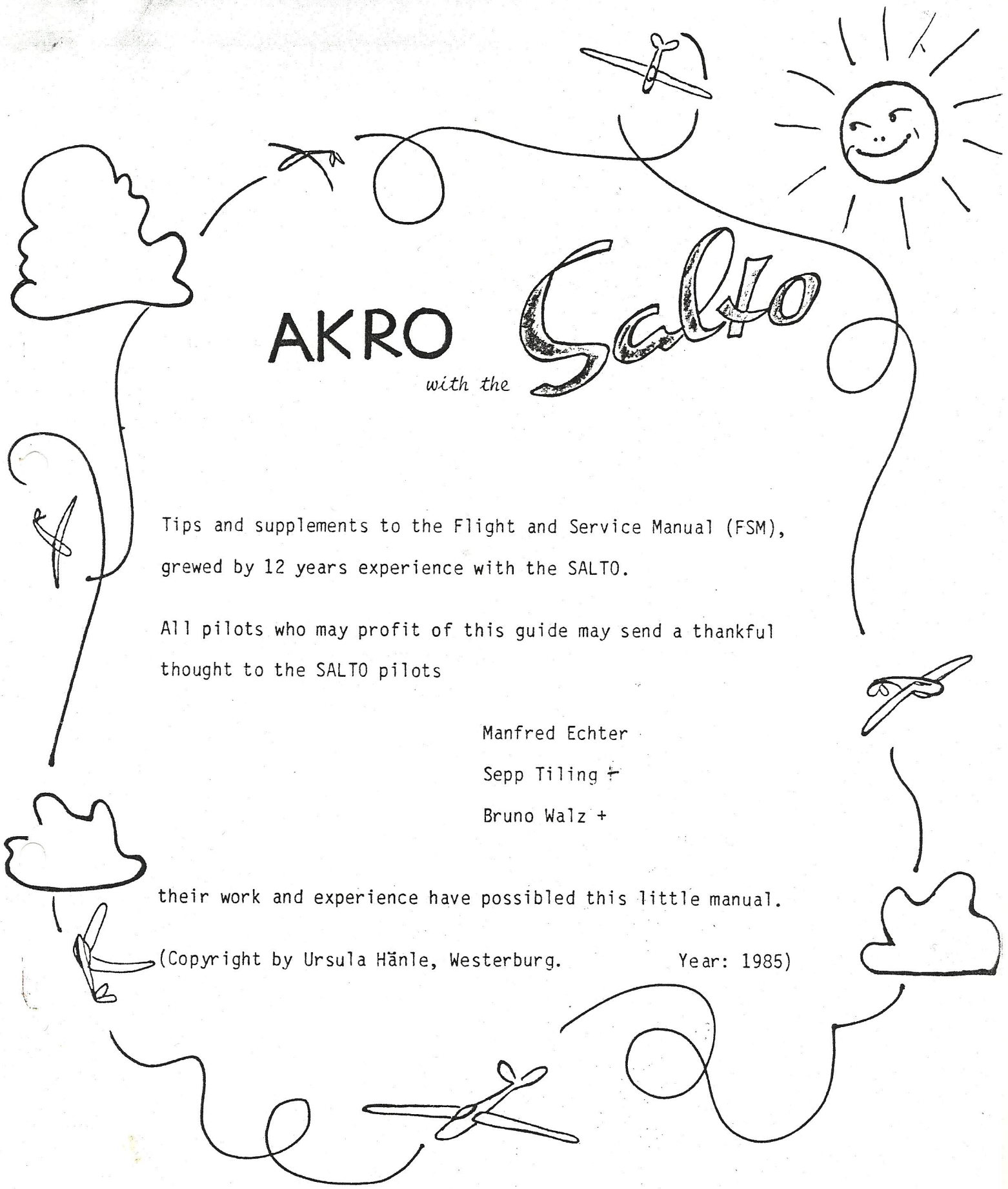

AKRO *with the* Salto

Tips and supplements to the Flight and Service Manual (FSM),
grewed by 12 years experience with the SALTO.

All pilots who may profit of this guide may send a thankful
thought to the SALTO pilots

Manfred Echter
Sepp Tiling +
Bruno Walz +

their work and experience have possibled this little manual.

AEROBATICS WITH THE SALTO

Appendix to the Flight Manual

If you want to get started in aerobatics it takes a little more than just the normal pre-flight check. You must consider the appropriate regulations and a few more things which aren't written down in regulations.

First the written rules: For aerobatics, the operating data and limitations of Category A apply:

See page 15 of the Flight and Service Manual (FSM).

The sailplane itself won't need any modifications. However, you must remove the wingtip extensions, the oxygen-bottle (if it was installed) and all loose objects from the cockpit and the baggage-compartment. The only specialized equipment mandatory for aerobatics are g-meter and loops on the rudder pedals. The side-pocket in the cockpit must be shut securely.
The maximum allowable mass of the instrument panel for aerobatics is 8 kg (17.6 lbs). Heavy instruments, with a c.g. behind the panel must be secured by an additional mounting bracket attached to the horizontal part of the instrument panel.
Sit in the cockpit with your normal equipment (parachute, seat cushion etc.) which you'll be using during aerobatics and check whether you get full control deflections without any restriction. Check that the cover over the control linkage underneath your knees is securely fastened. You know, this cover carries the stops for the stick travel. If it moves when you're bumping the stick against the stops, you must check if the mounting holes are worn out. If necessary, the holes can be mended with washers of the proper size, laminated on with some fiberglass and epoxy.
You know that aerobatics performance in a competition will be graded by judges as in figure-skating or in gymnastics. Just as in these sports, you can only perfect your skills if you practice under the supervision of a coach who can recognize your errors and help you to correct them.

