Common faults in turns, and how they can be corrected:

Nose too high - stick back and ease off bottom rudder.

Nose too high - stick forward and more bottom rudder.

The machine is skidding - less turning controls - less elevator - less bottom rudder.

The machine is slipping - more turning controls - more elevator - more rudder.

Common faults when leaving turns, and how they can be corrected:

The rudder is applied too late or to little, and the machine turns in the wrong direction because of the aileron drag. The stick is not brought forward and the nose is too high. Applied controls are reduced during the operation. Leaving the turn is slowed down and the nose wanders along the horizon.

The controls are centred too early and the machine is banked after finishing the turn.

Opposite aileron input is too rough and sudden, and this makes a smooth leaving of the turn difficult.

- Think over again how you fly along a glide path.

## During the flight

- Keep a good look out during the turns.
- Practise turns with different rates of turn.
- Remember to check where you have the landmark before you leave the turn, and keep a good look out.
- Be prepared to explain your position in relation to the correct flight path.
- You are expected to operate the air brakes.

## Instruction

We will now practise normal turns. We split the exercise into three parts: holding a turn, leaving a turn and entering a turn.

I will now show holding the machine in a turn. Follow me through on the controls. We look around and enter a turn to the left. We are now in a normal left-hand turn. The nose is moving at a constant speed along the horizon and we are neither skidding nor slipping. Note the bank - about $35^{o}$ - and the attitude of the nose in relation to the horizon.

The outer wing has a greater speed than the inner and therefore it has a greater lift. I give opposite aileron so that the bank does not increase.

A rudder input up in a turn is called "top rudder" and down it is called "bottom rudder".

The position of the controls in a turn is: a little bottom rudder, the stick a little back, and opposite aileron.

You have the controls and continue turning. Note that bank and the turning rate of the machine, and try to hold it in the turn.

I have the controls and straighten out. We will now practise how to leave a turn. Follow me through on the controls. We enter a normal left-hand turn.

I will now show how to leave a turn. We first revise the position of the controls in a turn: a little bottom rudder, the stick a little back, and opposite aileron.

In order to leave the turn we must give opposite aileron and, at the same time, quite a lot of rudder, to stop the turn. As we have been turning with the stick a little back, we must move the stick forward to keep the nose down. I will now show this.

We look around. We are in a left-hand turn. We straighten out in the direction of ... Aileron - stick a little forward - and stop when the machine is level. Note that the nose should be on the landmark all the time.

We now enter a left-hand turn. You have the controls. Leave the turn in the direction of .... We enter a right-hand turn. You have the controls.
Leave the turn in the direction of ....

We turn into downwind leg and continue our precision landing. You have the controls. Try to fly the glide path with constant speed.

I have the controls. Follow me through on the controls. At a height of about 5 metres we raise the nose by taking the stick slowly backwards. Now the machine touches down. We keep a straight course and the wings level. The stick should be held just behind neutral position until the machine stops.

# Exercise 7 (Dual)
# Entering a turn

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## Aim of the exercise

- To learn to enter a turn and to practise holding a turn and leaving a turn

## Before the flight

*Entering a turn*
Before you turn, you should look around carefully, especially in the direction you are going to turn.

You start entering a turn by lowering the nose, and after that you give both rudder and aileron, at the same time, in the direction you want to turn.

In short, this is the procedure:

- Look around carefully
- Lower the nose
- Rudder and aileron at the same time
- When you have reached your intended bank, take the stick a little back, give opposite aileron and reduce bottom rudder.

Common faults when entering a turn:

- You give too little rudder and the machine starts the turn by slipping inwards.
- Aileron and rudder are not applied at the same time, but one at a time.
- You forget to reduce rudder and skid outwards after entering, and the speed goes up.
- You forget to take the stick back, the nose goes down, and the speed goes up.
- You forget opposite aileron, so that the bank increases and the nose goes down.
- You take the stick back too late, so that you must correct the nose attitude afterwards.

## During the flight

*Remember*

- to look in the direction you are going to turn, before you turn
- to lower the nose before you turn
- to make gentle but firm control movements
- that turns should be made with a distinct bank
- that the position of the controls in a turn is: a little bottom rudder, the stick a little back, opposite aileron
- that speed and bank should be constant.

