Atos Exchange of Experiences

In this article you will find a summary of important experiences with the Atos. In addition I have included what, from my point of view, are the most important check-points of the glider and some common "daily" mistakes I have noticed. This is to keep the accident risk as low as possible.

Since quite a lot of Atos are flying worldwide (some of these have more than 300 hrs), the experiences compilation should be correspondingly large. This is why I would like to ask all the pilots to read these pages attentively, together with other flying colleagues in order to discuss about it and, if possible, to share with us your positive and/or negative experiences.

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1. Stalling and Spinning

Every flying machine can be brought to a stall by flying it too slowly, This can be done by pulling the control stick very strongly on aerodynamically controlled machines or by heavily moving the center of gravity backwards on weight-shifting controlled machines. Almost every sailplane can be made to spin. It represents a risk for flying machines that, while spinning, have the center of gravity lies too far behind.

A flying machine will spin when the airflow is interrupted in a stronger manner in one wing than in the other, by which the latter wing loses its lift and it sinks. The angle of attack will be increased and the drag increases, as a result the wing falls back and turns in. Through this rotation the airflow speed will decrease in the inner wing while it will increase in the outer one.

The hang glider pilot can avoid spinning when he/she does not shift the center of gravity too far backwards.

Other factors that may affect spinning, besides the position of the center of gravity, are the type of the wing profile, lift and mass distribution. With the VG-on and a low twist it is possible, for instance, to spin easier. On the rigid wing, the position of the flaps has little influence on the spinning behavior. The mass on the outer wing does affect, though, on how fast you will be able to come out of it. Regarding sailplanes, for instance, there are big differences to determine. When carrying water ballast it is harder to come out of a spin than when flying without it.

While in sailplanes spinning is part of the training and before getting the license the instructor will show you how it works, in hang gliding this is not done. Should a pilot unintentionally spin a glider, it is good for him/her to know its behavior during it and how it will come out of it.

It is only possible to spin a glider if the pilot pushes the control bar too far out. In calmer air mass you can usually perceive the signs of a stall easier than in rougher conditions in thermals.

Essential for the "good nature" of a glider is whether it can actually be made to spin. In order to avoid an unplanned spin, it is also very important to know which signs the pilot gets before the glider enters a spin.

1. Pre-stalling and Spinning the Atos

Influence of the Velocity

Depending on the load the Atos, at speeds under 39-43 km/h, slowly begins to stall. The sink speed increases, the bar pressure intensifies and the roll response slows down. The control bar is, depending on the pilot's height, roughly in front of his/her head. With this flight speed it is possible to thermal. The pilot has, though, limited maneuvering capability, higher sink and a smaller clearance to stall (mostly soft dive in) in more turbulent air.

At, approx., 29-32 km/h (depending on the load and the flaps) the sink strongly augments and the bar pressure will be significantly higher. The glider loses the "direction stability" which means it must be kept on course using the spoilers. Otherwise, it lightly drops a wing and picks up speed. At this point your arms should be almost stretched out. If you try to stop the wing dropping in curve by pushing further out, the inner wing may stall and make the glider spin. Best way to get out at this point is to move the bar back to neutral or pull and move to the higher side.

This sounds maybe strange for pilots used to planes with ailerons. Trying to get out of a slow turn with aileron controlled plane, the aileron at the inner (lower) wing goes down which increase the drag at this wing and which reduce the max. angle of attack before stalling. This means trying to go out of a turn with the aileron flying closed to stall can start a spin. Better way here is to get speed first and stop getting into the turn with the side rudder.

Getting out of a turn with a spoiler controlled wing, you increase the drag and degrease the lift at the outer or higher wing, the inner wing moves forward and the angle of attack decrease at this side. Both effects help to avoid spinning.

Trying to tighten a slow turn has the opposite effect. You degrease the velocity at the inner wing cause of the deflected spoiler there and increase the angle of attack at this wing which makes separation of the airflow and entering into a spin possible.

During tests two different types of spins have been observed.

The glider spins with low speed and turn quite flat and slow. One way to stop this first type of spin, is to move the control bar to neutral and the glider will then stop the turn picking up speed by droping the nose slightly. The loss of altitude is minimal and some pilot maybe will not know, was this a spin or not.