In order to qualify for an aerobatics ticket, you probably have to pass some sort of a formal course. If there is no glider aerobatics training of any kind where you fly, try to get some basic aerobatics instruction in a suitable airplane from a qualified instructor. Never attempt to learn aerobatics from the beginning on your own! After you have been shown the first figures in a dual-control trainer, you can safely get into your own familiar sailplane for further practice. If you are not yet familiar with the SALTO you must first get accumstomed to the flight characteristics of the SALTO in some hours of thermal flight before you may start practicing aerobatics in it. The optimum way of learning glider aerobatics is undoubtedly first to learn the maneuvers in one of the modern aerobatics fiberglass two-seat sailplanes, and then to go on practicing solo in the SALTO.

It may be helpful for the beginning to apply a grease-pencil mark to the canopy for a "nose-reference" in various maneuvers. This mark should be in the place where you see the horizon when you fly a steady airspeed of approx. 150 km/h (80 knots). Naturally, the good old yaw-string is important to check whether you're skidding or not.

Some Words on the SALTO's Characteristics

As you can see from its outward appearance already, the SALTO from its design is not specialized only for aerobatics. It is rather a typical modern fiberglass high-performance sailplane, which due to its structural strength and its maneuverability is suited equally well for aerobatics. Some of its design characteristics have a strong influence on its handling and performance in aerobatics:

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- wingspan

The 44.6 -wing will certainly not produce the roll-rate of a Pitts. The average SALTO takes approx. 7.5 seconds to do a 360° roll. If you are one of the lucky few with a Mk. 2 SALTO, you can do a roll in a little less than 6 sec.

- high aspect-ratio wing

For good glide ratio, a sailplane needs a high aspect-ratio wing. In a small sailplane like the SALTO, this means a narrow chord and consequently a small permissible c.g.-travel. For aerobatics, you must be extra careful to check your actual c.g.-position within limits. Particularly an aft-c.g. position can be a hazard, as it will adversely affect the spinning characteristics.

- dihedral

For good lateral stability and sufficient ground clearance of the wingtips, the SALTO has a dihedralled wing. This will naturally reduce lateral stability in inverted flight.

- cambered wing section

For good gliding performance the SALTO wing has a cambered airfoil section. Therefore, the flight characteristics differ markedly from upright to inverted flight.

- Vee-tail

The Vee-tail will not normally influence the aerobatic performance of the SALTO. But like in all fiberglass high-performance sailplanes, the rudder effectiveness is somewhat limited, which requires a few special tricks to do some aerobatic maneuvers well. The center of pressure of the tail is above the longitudinal axis, which produces a slight rolling moment with rudder deflections. In a turn entry, this rolling moment

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counteracts the roll introduced by the aileron deflection, but compared to the leverage of the ailerons, the distance of the center of pressure of the tail from the longitudinal axis is very small and thus the effect is practically insignificant.

light control pressures only and small control travels (particularly the rudder)-

so be gentle on the controls especially at high airspeeds. Remember, the maneuver-speed is 160 km/h (86 knots). At speeds above the maneuver-speed, only limited control deflections are permitted (you won't need full control deflections at high speeds anyway). The SALTO's structure is tremendously strong, but you can't design an airplane so strong that it couldn't be overstressed by some ham-fisted pilot.

small dray and a very small change of longitudinal axis over a wide area of speed - this is necessary for a good cross-country performance but:

When practicing aerobatics in the SALTO, keep in mind that it picks up speed very rapidly whenever you are descending steeply. In any aerobatic figure where a vertical descending line is required, the line will only be shown for a short moment to prevent the sailplane from picking up excessive speed before it is recovered to a normal glide.

Remember all these facts and play your trumps given by the plane, but observe also the dangerous possibilities.

- effective airbrakes — You may deploy the airbrakes any time up to the max. permissible airspeed. Never open the airbrakes abruptly, but don't hesitate to use them if necessary to keep the airspeed from exceeding in critical situations. Keep in mind that with airbrakes deployed, the max. positive load factor is + 3.5 g.

Checks

Preflight check:
- all loose objects removed
- all 4 canopy latches engaging properly
- all covers closed, sidepocket closed
- lap belt and shoulder harness properly attached and snugly fitted
- c.g. - position correct *
- parachute properly fitted
- airbrakes in and locked
- rudder pedals adjusted and secure, toes in inverted flight loops
- all controls free and full travel
- trim set neutral

Before starting aerobatics:
- airspace clear
- harness tight
- trim neutral
- sufficient height

* with the choiced equipment, clothes, shoes

It may be helpful to cut out a little paper glider, for to play with it the control maneuvers of the figures. Such a little thing can explicate you sometimes to overlook a bad problem.

How to do some of the most common aerobatic figures in the SALTO

The following tips are coming from Manfred Echter, pilot of German aerobatic championships.

There are sometimes little differences in the method of other experienced pilots as Sepp Tiling and Bruno Walz, they feel that the good command of inverted flight shortly after learning the loop should be raisonable. Walz recommands to study in a very early state all straight lines - normal, inverted, 45 degrees.

It may be a discussion concerning the time table - but it is clear that these lines should be exactly mastered. In a competition a line of 45° has to have 45° - otherwise you earn minus points. And also a turn will not be lucky if the plane will not shut into the sky fully aligned.

Certainly there will be some different ways to come to perfection. Let us hear what Manfred Echter recommands:

Spins

To some pilots the spin is not a "true" aerobatic maneuver. They consider it a situation, into which you can get inadvertently and thus there can't be much finesse required to do it. Is that really so?