## Instruction

I will now show you how to enter a left(right)-hand turn. Follow me through on the controls. We look around carefully, before we turn.

Lower the nose - aileron - rudder - the stick a little back - opposite aileron - reduce bottom rudder. Leave the turn and fly straight.

I repeat the same thing. Note the sequence of control movements and the smooth co-ordination of the controls. We look around. Aileron - rudder - the stick a little back - reduce aileron a bit - opposite aileron and reduce bottom rudder at the same time. Leave the turn and fly straight.

You have the controls. Enter a left (right)-hand turn.

# Exercises 8-9 (Dual)
# Practising turns, Wrong control combinations during turn

---

## Aim of the exercises

- To practise turns, full turns left and right with varying degrees of bank
- To practise course corrections, entering and leaving turns correctly.
- To be able to correct turns, during constant bank, when the machine is skidding or slipping
- To be able to correct the nose attitude without changing the rate of turn.

## During the flight

*Remember*

- to keep a good look out for other machines
- to enter and leave turns correctly, with the wool string in the middle
- to keep correct speed on entering a turn, and during and leaving the turn
- to turn correctly with constant speed and bank
- that the speed is decided by the nose attitude, and the ASI is the instrument to check this
- to fly smoothly but firmly.

- If the machine is slipping, apply more turning controls.
- If the machine is skidding, apply less turning controls.
- If the speed goes up, raise the nose by taking the stick backwards and at the same time applying top rudder.
- If the speed goes down, lower the nose by moving the stick forward and, at the same time, applying bottom rudder.

## Instruction

Follow me through on the controls. We do the turns again. We look around and enter a left-hand turn. Lower the nose - aileron - rudder - the stick a little back - opposite aileron - reduce bottom rudder. The position of the controls in a turn: a little bottom rudder - the stick a little back - opposite aileron.

You have the controls. Enter a left(right)-hand turn. After 2 turns you leave the turn and fly in the direction of .....

Turn 90 degrees left ..... etc

We are now going to practise wrong control combinations in a turn. Enter a left-hand turn. Follow me through on the controls. If the nose goes down - correct by taking the stick backwards and ease off the bottom rudder a little - like this. Now the turn is correct.

If the nose goes up - correct that by moving the stick forwards and applying a little bottom rudder - like this. Now the turn is correct.

If the machine is slipping inwards in the turn - as it is doing just now - we can see that by the ball slipping inwards and the canopy wool string pointing outwards - then this means that we have too slow a turning rate in relation to the bank we have. Correct this by applying more turning controls - more elevator, the stick back and more bottom rudder - like this. Now the turn is correct.

If the machine skids outwards in the turn - we see this by the ball skidding outwards and the canopy wool string pointing inwards - then this means that we have too high a rate of turn in relation to the bank we have. Correct this by applying less turning controls - less elevator, the stick a little forward - less bottom rudder - like this. Now the turn is correct.

Now I will go through the position of the controls in a turn again. A little bottom rudder, the stick a little back and opposite aileron. You have the controls! Keep the machine in a turn and try to fly with correct control combinations.

The height is now 300 metres and we are in the KP-sector. Now you fly down to a correctly judged landing.

# Exercise 10 (Dual)
# Stalls

## Aim of the exercise

- To be able to fly the machine in a stalled condition and to resume normal flight attitude.