In the second type, one wing will stall decisively. The glider will turn approx. half or three quarter of a turn and the wing leans towards the nose. This will happen so fast when the spin has started that the pilot has no time to react. The glider starts to dive with the nose down. During the tests the control bar was moved to neutral or slightly pulled in after entering into the spin.

Spinning the ATOS s

With the small Atos (ATOS s) it was possible to spin stable with full deflected flaps. The rotation was not as fast as with the Atos. To exit the spin you should pull the control bar in, by which the rotation quickly stops and the Atos dives lightly (This was done during certification test and after getting certification several times). With the other flap settings the bank angle when stalling gets flatter. With higher flaps deflection, the control bar position in trim speed is further back than with less flap deflection. This makes pushing out at landing easier and has to be considered while thermaling or doing the landing approach.

With full flaps deflection the pre-stall starts with the control bar a bit in front of your head. Until the possible spin (arms almost stretched out) the bar pressure decisively augments and the glider increasingly loses "direction stability". One wing drops and if you try to stop it by pushing the bar further out, it will begin to spin. In practice, it can happen unintentionally, for instance, when you turn in the typical hang gliding way where the already slow flying wing just needs a little "kick" to stall. The DHV tests have demonstrated that the Atos has no aptitude (pre-disposition) for spinning which means, that there are enough signs present before the stall and spinning but this means not that it is not possible to spin!

When the Atos is trimmed slowly, you only need to push, with much less strength compared to a fast trimmed glider, to reach the stall. The Atos should be trimmed in such a way (it depends on the pilot's weight) that, during thermaling you should not need to pull in or push out flying the right speed (see below). Whoever is used to pushing-out while thermaling should move the hanging point forward.

In spite of several pilots not succeeding to intentionally spin the glider; this does not mean that with a small influence from turbulence and the same reactions from the pilot, it would be impossible to make the glider spin with the same pilot reaction!

2.2. Pre-stalling and Spinning the Exxtacy

Its pre-stall characteristics are similar to those of the Atos; the Exxtacy forms part of the wings that I know best. In a flat spin if you push further out it makes ¾ of a turn very fast and the rotation stops with the nose down and a dive. This rotation is so fast that, as soon as the glider suddenly starts to turn away, the pilots cannot do anything to influence it. The spin was so hard that no test pilot liked to do it a second time.

Due to these harsh reactions the control bar was subsequently set so far in front that, with his/her hands on the bar an average sized pilot could not spin it. The small Exxtacy behaves in a similar way. Since it has the control bar behind the one of the bigger glider, because it was designed for smaller pilots, it is possible to spin it.

3. Conclusions for the Pilots

Each pilot should test, in calm conditions and with enough height above the ground (approx. 800 mts), how far it is possible to push the bar out, before any signs of a stall are noticeable, as described above. If the glider tends to dive or drop a wing, the bar should be let loose and must not be pushed further out.

You may ask why spins are not intentionally practiced. During intentionally spinning flexible wings several accidents have happened. Weather conditions and pilot weight may cause different spinning behavior.

From my point of view it is very important to know at which control bar position the stall begins and how it announces itself, in order to stay away from this position during your flight. This is why when a stall begins the control bar should be moved to the neutral position. Should the Atos drop a wing during thermaling due to a stall, the best way to avoid a spin is to pull the bar in **and** at the same time shift your weight to the opposite side. If you are already in a spin, the fastest way to come out of it is by pulling the bar in (little bit more than neutral position).

It is very important for every pilot to fly with an anemometer, in order to be able to control your airspeed.

According to my own experience and those I've shared with other pilots, the airspeed cannot be accurately estimated. In more turbulent conditions usually you thermal at a higher speed than what you think. Flying too fast, in this case, decreases the climb rate. The opposite situation happens, at least, as often: if you thermal too slowly, the performance will be reduced and, at the same time, the safety reserve will decrease in a fatal way, as it has been described above (see previous information and following one too).

4. Constructive Modification Possibilities.

It is possible to set the control bar further in front by modifying the under wires, so that the push out range will be minimized. Compared to the Exxtacy, the bar on the Atos during thermaling is set approx. 15-20 cm further backwards. Many Atos pilots felt more comfortable with this setting.

Using an alternative A-frame (apt for already existing Atos too) is presently being tested. This A-frame is somewhat bigger and it makes it easier to hook-in. In order to change your velocity with this new A-frame, you will need to make bigger shifts. The control bar setting, at trim speed, will be further in front.