First to dispel an old rumor: If you have heard that airplanes or gliders with Vee-tails are difficult to recover from a spin, forget it, at least as far as the SALTO is concerned. You'll recover your SALTO from any upright spin by the same standard procedure that is applied for recovering practically any modern sailplane:

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Standard Spin Recovery Procedure

- Determine direction of rotation
- Apply full rudder opposite the direction of rotation, maintain full rudder deflection- Push the stick well forward of the neutral elevator or more position and hold
- As soon as the rotation stops, neutralize rudder and recover smoothly from the dive
- Maintain aileron neutral or apply aileron with the direction of rotation; never apply opposite aileron before the rotation has stopped.

You'll enter an intentional spin from a speed that is approx. 10 km/h (5 knots) above the stall speed for your weight. You start with a full rudder deflection in the intended direction of rotation. Immediately after, you pull the stick fully back and hold both full rudder and elevator. You may accelerate the spin entry by an opposite aileron deflection, as the adverse yaw produced by the aileron assists the yaw introduced by the rudder and thus helps to produce a stall with a rotation. However, as soon as the spin rotation starts, you must neutralize the aileron again!

It is possible that you won't get your SALTO into a spin, if your c.g. is too far forward. In this case, it may enter a steep spiral, which could be hazardous insofar as the speed picks up rapidly and you may overstress the sailplane if you try to recover incorrectly. You can recognize the steep spiral immediately by a sudden and marked increase of the wind-noise and a simultaneous increase of seat-pressure and control forces. Recover from the steep spiral immediately by first rolling wings level (like recovering from a steep turn with aileron and rudder) and then pulling out of the dive. If you attempt to recover from a steep spiral by simply pulling back on the stick, you'll only aggravate the situation, as the spiral will be tightened, the load factor increased, and because the glider's nose stays below the horizon, the speed will increase even further.

Let's assume, your SALTO did enter the spin without any problems. You'll notice that the SALTO - like most modern fiber-glass sailplanes - initially oscillates very markedly around all three axes. Pitch attitude and rate of rotation will vary considerably in the course of one revolution. The sailplane's nose may even swing back above the horizon. Beginning with the

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third revolution, the oscillations will die out. Especially with an aft c.g. the spin will probably become "stabilized" i.e. the rotation becomes completely steady and the pitch attitude remains constant. In this stage of a spin, watch out carefully that the nose of the sailplane doesn't start to rise. This would indicate a tendency to go into a flat spin. Opposite ailron in the spin will tend to flatten the spin and should therefore be avoided.

When recovering from a developed or stabilized spin and in any case when there is an aft c.g. condition, the stick should be brought all the way forward, rather than just ahead of the neutral position. Ailerons deflected in the direction of rotation produces additional drag on the outside wing and thus assists the recovery. If you recognize a tendency towards a flat spin or if you have the impression that the recovery takes inordinately long, don't hesitate to use the dragchute. Under normal conditions, the SALTO should't take more than 1/2 revolution to recover, once recovery controls are applied properly.

Now that we have covered spinning in the SALTO, let's have a closer look at the figures required for the German aerobatics rating:

Loop

The loop is the simplest of all aerobatic maneuvers, yet there are still a few things that can be done wrong. There is one particular criterion for a correctly executed loop: it must be circular. This requires careful matching of elevator pressure to the varying speed throughout the maneuver.

Entry airspeed should be 180 - 200 km/h (100 - 110 kts). The nose of the sailplane is well below the horizon at the start. Select a line on the ground along which you can line yourself up, so you can check the direction again when completing the figure.
Now you pull up smoothly with steadily increasing back pressure. As soon as the horizon disappears below the nose, you switch your visual reference to the wingtip for better bank control. You keep increasing back pressure as you go through the vertical attitude towards the inverted position. Now you look again to the horizon, which should become visible when you move your head back. As the nose comes to the horizon in the inverted attitude, you

must release back pressure sufficiently to keep your loop circular. If you would maintain the elevator deflection that brought you over the top, the sailplane's nose would drop very rapidly with the now relatively low airspeed and you would end up with an egg-shaped loop. Don't overdo releasing the back pressure: You should always keep positive seat pressure. On the other hand, if you release back pressure too early i.e. before the nose has reached the horizon, the sailplane will go on travelling on an upward trajectory, losing even more speed, till it drops off sharply, spoiling the symmetry of your loop.

As the nose drops further towards the vertical attitude, you start to increase back pressure again, in order to recover in a proper circular trajectory, pulling the same loadfactor you started with (+3 ... 4 g) and coming out of the loop with approximately your entry airspeed.

Hammerhead or Stall Turn

If you look back to your dual instruction in the two-seater sailplane, you will remember the difficulties you had initially with the hammerheads. It is not much different in the SALTO:

In most fiberglass sailplanes the rudder effectiveness in relation to their wingspan is somewhat limited, making the hammerhead one of the trickier maneuvers.
Let's have a look at the criteria for a good stall turn: First, you must show an accurately vertical climb, then the turn itself must be done exactly in one plane i.e. the sailplane must turn about its vertical axis only, there must be no movement neither about the longitudinal nor lateral axes. And last not least, the figure must be completed with an accurately vertical descent before recovering into level flight.
The entry airspeed is the same as for the loop 180 - 200 km/h (100 - 110 kts) but since you have to show the vertical before starting to turn, you should pull up more sharply to tighten the upward arc. However, in no case should you pull more than +5 g. As you approach the vertical attitude, have a look at the wingtip you want to turn about. By aiming along the upper side of the wing, you can check the vertical attitude and make corrections as necessary by slightly increasing or releasing back pressure. In order to maintain a vertical climb or descent, you must hold the elevator "neutral": This means, you must maintain exactly the zero-lift angle of attack.

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Otherwise, if the wing would produce positive or negative lift, the vertical would "lean" backward or forward. This doesn't only apply to the hammerhead but to all other figures requiring a vertical climb or descent. You will have to maintain the zero-lift angle of attack through the turn at the top, in order to keep the turn in one plane.