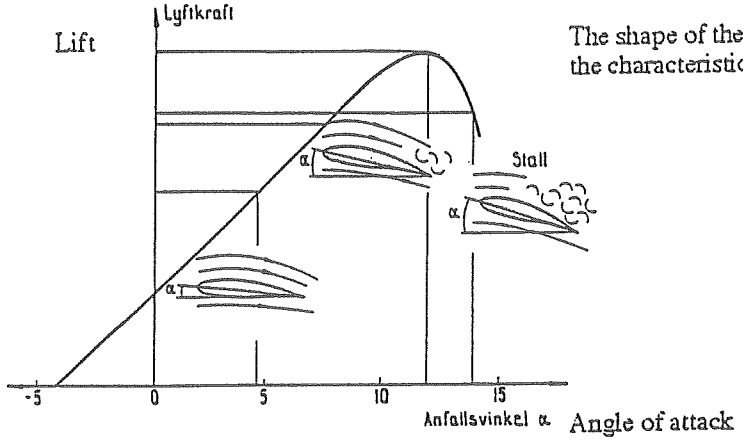
## Before the flight

*Stall*

The lift of the wing increases with increased angle of attack, up to a certain angle of attack. If the angle of attack is increased above this value, then the air flow cannot follow the upper side of the wing but separates from the surface, causing a strong turbulence. The wing is said to be stalled, and the result is less lift. The machine is in a stalled condition. See Figure 11.1.

To put it simply, a stall is what happens when the wing quits flying. A stall can occur at all speeds, depending on the wing load.

Stall means that the drag is great, which is reason enough to avoid getting into a stall (abrupt loss of height), or it can lead to the machine entering a spin. In a full stall, or, even more so, in a spin, you lose height very quickly. To get into a full stall at a low height is therefore very dangerous.




The shape of the curve top decides the characteristics at low speed

FIG 11.1 The figure shows how the air flow over the wing is changed at increased angle of attack. At a certain value of the angle, it cannot be increased any more. The machine stalls.

Remember!

**A stall is due to the angle of attack being too great**

The most common cause of a stalled condition is that the speed is low, in combination with turbulence. If we want, intentionally, to stall the machine on a straight course, we do like this. We reduce the speed gradually by taking the stick backwards, which means that we are increasing the angle of attack of the wing. To begin with, we notice that the speed sound starts going down. This is a sign that the speed is getting low. Also, we notice a high nose attitude on the horizon. We also notice how the controls become slow and sloppy, particularly the ailerons. The lowest speed we can register is the stalling speed. This speed depends on a lot of factors, such as type of machine, the load, dirt on wings, etc. Most often, when the machine is fully stalled, you have the stick fully back.

The stall is stopped by reducing the angle of atack. This is effected by lowering the nose (moving the stick forward).

## During the flight

*Remember*

- A stall is due to too high an angle of attack.
- You get out of a stall by reducing the angle of attack, which means by lowering the nose.

## Instruction

We will now practise a stall. Follow me through on the controls. We put the machine into a stall by moving the stick slowly back - like this. The control of the machine is bad. Feel the ailerons. Feel the rudder. Notice the change in the speed sound. We resume normal flight attitude by moving the stick forward - like this.

You have the controls. Put the machine into a stall by taking the stick slowly backwards. Now the machine is going into a stall - stick forward and back to normal flight attitude. We do this again ....

We enter a left/right-hand turn and do the same thing again. I have the controls and go on a straight course.

# Exercise 11 (Dual)
# Preventing a stall.
# Recovering from a full stall

## Aim of the exercise

- To fly the machine into a stall.
- To be able to prevent a stall
- To be able to resume normal flight attitude after a full stall.

## Before the flight

*A full stall*
If we fly the machine in a stalled condition and continue to increase the angle of attack, the machine will get into a full stall and drop its nose. The air flow has now separated from the wing and as the nose attitude is very high, the machine drops its nose. It does not want to fly any more! The full stall is a fact. It is important to notice the stall in time, so that the machine does not get into a full stall and drop its nose. If this occurs, it means a height loss of about 50 metres.

By reducing the angle of attack, that means by lowering the nose, we can get out of the stall. In order to minimize the height loss, it is important, quickly and firmly, to push the stick forward to neutral or a little more forward, even if the nose is already pointing down towards the earth. Keep the wings level, give opposite rudder to the rotation, if it occurs. Make a smooth recovery. See Figure 12.1.

In a stall or a full stall in a turn, in principle, you act in the same way. What happens when you fly into a stall in a turn is that the inner wing has a higher angle of attack than the outer wing. Therefore, the inner wing stalls first. The result is that you drop the inner wing. You get out of this by moving the stick forward (lower the nose), give opposite rudder to the rotation, keep the wings level with the ailerons and, finally, you make a gentle recovery.

