short acceleration on brake release. More time to recover is needed by the Mentor 3, the glider turns through a further 360° with a high sink rate on release of the inner brake before beginning self recovery. The Mistral 7 is somewhat more challenging and looses the most height after initiating recovery but is a great improvement over the Mistral 6.

Spiral dives							
Glider	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
Advance Epsilon 7.26	8 m/s 18 m/s 22 m/s	2,2 G 3,7G 3,8 G	30m 90m	40m	0-6 s 7-9 s	Acceleration from 18m/s to 22 m/s in the next 90°, then recovery within the next 180°	Dynamic transition from entry to spiral. High sink rates attained in short time. Exit relatively easy, automatic recovery with low course change
Swing Mistral 7.26	7 m/s 16 m/s 18m/s	2,1G 3,2 G 4.0 G	30m 60m	90 m	0-8s 9-14s	Acceleration from 16m/s to 18 m/s, constant sink rate >16 m/s for 360° then automatic exit and recovery in the next 180°	Relatively dynamic transition from entry to spiral. Exit relatively challenging due to constant sink rate for 360° and large height loss.
U-Turn Blacklight M	8 m/s 14 m/s 18 m/s	2.1 G 3,5 G 3,8 G	30 m 80 m	20m	0-8s 9-12s	Acceleration from 14m/s to 18 m/s in the next 90°, then automatic exit and recovery in the next 90°	Easy behaviour. Glider collapses on outer wingtip at 14 m/s preventing further acceleration. Very short acceleration phase on exit, automatic recovery.
Nova Mentor 3 M	9 m/s 16m/s 20 m/s	2,3 G 3.4 G 3.8 G	30 m 80 m	80 m	0-7s 7-10s	Acceleration from 16 m/s to 20 m/s constant sink rate >15 m/s for 270° then automatic exit and recovery within the next 180°.	Relatively dynamic transition from entry to spiral. Exit relatively challenging due to constant sink rate for 360° before recovering automatically

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.

All gliders tested here had no real issues with big ears. The Epsilon 7 was the easiest glider to fly in big ears, on the Blacklight a little brake is needed to aid recovery, especially when flying accelerated big ears. As the Blacklight only has two main A-suspension lines, the highest sink rates were measured here. Both the Mistral 7 and Mentor 3 tend to flap their ears, but this does not provoke roll or yaw movements.

Big Ears					
Glider	Entry	Exit	Vsink (trim) Vsink (full)	Speed difference trim - full	Notes
Advance Epsilon 7.26	simple	Automatic	2.5 m/s 3.5 m/s	approx.3-5 km/h less than trim speed approx. 5-8 km/h more than trim speed	Very easy
Swing Mistral 7.26	simple	Automatic	2,5 m/s 3.5 m/s	approx.5 km/h less than trim speed approx. 5-8 km/h more than trim speed	Ears flap at trim and full speed, no course change
U-Turn Blacklight M	simple	Trimmspeed: automatic, delayed Accelerated: requires pilot action	3 m/s 4,5 m/s	approx.5 km/h less than trim speed approx. 5 km/h more than trim speed	Ears open with marked delay or require pilot action
Nova Mentor 3 M	simple	Automatic, at times markedly delayed	2.5 m/s 3.5 m/s	approx.5 km/h less than trim speed approx. 5-8 km/h more than trim speed	Ears flap at trim and full speed, no course change