While you are zooming upwards vertically, your airspeed bleeds off rapidly and you must be very careful not to miss the right moment to start the turn. For the beginning it is best to do it by airspeed indication. As soon as you have made sure that your climb is vertical, look at the airspeed indicator. At approx. 120 km/h (65 kts) kick the rudder to the desired direction. You hold the rudder fully deflected and immediately switch your visual reference to the inner wingtip again. You can judge the turn very well by watching the track of the inside wingtip. Provided the rudder was applied at the right moment, your SALTO will start to turn immediately with the remaining airspeed. Looking at the wingtip, you will most likely notice a tendency to roll in the direction of the turn. You counteract this with opposite aileron. As the airspeed in this phase of the figure is very low, control deflections must be quite large. Sometimes you may see that the nose tends to rise out of the plane of the turn. This is probably caused by dihedral effect, the yaw causing both a rolling and pitching moment. You can counter this only by forward stick during this phase of the turn. You see that the hammerhead turn can't be flown mechanically i.e. apply the controls and wait till the turn is completed, you rather have to control the turn by positive adjustments to the sailplane's attitude throughout.
As the flightpath is beginning to point downwards again - approx. 45° before you reach the vertical - you apply full opposite rudder to stop the turn and prevent oszillations about the vertical axis when reaching the vertical attitude. Naturally, you must neutralize the rudder immediately when the vertical attitude is reached to prevent skidding.
As the SALTO picks up speed very rapidly in the vertical descent, you may show the vertical line for a short moment only before recovering to level flight. You recover with about the same load factor you started with, to preserve the symmetry of the figure.

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Most common errors in the hammerhead:

- Initial climb not vertical

  You did not fully neutralize the elevator after the pullup. You can only recognize this error by checking the wingtip vertical on the horizon and correcting by a slight increase or decrease of back pressure. It is more common to climb with an angle less than vertical than to exceed the vertical line.

- Rudder applied too late

  You looked at the wingtip too long. The SALTO will do a small amount of turn and then it stops in mid air. Don't panick! Pull the stick all the way back and neutralize the rudder. Hold all controls firmly in place. The result will be a tailslide falling off to one side. It is not hazardous as long as you hold the controls firmly. Once your SALTO has flipped over into the dive, you can recover and try another hammerhead.

- Rudder applied too early

  You'll feel by the "seat of your pants" that you were too eager kicking the rudder. The SALTO will skid upwards more or less and eventually it will start to turn. The radius of the turn will be too wide and it is extremely difficult to keep the turn in one plane. Sometimes the turn will stop around the half-way point and you can't prevent the sailplane from flipping over. If this happens, keep the elevator pulled back, neutralize rudder and ailerons to prevent damage to the controls in case of a tailslide.

  You see: The key to a good hammerhead is applying rudder at the right moment. Find out and remember the optimum airspeed indication for your weight and don't fix your eyes to the wingtip too long.

- Skidding in the climb

  This happens, if your foot starts "thinking" ahead. Involuntarily, you deflected the rudder a small amount prior to the turn. When looking to the side, you can check the proper position of the wingtip on the horizon and correct a skid by neutralizing the rudder before the start of the turn.

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- Descent not vertical

  You started to pull out too early. You should hesitate a moment before pulling out of the dive. If you want to check your attitude by looking to the side, don't overdo it, and don't pull out too sharply. The arc should have the same radius as your pullup at the beginning.

Slow Roll

With slow rolls, it is important that the axis of the roll is exactly straight and that the rollrate remains constant throughout the figure. Before you start doing rolls in your SALTO, you should visualize what kind of picture of the sailplane's nose in relation to the horizon you expect to see in the course of a slow roll. Seen from the cockpit, the exact axis of the roll will go through a point in the canopy where the horizon is at a constant airspeed of 150 - 170 km/h (80 - 90 kts.). This incidentally is also the entry airspeed for the slow roll. If you keep in mind that the angle of attack required for level inverted flight in the SALTO is relatively high due to its cambered airfoil, you will understand why you must raise the nose well above the horizon before you can start to roll. If you didn't, the angle of attack when reaching the inverted attitude would be too small to produce the required lift and you would start to lose altitude. As the roll progresses from inverted to normal flight, the nose will drop back to the nose-low pitch attitude you started from. The pattern, the "nose" of your SALTO (actually the reference point for the nose in the canopy) follows in the course of a slow roll resembles a slender letter "D". As you raise the nose at the start, you describe the straight vertical line of the "D". The first half of the roll is done around the point at the upper end of this line. The curve of the "D" is produced as the nose drops back below the horizon in the second half of the roll. When you go through the knife-edge position, the wing must not produce lift, otherwise you would be turning away from the roll axis. Since the zero-lift angle of attack for the cambered wing is a few degrees negative, the nose must be deflected by this amount away from the exact roll axis, thus forming the curve of the "D".

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Contrary to modern competition-aerobatics airplanes, your SALTO cannot do slow rolls where the longitudinal axis is exactly parallel to the roll axis. The SALTO's longitudinal axis will always follow a corkscrew-shaped line. This is due to its cambered airfoil and the positive incidence of the wing. (You could design an aerobatic glider with a symmetrical airfoil and zero incidence. However, this would be no sailplane, but a "glide bomb" unsuited for cross-country soaring).
This should satisfy anybody's desire for theoretical explanations....