2. **Tuck**

Often we have heard that rigid wings don’t tuck. The DHV, under the guidance of Martin Jursa, performed drop tests with flex wings. A weight was fixed on the glider, which simulated the pilot’s weight so the glider would fly at trim speed; the glider was then dropped at different angles of attack. It was amazing that the glider, already at small angles of attack, would dive radically and/or even tumble. The Exxtacy that was also tested dove quite fast and even tumbled just like the flex wing. The rotation started very fast and it would increasingly slow down until it came out of the inverted position and quickly re-acquired its normal flying position. A stable tuck, where the glider tumbles several times, could not be observed. The cause of this, compared to the flex wing, could be that the lying pilot’s center of gravity is closer to the wing through the smaller A-frame which acts in a positive manner, as well as the minimal deformation of the outer wing.

Generally it is possible to tumble every flex and rigid wing, still the following factors may have an influence.

The further back the center of gravity is, the easier the wing will tumble (less damping by rotation around the lateral axis as with the bare pulled in). Substantial dive damping like, for instance, with the use of a rear stabilizer or by setting the center of gravity further in front, is favorable. Hanging closed to the wing with a short A-frame is favorable too, cause the mass moment of inertia is low.

Turbulence, relative to airspeed, should be low. If the pilot flies with, for example, 45 km/h a wind sheer of 20 km/h can reduce his airspeed in the worst case, to 25 km/h. In an other case if the pilot, flying that slow, encounters a strong lifting or sinking air mass of 45 km/h, the angle of attack will change about 45° which, in any way, means a stall. If the speed is higher and the glider is flying fast enough, in the first case, there could still be enough airspeed left; in the second case, the change in the angle of attack would be smaller. In both cases the extra speed would prevent a stall situation.

All the competition pilots we questioned reported that the Atos showed more damping when flying in turbulent air, as their previous flex wings. All in all the pilots reported that flying rigid wings, especially in turbulent conditions, made them feel safer.

Nevertheless, Atos and other rigid wings have tumbled. One pilot was thermaling at 30-35 km/h in strong lift and probably fell out of the thermal. At this point the glider tumbled forward. The pilot deployed his emergency parachute and landed safely. Two other cases where reported in similar non-flyable conditions, in extremely strong turbulence; one in presence of Mistral wind in southern France and the other one flying on the lee side in Wallis (Switzerland, Fiesch region) with very strong NW-wind. In both cases, the glider tumbled forward but, eventually, it returned to its normal flying position. Both pilots ended their flights unharmed and their wings without damages.

1. Recommendations for Pilots

The more turbulence you encounter, the faster you should fly. This has the advantage that the changes in the angle of attack caused by turbulence will be diminished and you will not fall below the minimum velocity (see above). Flying faster is safer ,even if you don’t expect turbulence it can suddenly appear that you fly into turbulent air.

If it is turbulent and the thermals quite narrow, thermaling with high bank angle has been proven the best. Thereby, you will stay in the core of the lift and will not end up easily in the turbulent downwind area (surrounding the lift). In addition, when thermaling steeply you should fly with extra speed in order to maintain your wing load high (better stability) and the center of gravity will be further in front (greater damping). If the load factor is shortly reduced, the pilot can briefly add some quick spoilers deflection since, especially at higher speeds, the spoilers create a strong pitch up moment which will get you back into place.

Thermal with about 5° flap deflection when you expect turbulence.

Flying with flap 5° makes it easier to fly fast as with more flap deflection. Additionally the pitch characteristic of the glider is more constant as with more flap. The roll rate is slower as with more flap but due to the higher speed you have a better control and the influence from turbulence is less.

3. Recommendations from A-I-R and Other Atos Pilots.

Enclosed you will find the initial notes of a compilation of occurrences submitted by Atos' pilots which appear, and we consider, to be of great importance.

1. Recommended flight speeds in thermaling

In completely calm conditions and sufficient height above ground:

Approximately 39-42 km/h (minimum sink)

In average lift, light turbulence or calm conditions when flying close to the slope:

Approximately 50-55 km/h

In stronger turbulence and strong lift:

Approximately 55-70 km/h

Note:

These values have been collected through verbal reports of several pilots who fly very often with their Atos, and often in competition as well. Please note that depending on the way of fixing of the anemometer to your glider, different values may be attained.