Common faults when bringing a machine out of a full stall:

- When the nose drops, you push the stick forward too much and hold it forward too long. The height loss will then be unnecessarily great and there is a risk that you exceed the maximum permitted speed.

- In an unintentional full stall, you do not notice that the nose wants to drop. You try to keep the nose up by moving the stick more back, which may lead into a spin. There have been occasions when pilots have spun several turns without releasing the stick back pressure. This is one of the most dangerous situations you can get into as a pilot!

- When you get into a full stall in a turn you try to level out by using the aileron. This will only increase the rotation speed.

## During the flight

*Remember*

- You get out of a stall and ensuing full stall by reducing the angle of attack. Lower the nose!

- In a stall and ensuing full stall in a turn, you give opposite rudder to the rotation!

- Pulling out after a full stall must be done gently, and before the speed has become too high.

## Instruction

We are now continuing with a full stall. Follow me through on the controls. We fly the machine into a stall. Now the machine wants to drop the nose, we get a full stall - stick forward and resume normal flight attitude - like this. Now you have the controls and do the same thing.

I have the controls. I will now show how to recover from a full stall. When the machine drops the nose - stick forward - rudder opposite to the rotation. As soon as the machine has got the flying speed back, we level the machine up with aileron and rudder and resume normal flight attitude by moving the stick gently backwards.

Follow me through on the controls. We put the machine into a full stall - like this. Stick forward - rudder opposite to the rotation - level out with the ailerons - rudder - resume normal flight attitude. Remember not to have the stick forward too long, it only means too high speed and unnecessary height loss. You should try to bring the machine back to normal flight attitude with as little height loss as possible. Now you fly and do the same.

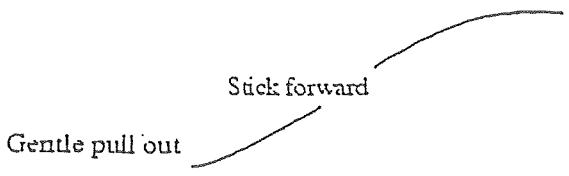
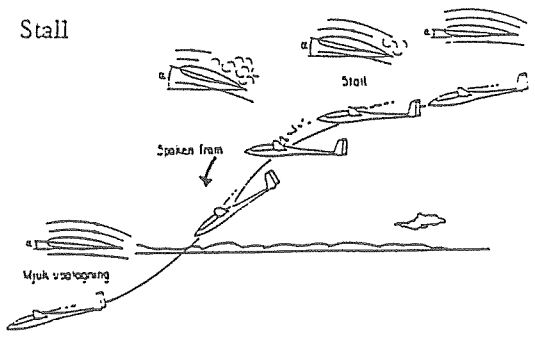



FIG 12.1 Recovery from a full stall



# Exercise 12 (Dual)
# Preventing a full stall with brakes out.
# How to recover from a full stall with brakes out

## Aim of the exercise

- To fly the machine into a full stall with the air brakes out.
- To recover from a full stall with air brakes out.

## During the flight

*Remember*

- Stall/full stall are stopped by decreasing the angle of attack.
- In a stall/full stall with the air brakes out, they should immediately be retracted.

## Instruction

I will now show you how to recover from a full stall with the air brakes out. Follow me through on the controls. We open the air brakes and go into a full stall straight ahead - like this. Stick forward - rudder opposite to rotation - level out with the aileron, rudder - resume normal flight attitude.

As you noticed, it took a longer time to go back to flying speed when the brakes were out, compared with brakes in. We lost almost twice as much height as in a full stall with the brakes in. Therefore, remember: When the machine gets into a stall or a full stall with the brakes out, you must immediately retract the brakes to locked position.

We do the same thing again. We get into a full stall with the air brakes out - like this. Stick forward - brakes in - resume normal flight attitude. Now you fly and do the same again!

# Exercise 13 (Dual)
# General flight training before first solo flight.
# Low approach for landing.

## Aim of the exercise

- You carry out the whole flight, from start to landing.
- To judge a landing correctly, in spite of too low height before landing.

## During the flight

*Remember*

- to keep a good look out for other machines
- to be in the KP-sector not lower than 300 metres
- that if you leave the KP-sector too low, you must fly the downwind leg and the base leg nearer to the field
- to make sure that the turns into base leg and finals are flown correctly and at the correct speed.