Let's try the practical part: For your first attempts, an entry airspeed of 160 km/h (85 kts) should be best. Pick a reference point on the horizon and raise the nose quickly to about 10 - 15 degrees above the horizon. As soon as the pitch attitude is established, neutralize the elevator and apply full aileron in the direction of roll. (If you are doing rolls at higher airspeeds, remember the maneuver-speed and reduce your control deflections accordingly!). As the adverse yaw helps you to keep the nose of the sailplane up in this part of the roll, you won't need the rudder to hold the nose up through the knife-edge position. However, you must watch out that the elevator is really neutral in the knife-edge to keep you from turning (zero-lift AoA). As you approach the inverted position, you must progressively push the stick forward in order to maintain the required angle of attack for inverted flight. In the second half of the roll adverse yaw will pull the nose down: Through the knife-edge position you will need full "up" rudder to keep the nose from slicing through the horizon prematurely. The elevator is brought from the "down" position in the inverted attitude through neutral in the knife-edge to slightly aft of neutral as you reach level flight again. In order to maintain a constant rate of roll, you leave the ailerons fully deflected until you reach a point just before wings level; then you stop the roll with a short and sharp reverse aileron deflection.

Common errors with the slow roll:

- Pitch attitude too low at the start
  The flightpath will be pointed downward. This results in unwanted loss of attitude and rapid increase of airspeed. Particularly in the inverted attitude the speed increase may become alarming. In this case you must always bring the nose up by pushing forward on the stick, before you start to roll upright. Never attempt to split-S out of this situation!

- Roll interrupted

A common beginner's error: Involuntarily, you reduced the aileron deflection, consequently the roll will slow and eventually stop somehwere - mostly in the inverted position. Force yourself to maintain the full aileron all the way through the maneuver.
Whenever things start to become confused while inverted, use the standard recovery procedure:

= Push the nose up
= Apply rudder and aileron in the same direction.
At high airspeeds: Do not use full control deflections!

- Poor directional control during first half of roll

The elevator was not neutralized before the roll was started. Remember the sequence:

= Establish the nose-up pitch attitude
= Stop the upward movement of the nose
= Start the roll

- Pool directional control during second half of roll

Two different errors can be the reason:
Most commonly, the elevator, which had been pushed forward in the inverted attitude, was held this way as the roll progressed to the knife-edge position. The flightpath will be curved in the direction of roll and the roll is widened to a spiral.
Or you tried to "speed up" the roll by starting to pull back when the sailplane was still partly inverted. As a result the flightpath will be curved away from the direction of roll and altitude is lost unnecessarily.

Immelmann

This figure is composed of a half loop and a half slow roll. As you must have still sufficient speed for the half roll when you reach the top of the half loop, you need considerably more airspeed at the start than for the simple loop. The half roll off the top should be done immediately after completing the half loop. There must be no visible portion of inverted flight between the two parts of the maneuver.

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You start the Immelmann with an airspeed of 210 - 230 km/h (115 - 125 kts) exactly like a loop. You should make sure that you don't pull up too softly, as you will need the extra airspeed later on. Around +4 .... 4.5 g should be a good pullup for the Immelmann. The further technique to come to the top is exactly the same as for the loop.
As soon as the sailplane's nose reaches the horizon in the inverted attitude, you start the roll by first neutralizing the elevator (zero-lift). As you are not going to fly off the top inverted, you won't have to push to the inverted angle of attack. Next you apply full aileron in the direction of roll, followed by full rudder in the same direction to keep the nose from slicing down. You'll see that the reference point for the roll axis will describe the arc of the letter "D" known from the slow roll.
Exactly like for the slow roll, you must be careful to hold the elevator in the zero-lift position through the knife-edge in order to maintain the direction of the figure. The roll is completed like the second half of a slow roll: Aileron remains fully deflected until shortly before level flight, elevator is gradually brought back as level flight is approached and rudder is continuously reduced to neutral from the knife-edge to the level attitude. At completion of the half roll you should be in a shallow glide, airspeed slightly above V_{min} and the direction of flight exactly 180° from the entry.

Common errors with the Immelmann:

- Roll initiated too early

  The roll was started when the nose was still well above the horizon. Depending on the rate of roll, the roll will be either completed above the horizon, then the sailplane will stall at the end of the roll from lack of airspeed, or the sailplane will skid down considerably in the knife-edge position, resulting in a large, spiral-shaped roll.

- Poor directional control during the roll

  Either the elevator was not released sufficiently, then the roll axis is curved away from the direction of roll and the flightpath is pointing steeply downward, or elevator was pushed too much, then the roll axis curves towards the direction of roll and the flightpath is also inclined downwards. Compare the same errors made in the slow roll!

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- Roll started too late

  The roll was initiated after the nose had fallen well below the horizon. In this case, the roll axis is not horizontal and the figure is incorrect according to the aerobatics criteria.

Reverse Half Cuban or Fishhook

This figure differs from the well known split-S in that the axis of the half roll at the beginning is pointing upwards at an angle of 45 degrees. The half roll is followed by 5/8 of a loop back to level flight. Since the roll rate of the SALTO isn't really breath-taking (unless you have a Mk. 2, which is somewhat better in this respect) you'll need an entry airspeed considerably higher than for a slow roll. Done properly, the 45°-line must be visible both before the start of the half roll and after it, before the part-loop is started. For this you obviously need some extra speed. Furthermore, to perform a nicely rounded loop, you'll need some extra airspeed over the top, to prevent a sharp "corner" when the nose is pulled down into the loop.
The entry airspeed should be 220 - 230 km/h (120 - 125 kts). With this speed you pull up fairly sharply to establish the 45°-line. The correct angle should be checked by a quick look towards the wingtip. With the angle established, elevator must be released to maintain the line. This short moment must suffice to show the correct angle, now you must start the roll at once to keep the airspeed from bleeding off. The technique for the roll is the same as for the first half of the slow roll, the only difference being the much higher pitch attitude. As you approach the inverted attitude, make sure that you push the elevator sufficiently to maintain the ascending line in inverted flight. Upon reaching the inverted attitude, you must show the line for just a moment, before you start bringing the nose gently down to the horizon to start the loop. When the nose goes through the horizon, you must release back pressure as in the normal loop to keep it nicely rounded. The remainder of the figure is done exactly like the second half of a normal loop, which should be well familiar to you by now.