My opinion is that it is best to check by yourself, with enough height and in calm conditions, below which speed the sink rate increases and at which speed it decreases. This way you will be able to get your flight speed for minimum sink. The advantage of doing it yourself is that the error of your anemometer will be taken into consideration.

The speed of min. sink should be your minimal speed when thermaling. Flying slower not only diminishes the performance but also the safety reserves. When flying in turns the glider needs to have more lift, since one portion of this lift must work against the centrifugal forces. This extra lift must be considered by increasing the speed.

Example:

The minimum sink of the Atos in straight flight is at 42 km/h, with a 30° bank angle the minimum sink is at approx. 45 km/h, with a bank angle of 45° at 50 km/h and with 60° bank angle at approx. 59 km/h. Correspondingly the stall speed is higher at higher bank angle. Flying slower will cost performance. In turbulent conditions the speed must be additionally increased.

2. Take Off

- It is important to control you flap setting (about 15-20°). This means that the knot on the cord that with 0° flaps is in the clam, should be in the middle between the first and second speedbar bent, in take off setting (rope is pulled out about 16 cm).
- Before your take off run check once again, by moving the A-frame and pulling the spoilers totally, if steering is light and if the wings are leveled. In addition take a look to one wing to be sure the wing is leveled.
- Start your run with a flat angle of attack. The wing tips will have more free space regarding the ground and the glider will react better to any corrections. Before your first flight or when feeling unsafe, practice your run in a flat field with different wind conditions!
- Especially when you need to make steering corrections, as you are taking off make sure to have some extra speed (pitch up moment of the spoiler).

3. Landing

- With full flaps, don't do any harsh steering. If possible, check the flight behavior with full flap with enough altitude and different speed to get practice.
- When changing your hands' position make sure to have extra speed. Grab the lower part of the downtubes; if you put your hands too far up you won't be able to maintain the necessary speed. It also helps to have the glider trimmed a bit faster.

4. Check

1. Steering

- You should be able to steer quite easily (lightly). Regularly check your cables and pulleys to see how worn out they are and, in case of damage, replace them. All bolts are secured with safety laquer; when you change one, use new safety laquer.

2. Nose Fitting

- After a nose-in (crash with the nose), you must check the nose fitting. The screw-fitting may bend, the flap lever's hook can be damaged and/or the nuts can be bent.

3. Sail

- Every time you assemble and disassemble your glider make sure that the sail is tight enough and, if necessary, adjust it. This applies for the wing tips, carbon ribs and the fixing mechanism to the keel (straps and rings).
- Check your sweep: If the webbing connection get stretched during the time the sweep back of the wing get less. Note: Adjusting the wing with more sweep didn't change much, too less sweep can cause safety problems. If you have to readjust this the rope which mark the sweep dimension at the keel should be 1-2cm more in the rear to be sure you are on the save side. How to measure: Connect fish cam of rib no.9 with a rope from one side to the other/ hold the keel in water level/ the rope should touch the keel at a point were a mark is or 2cm further back/ the mark is 2285mm from the front edge of the upper plate which connects the spars.
- The flaps has to be fixed at the trailing edge in a way, that the outer side of the flap is in line with the trailing edge of the sail. If you readjust this fix the flap about one ore two cm more inside cause they will move out little bit till the velcro connection is stretched.

4. Most Common Mistakes

1. Assembly

- Not fixing all the ribs to the sail
- The nose fitting (referring to the former screw-fitting; which, can be exchanged for the latest version with the lever) is tensioned under load, because the wings are not totally open, don't have the wing tip in and are touching the ground.
- Absolutely pay attention that the quick-pin on the A-frame is secured with the safety ring or cap.

2. Take Off

- Nose angle is too high
- Wings are not leveled when you start to run
- Running too slow and pushing out too early

3. Landing

- Full spoiler deflection at high speed
- Very low speed at the moment of changing your hands' position or because of gripping the dowuntube too high.
- If it is hard to flare, check your harness. At some harnesses the hang strap is further at the back. The hang strap can interfere with your flap rope. Check this before flight by doing a hang check with full flap setting and pushing out. Knotting the rope from the pulley to the flap tighter can help. Important: When doing a hang check lift the keel end. Don't pull the nose down.

4. Flight

- Flying too slowly, especially when thermaling
- Best glide flap position 5°! When thermaling, somewhat higher. Turbulent thermaling with 5°

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