## Instruction

We will now be towed up to about 500 metres. You will get the release sign from the tow-pilot. After release, you turn left and after a full turn you go straight upwind. Pick out a landmark. Stabilize the machine on a straight course.

Look around - then make a 360 degree turn left. The bank should be about 35 degrees. Go straight in the direction of the landmark - stabilize the machine and then make a right-hand turn 360 degrees. In the same way make two more turns, one in each direction. Then, fly in suitable flight paths to the KP-sector.

We are now in the KP-sector and I will tell you when to leave the sector. Leave the sector and begin the downwind leg. As you can see, we are too low compared to a normally judged landing. Therefore, place the downwind leg and the base leg nearer to the field. When turning at the height we now have, make sure to check horizon attitute and ASI, so that you really keep the correct speed.

We are now on the finals. Make a normal landing.

# Exercise 14 (Dual)
# General flight training before solo flight.
# downwind leg too close to landing field.

## Aim of the exercise

- You carry out the flight yourself.
- To make a correctly judged landing with the downwind leg too close to the landing field.

## During the flight

*Remember*

- to keep a good look out for other machines
- always to make sure that the base leg is not too short.

## Instruction

We will be towed up to about 500 metres. You will get the release signal from the tow-pilot. After release you turn left and after one full turn you go straight out upwind. Pick out a landmark. Stabilize the machine on a straight course.

Look around - then make a 360 degree turn left. The bank should be about 35 degrees. Straighten out towards the landmark - stabilize the machine and make a 360 degree turn right. After that, make two more turns, one in each direction. and then fly suitable fly paths to the KP-sector.

We are now in the KP-sector and I will tell you when to leave the sector. You can now leave the sector and begin the downwind leg. We now have the normal height of about 150 metres opposite the landing area but, as you can see, we are now too near the field compared with a normally judged landing. Keep good attention to the field and your touchdown point. As we are now too near the field, edge out from the field so that we get a normal base leg.

Now turn into base leg and do a normal landing.

# Exercise 15 (Dual)
# General flight training before solo flight.
# Landing from too great height.

## Aim of the exercise

- You will carry out the whole flight yourself.
- You will carry out a landing from too great initial height.

## During the flight

*Remember*

- to keep a good look out for other machines
- to adjust the size of the landing circuit according to the circumstances.

## Instruction

We will be towed up to about 500 metres. You will get the release sign from the tow-pilot. After release you turn left and after a full turn you straighten out upwind. Pick out a landmark. Stabilize the machine on a straight course.

Look around - then make a 360 degree turn left. The bank should be about 35 degrees. Straighten out towards the landmark - stabilize the machine and make a right-hand turn 360 degrees. After that do two more turns, one in each direction, in the same way and then fly suitable fly paths to the KP-sector.

We are now in the KP-sector and I will tell you when to leave the sector. Now you can leave the sector and begin the downwind leg. Remember very carefully where you have the field and the touchdown point. As you will see, we have far too much height. We open the air brakes and start reducing our height to not lower than 150 metres opposite the landing area. If we still have too much height, keep the brakes out down to not lower than 100 metres, when we join the base leg.

Fly on your own and make a normal landing.

# Exercise 16 (Dual)
# General flight training before solo flight.
# Interrupted start, turns.

## Aim of the exercise

- To take the correct steps in the case of a towline break, an interrupted start, etc.
- You will practise 180-degree turns.

## Before the flight

Assume that the towline breaks, comes loose, or that you have to release for some reason. One reason, for example, can be that the tow-plane engine quits. If the tow-pilot has to "get rid of" the glider, he waggles the tow-plane's wings very clearly. The glider pilot then has to release immediately. If you have got height enough, this is no problem. If the height is under 50 metres, however, you will be in a very tricky situation. Continue straight ahead! Never turn back! Choose the best possible area to land in a sector 45 degrees left and right and land there. If there are no good areas to land, go for the area which is "softest". Trees are better than rocks, a lake is better than a forest clearning. To try to turn back from this low height and land downwind is absolutely fatal!