Common errors:

- Ascending 45°-line too shallow

  Don't forget to check the proper angle by a look at the wingtip.

- Line not maintained during the roll

  You didn't establish sufficient forward stick pressure as the roll progressed from knife-edge to inverted attitude. Remember the negative angle of attack, you need to maintain the ascending line in inverted flight (actually you must gradually increase forward pressure as the speed bleeds off). It might help, if you ckeck the correct angle by another quick look at the wingtip: The upper side of the wing must again form a 45°-angle with the horizon. Don't make that look too long though, the airspeed needed for the transition to the loop will otherwise be gone!

- Sharp "corner" at the transition to the loop

  The most common error in connection with this maneuver is caused by either extending the ascending line too much or by insufficient entry airspeed for the roll. You might try to increase the entry airspeed somewhat, until you are sure that you can do the roll properly with some speed to spare at the end.

This completes the discussion of the figures required to get the German aerobatic rating.
The following chapters were written to hand on to you the experiences other SALTO pilots made with the execution of the more advance figures of the ALFA-Catalog. If you don't know this catalog yet, it was officially accepted by the International Aerobatics Committee C.I.V.A. as the mandatory listing of figures for international sailplane-aerobatics competitions. I would recommend for anybody who is truly interested in competition glider aerobatics to get a copy of this book, as it contains not only a list of the competition figures and their coefficients, but also valuable hints on the construction of aerobatic programs and the proper execution of the figures.

Tailslide

From your first attempts to master the hammerhead, a number of unintentional tailslides will probably be still quite fresh in your memory. In order to do the tailslide correctly, a few tricks must be learned. First for clarity: There are two basic types of tailslides. First the tailslide with stick backward, where the sailplane flips forward into the dive, and second the stick forward tailslide, where the sialplane falls backwards into the dive.

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The following points are important for the grading of a tailslide by the aerobatic judges:

- The vertical climb at the start and the vertical dive at the end of the figure,
- the visible slide backwards before flipping over,
- the proper attitude throughout the slide and the fallthrough i.e. the sailplane must not turn about either the vertical or longitudinal axes: The entire maneuver must consist of movements about the lateral axis only.

Here a few hints for the practical execution of the tailslide:
Entry airspeed and transition to the vertical climb are done exactly as for a hammerhead. It is extremely important that you do not skid during the vertical climb, particularly during the last phase immediately before the backwards slide. The slightest amount of yaw at this moment will cause your SALTO to fall off to one side, totally spoiling the figure. You may want to check the absence of a skid by a look at the yaw string. Naturally an unwanted aileron deflection during the vertical climb will cause a rolling movement and apart from that will also cause fall to one side.
When your SALTO is hangig vertically in the air, starting to slide backwards, you may only hesitate for one short moment, before you either pull the stick fully back or shove it all the way forward. If you hesitate too long, your SALTO will pick up speed in the tailslide very rapidly and the resulting fallthrough will be so violent, that you certainly won't try it a second time. I won't have to point out to you that you'll be overstressing the elevator and its hinges that way. Therefore, the slide backwards is done so that it is just visible, but not more!
The direction of the fallthrough is always prescribed in competitions, fallthrough in the wrong direction causes a grade of zero for the figure. Therefore many pilots try to "cheat". As always when you are cheating, it's important not to overdo it... To ensure that the fallthrough will occur to the correct side, you may bend the flightpath imperceptibly forward or backwards by a tiny amount of forward or back pressure on the stick, depending on what direction you must do the fallthrough. The stress with this technique is on the "imperceptible" amount for obvious reasons.

The inertia of the sailplane will always cause your SALTO to swing past the vertical line initially as it falls through. This is allowable and has no influence on the grading of the figure, as long as the movement is exclusively about the lateral axis.
The remaining vertical dive and the recovery into level flight are again done exactly the same way as for the hammerhead.

Inverted Flight and Inverted Turns

Although you have certainly practiced inverted flight several times in the two-seater during your initial aerobatic instruction, inverted flying is nevertheless part of advanced aerobatics and it is the basis for all the further inverted maneuvers.

The simplest and safest way to get into the inverted attitude is by a half roll. Entering inverted flight from a half loop only looks simpler, as you are starting inverted at minimum or near minimum speed, the SALTO will be quite unstable in this regime. For the half roll you'll only need about 150 km/h (80 kts). You roll as in a normal slow roll and just stop in the inverted position. Make yourself thoroughly familiar with the unusually high pitch attitude. For the beginning, you should always fly by reference to the airspeed indicator (the ASI error in the SALTO is negligible). Memorize the relationship between pitch attitude and airspeed in inverted flight. You will notice that the SALTO stalls inverted around 100 km/h (55 kts) or slightly less. Due to the dihedral of the wing, it will pick up speed again and you can push the nose back up into normal inverted attitude.

For inverted turns you need considerably more speed than for straight and level inverted flight. In competition aerobatics, inverted turns must always be flown with 60° of bank. For such steep turns you need at least 150 - 160 km/h (80-85 kts). It is very awkward at first to use "cross controls" to enter an inverted turn. It may help to remember that aileron always acts as if the stick were fixed rigidly to the cockpit floor and you were trying to use it as a lever to control the sailplane in bank. Consequently, the rudder always yaws the sailplane in the direction of the turn. Apart from that it just takes practice to fly inverted turns just as easily as upright ones.

Back into normal flight you can naturally do another half roll or a half loop. For the half roll 160 km/h (80 kts) are sufficient, for the half loop, you should always reduce the speed to approx. 110 km/h (60 kts) before pulling the nose down.

Inverted Spins

The SALTO is quite reluctant to enter an inverted spin. If you try to get into an inverted spin from an inverted stall, your SALTO will most likely go into some steep inverted spiral but it won't spin and it picks up speed quickly. To enter an inverted spin, the preferred method is to take an airspeed well above the inverted stall speed, about 110-120 km/h (60-65 kts) should suffice, and to push the stick sharply all the way forward, followed a moment later by full rudder. Due to the "reverse" rudder effect in inverted flight, the rotation will be opposite the direction of the rudder. The spin entry by this method is quite abrupt and the spin axis will be steep with a rather fast rate of rotation. The inverted spin will stop immediately if rudder or elevator are neutralized. There is no tendency to continue the rotation after recovery controls are applied. After recovery from the inverted spin you'll normally pull out into normal level flight.

Negative Loops

To most beginners in glider aerobatics, the negative loop is a figure which is approached with much respect. This is only justified insofar as the negative accelerations are quite unpleasant at the beginning and physically exhausting even to the experienced pilot.
Keep in mind that with the SALTO's cambered airfoil, only moderate coefficients of lift can be achieved at negative angles of attack. This means that any negative loop or part thereof must have a wider radius than a positive loop flown with the same load factor, since it must be flown at a higher airspeed to produce the required lift.
It is easiest to start negative loops from the inverted position upwards. The psychological barrier is more easily overcome this way than by pushing the loop forward from normal flight.
To perform the negative half loop upwards, you'll need an entry airspeed of at least 230 - 240 km/h (125-130 kts) rather more than less for the beginning. You are likely to push too softly at the beginning, so take your courage and force the nose up by forward pressure. As you lose sight of the horizon, look to the side and check for wings level. Don't get upset when you see the wings of your SALTO bending "downwards" alarmingly:

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It looks different from the familiar look of your plane, but the same strength of the main spar for bending positive or negative is one of the important points of the fully acro quality. The maximum load factor you'll be pushing will be around minus four. From the vertical attitude onwards, the outside loop must be flown with some finesse. Since the stall margin is quite narrow at large negative angles of attack, you must release some of the forward pressure to prevent a stall and to keep the radius of the loop constant with the speed dropping. If you release too much forward pressure, you'll run out of airspeed before you reach the top. The optimum angle of attack may be felt by the slight buffet, anouncing the onset of the stall.

Once you have mastered the half negative loop upwards, the other half should not be too difficult any more. You start with about 80 km/h (45 kts) and keep on pushing forward stick pressure until past the vertical attitude. You will also notice here how close you are to the stall, so be gentle on the stick and release forward pressure a little if you feel the characteristic buffet. Past the vertical attitude you must increase the forward pressure and the load factor to keep the loop rounded. "Play" the forward pressure so as to arrive at the bottom of the loop with approx. 230 km/h (125 kts). The rest should be familiar....

A few further hints for "negative" maneuvers:

- Strap in as tightly as you can. You'll be surprised how painfully the lap belt can cut into your thighs.
- In negative loops, it is particularly difficult to maintain wings level. Force yourself from the beginning to look to the side to check.
- Remember that negative loops or parts thereof must have wider radiuses than positive loops. In all figures which are composed of positive and negative loops you must fly the positive loops intentionally wider to preserve the symmetry.

Inverted Hammerhead and Inverted Tailslide

Naturally, a hammerhead or tailslide can be flown from the inverted position upwards. In the same manner, these figures can be followed by a recovery into inverted flight. For the transition from inverted flight to the vertical climb of a hammerhead or tailslide, the same rules apply as

for negative loops upwards from the inverted position. Many pilots tend to feed in a small amount of aileron when pushing up into a loop or vertical attitude. This will naturally result in a line slanting sideways, and the hammerhead or tailslide is spoiled thereby from the beginning. Again, the only way to prevent this is by checking wings level with a sideways glance.

Flick or Snap Roll

Due to the particular stalling characteristics of the laminar-flow airfoil, the flick or snap roll can be quite tricky in the SALTO.
Like in spinning, the behavior of your SALTO in flicks is very much dependent on the c.g. position. Since you are aware that the SALTO has narrow c.g. range, you will certainly have checked the c.g. in limits at your flying weight. With a forward c.g. your SALTO may be quite unwilling to do an accelerated stall which is the prerequisite for a flick, while in the case of a rearward c.g. you may have difficulties stopping the flick properly.
The primary criterion for a correctly performed flick is the stalled condition which must be achieved prior to the start of the rotation and the rotation itself which must be caused by the stall and not by an aileron deflection. The stalled condition must prevail till the completion of the roll: the stall may not be broken prematurely and part of the roll completed by aileron pressure.
Before you start practicing flicks in the SALTO, you should visualize the necessary control movements carefully, as you won't have time to determine what comes next in the middle of the figure, and timing is extremely critical for a good flick. You start with 150 - 160 km/h (80-85 kts) from a normal glide. It is not necessary to raise the nose as for a slow roll:
The flightpath may be directed too much upwards, causing the speed to drop too quickly, resulting in an unwanted spin at the completion of the flick.
The flick itself is initiated with simultaneous full back stick and full rudder in the desired direction. The rapid rolling motion and the stall-buffet will immediately tell you that your SALTO has entered the flick as advertised. The time for a good flick in the SALTO is just under four seconds. If you keep the stick pulled fully aft, you will notice that the