If you have more height then you have more time to decide. Below 100 metres you should, in the first place, look for a possible landing area in a sector 90 degrees left and right. If you have more than 100 metres, you fly a shortened landing circuit, or, alternatively, land downwind. This is illustrated in Figure 17.1

If the airfield is big enough for both the tow-plane and the glider to land straight ahead on the field, the tow-plane should land to the left and the glider to the right.

If you have to make 180-degree turn back to the field, always turn upwind if there is a crosswind.

Actions in an interrupted start:

1) Lower the nose, keep correct speed.
2) Release (a bit of the tow-line may still be there).
3) Read the altimeter.
4) Below 100 metres, land straight ahead. Over 100 metres, turn back. Turn (preferably) upwind, with bank more than 30 degrees, and keep the wool string in the middle. Check your air speed. Do not open air brakes until you have finished the final turn.

## During the flight

*Remember*

- that the turn should be well banked
- to keep your air speed
- to make a correct turn
- never to open the air brakes in the turn.

## Instruction

We will not practise the steps we take in an interrupted start. We will also practise the turns you use after an interrupted start.

Follow me through on the controls. We now assume that there has been a towline break while we are on aerotow. I lower the nose - release read the altimeter. Over 100 metres this means turn back - I lower the nose - aileron, rudder - more than 30 degree bank - stick back - opposite aileron and ease off a little bottom rudder. Check the ball and be prepared for vibrations that may indicate a stall. I leave the turn - wings level, and open air brakes as required.

You have the controls and take the correct steps in an interrupted start - towline break! Practise one more time - towline break!

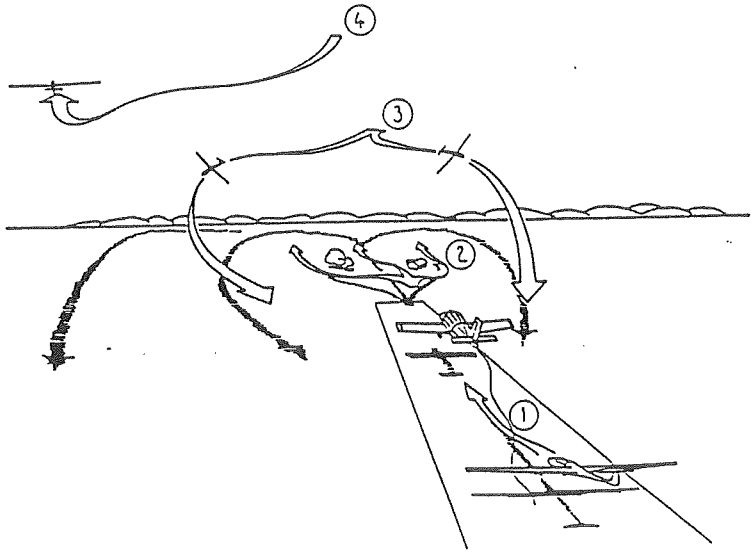
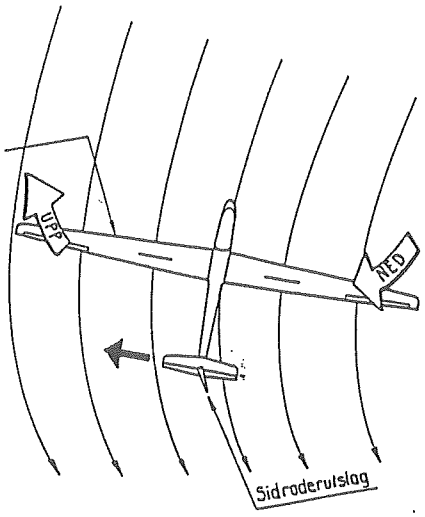



FIG 17.1 The towline comes loose at a low height - emergency!
1) The towline comes loose before half the field - land straight ahead on the field.
2) The towline comes loose below 50 metres - land straight ahead.
3) The towline comes loose below 100 metres - land straight ahead or, alternatively, turn back and land downwind.
4) The towline comes loose over 100 metres - fly a normal circuit, possibly a bit shortened.