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nose of the sailplane travels around in a rather large circle. If you release back pressure somewhat, just enough to keep the sailplane stalled, this circle will be much tighter, with the result that you lose less speed during the flick, easing considerably the recovery. It is also recommended, to apply full aileron in the direction of roll immediately after the stall-rotation started. As the adverse yaw acts just like in a spin, slowing the rotation a little, it helps you to keep the flightpath spiral tighter and eases the recovery. As you are whirling around, it now becomes paramount to catch the 270-degree-point of the roll where you must start the recovery. First you apply full opposite rudder, then with a minimal delay, full forward stick to break the stall: The inertia will roll you the remaining 90 degrees, that's why you must start the recovery so early. The aileron remains fully in the direction of roll, until with about 45 degrees to go, you stop the roll by sharply reversing the aileron fully against the roll, neutralizing rudder and aileron immediately as the wings level position is reached. The elevator is brought back to a position according to the glide path after the roll.
Sounds confusing, doesn't it? Now you'll understand the advice, to memorize the control applications mechanically, as the sequence of events is so rapid.

Here are the control movements again in the proper sequence:

- Full back stick and full rudder
- As soon as the stall occurs and the roll has started, full aileron into the direction of roll (not mandatory, but highly recommended)
- Release some back pressure (particularly recommended, if you fly with an aft c.g.)
- At the 270-degrees-point, full opposite rudder
- Stick full forward
- 45 degrees prior to wings level, full opposite aileron
- Wings level, rudder and aileron neutral, stick back for normal glide.

Common errors in the flick:

- Rudder applied too late

If the rudder is not kicked simultaneously with the back stick or at least immediately after, your SALTO may not stall. It will rather pitch up and start an uncoordinated roll in the direction of the rudder deflection.

- Back stick not applied sharply enough

If the back stick was not applied sharply enough, you may not achieve a high-speed stall, and you will probably enter some sort of spiral, caused by the rudder deflection.
Your SALTO may behave similarly, if the c.g. is too far forward. If that is the case at your weight, it may be worthwhile to try to move the c.g. back somewhat by relocating some of the equipment (battery further back, lighter instrument panel etc.). Furthermore, you may check the elevator deflections. If the value for up-elevator is at or near the lower limit, you should find out by consulting an inspector or the manufacturer, if the elevator deflection may be safely increased. Remember, excessive control deflections may overstress your sailplane in aerobatics!

- Recovery started too late

If you missed the right moment for the opposite rudder, your SALTO will not stop rotating in the wings-level position. It will rather go on rolling, until the nose points straight down, and stop there after at least one and one half rotations. To recover from the resulting dive will cost you quite some altitude, therefore it's highly recommended to practice flicks at a safe altitude, at least until you know exactly what you are doing.

- Recovery started too early

If you were anxious to reverse the rudder, or if you released too much back pressure, the stall may break prematurely and the flick comes to an abrupt end, mostly at or near the knife-edge position.

Inverted Flick or Inverted Snap Roll

When you compare the behavior of the SALTO in upright and in inverted spins, you will agree that particularly the recovery from an inverted spin is much easier than from an upright one. The same is true of the inverted flick. Once you get the hang of it, you'll find it rather easier than the normal flick. There are two factors to be kept in mind when you try to understand the technique for the inverted flick: First, in order to produce a negative stall, you must reach a rather high negative angle of attack, and second, the rudder is apparently reversed in inverted maneuvers. The first factor is the reason why you start practicing inverted flicks from inverted flight, as you are flying there at a reasonably high negative AOA already. The second factor is responsible for the phenomenon that the roll in an inverted flick is always away from the rudder deflection.
You start from inverted flight:
The entry speed is the same as for the normal flick 150 - 160 km/h (80-85 kts). First you push the stick sharply forward all the way. With the full rudder opposite the direction of intended roll, you wait a short moment: The accelerated stall takes a little longer at negative AOA. As soon as the roll has started, you may add full aileron in the direction of roll. The stick remains fully forward: Any release of forward pressure would immediately break the stall. The recovery is initiated at the 270-degree-point by full opposite rudder. The forward stick is maintained until just prior to reaching wings level. Then you stop the roll by simultaneously bringing the stick back to a position well aft of neutral and sharply reversing the aileron against the direction of roll. When wings level, you neutralize rudder and aileron and bring the stick forward again for the inverted glide.

If you want to do an inverted flick from normal flight: At least the people designing the compulsory programs for aerobatics competitions like to see such perverted things - you should remember the two factors mentioned at the beginning of this chapter.
As you are flying in a normal glide at a positive angle of attack, while you need a large negative AOA to start the inverted flick, you must produce a large change of AOA before the negative accelerated stall occurs. You must not kick the rudder before the AOA has changed to negative:
The rolling moment caused by dihedral effect changes its direction as the AOA changes from positive to negative. Thus the rudder kicked prematurely would cause a rolling moment opposite the direction of intended roll.

For a negative flick from upright flight, you start in a nose-low glide at approx. 170 km/h (90 kts). From there you pull up to about 30° nose-high attitude. Before the speed bleeds off too much, you shove the stick forward to achieve the negative stall. When you can feel the stall buffet, kick the rudder opposite the direction of roll. As the roll starts, you can see, why you had to raise the nose so high at the start. If the initial pitch attitude was not high enough, the roll axis will be pointing well below the horizon. The recovery is the same as described before.
What I consider unjust is the fact that this kind of inverted flick has a coefficient of K = 30, whereas the one from inverted flight, which is far less uncomfortable gives you a K = 33.....

Hints of the editor:
As you may note, I am not only interested in selling sailplanes to you, but I also enjoyed to observe these planes in a progressed acro flight - not to speak about good places in competitions.

Please ask me or an experienced SALTO pilot if you need some advices. Manfred Echter, Gerd Ottensmann and Sepp Tiling are expert aerobatics teachers and may help you in SALTO-specific problems.