The outer wing has a higher speed than the inner

UP




DOWN

Rudder deflection

FIG 18.1 Secondary effect of the rudder

The machine is slipping

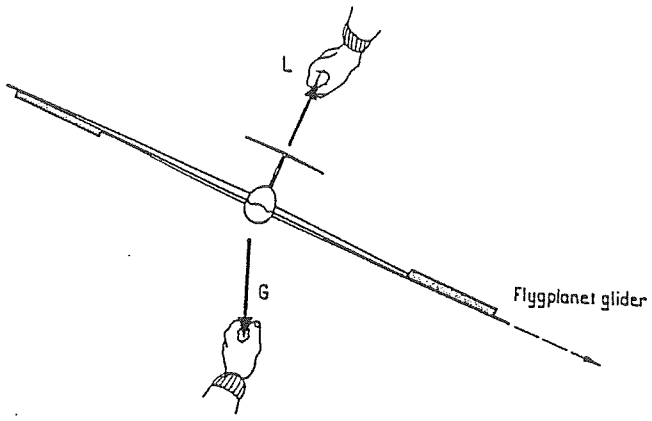



FIG 18.2 Secondary effect of the ailerons

# Exercise 17 (Dual)
# Secondary effect of the controls.
# Steep turns.

## Aim of the exercise

- To learn the secondary effect of the rudder
- To learn the secondary effect of the ailerons
- To practise steep turns.

## Before the flight

*The secondary effect of the rudder*
The primary effect of the rudder is to control the machine round the vertical axis, in the yaw plane. When the machine yaws, the outer wing will travel faster through the air, see Figure 18.1. This means that the lift of that wing increases and the machine will bank in the direction of the yaw. This is the secondary effect of the rudder. When rudder is applied, the machine will bank in the direction of the yaw. If nothing is done, the machine will continue in a spiral-like dive down, as the rudder forces the nose down when the machine is banked.

*The secondary effect of the ailerons*
The primary function of the ailerons is to control the machine round the length axis, in the rolling plane. The aileron drag will make the machine yaw in the direction of the up wing, and, at the same time, the machine starts slipping inwards, in the direction of the down wing. See Figure 18.1. The fin will now act like a wind wane and force the nose down. If we keep the aileron deflection, the machine will eventually finish up in a spiral dive.

*Steep turns*
If we turn with a steep bank (banking more than 45 degrees) there is an increased tendency for the rudder to decide the attitude of the nose and for the elevator to decide the rate of turn along the horizon. You also need considerably more lift in a steep turn and therefore you must move the stick much more back, and the speed must also be higher, so that the wing does not stall.

The entry into a steep turn is made by applying ailerons and rudder and keeping the controls there until the required degree of bank has been reached. Then, the stick is brought firmly back, at the same time as you bring ailerons and rudder back.

Common faults in steep turns:

- The entry speed is too low and the machine stalls or enters a down-spiralling turn when you want to adjust the speed.
- The stick is not brought sufficiently far back on entry.

- You use too little rudder to correct the nose attitude.
- You do not bring the stick sufficiently far forward when getting out of the turn.

## During the flight

*Remember*

- that in a steep turn the speed must be higher
- that the rudder and the elevator interchange their functions, the steeper you make the turn
- that the stick must be firmly moved forward when leaving a steep turn.

## Instruction

Follow me through on the controls. We are now going to practise the secondary effects of the controls. That means, what happens when we give a certain control input and keep the control in that position.

We start with the ailerons. Notice that I am keeping rudder and elevator neutral. Look straight ahead. I apply left aileron. The nose goes right - the machine is banking left and the nose goes up a little. The machine is now beginning to slip inwards and the nose goes down. I straighten out. The nose went left and down because the fin acting like a wind wane during the sideslip. Therefore, the ailerons have a secondary effect in the yaw plane.

We now do the rudder. Notice that I am keeping ailerons and elevator neutral. Look straight ahead. I apply left rudder. The nose goes left - the machine is skidding outwards - is banking left, and the nose goes down. I straighten out. The machine was banking left because the outer wing was travelling faster than the inner wing and therefore got more lift. The nose went down because the yaw plane was banked. The rudder works in the yaw plane and therefore it pressed the nose down. The rudder therefore has a secondary effect in the rolling plane.