10 - TURNING

The ability to roll the glider quickly and efficiently into well-controlled turns is fundamental to basic flying confidence. Since gliders spend much of their time in circling flight, failure to develop turning skills inhibits the development of a successful soaring pilot. In addition, stalling and spinning accidents are often associated with poorly coordinated turns.

Turning skills are fundamental to safety and soaring progress. Do not skimp on this training!

Learning to turn the glider begins after the introduction of the basic controls. It continues well into the post solo phase of flying. Post-solo development requires that pilots have already learnt from their instructors how to recognise turning inaccuracies, and how to correct them.

BRIEFING POINTS

Basic turning

The glider is turned by rolling it so that some of the lift force created by the wings produces the required 'pull' (acceleration) in the direction of the desired turn. Because this 'tilt' reduces the vertical component of lift supporting the glider's weight, an appropriate back pressure is needed on the stick to increase the AoA to make up the difference. This increases both the into-turn component and prevents the nose from dropping.

- before entering a turn look out and check that the airspace you'll be entering is clear, and will remain so
- while entering the turn, look over the nose of the glider to check the attitude, the roll rate, the angle of bank, and any yaw
- the rate of roll is determined by the amount of aileron applied. The larger the stick deflection, the faster the roll rate and the more rudder is required
- the rudder has two functions;
  - to overcome the adverse yaw (aileron drag) created by the ailerons when they are deflected, and
  - to keep the nose of the glider pointing into the airflow as the glider changes direction
- the rudder is applied in the direction of the turn. The amount applied is;
  - proportional to the aileron input
  - relatively large when rolling into or out of the turn
  - smaller when the desired angle of bank has been reached, and the ailerons 'centralised'
- the greater the bank angle, the faster the rate of turn
- during a turn the natural tendency is for the glider's nose to go down. If no action is taken both the rate of descent and the airspeed increase
- the ailerons are used to stop the roll continuing once the desired bank angle has been reached
- once the roll into the turn is complete, look out again. Set up a regular pattern of looking out for other traffic, then looking over the nose to check the attitude, the instruments, the angle of bank and the yaw string
- the bank angle will vary if the ailerons aren't properly coordinated with the rudder
- after any correction to maintain the bank angle, the ailerons and rudder are returned to their original positions; ailerons approximately central, and the rudder deflection reduced to a small amount in the direction of the turn
- rolling out of the turn is the reverse of rolling in
  - look out to ensure it is clear
  - look back over the nose
  - apply coordinated aileron and rudder

As the wings come level, centralise the ailerons and rudder and maintain the attitude by reducing the back pressure on the stick.

The turn should be demonstrated and thought of in three stages:

- **staying in, and lookout in the turn**
- **coming out**
- **going in**

The order recommended above may seem slightly strange but trainees often find continuous turns easier than the going in or coming out phases. It's also easier if they can fly straight and turn reasonably well before they try to join the two together - which is where most of the coordination problems arise.

Opportunities for teaching turning often occur when the instructor has, say, established the glider in a thermal, so the order above is then the most appropriate. However, if the turn is taught as one continuous demonstration then the order will obviously be 'going in', 'staying in and lookout', and 'coming out'.

BASIC TURNING DEMONSTRATION

The trainee should follow through on the controls.

Staying in the turn

- notice how the nose moves steadily around the horizon
- keep the bank constant, making any corrections with coordinated aileron and rudder
- continue to maintain a good lookout, particularly in the direction of the turn and along the horizon.

Coming out of the turn

- first check that it's clear to straighten up, especially ahead of and below the higher wing:
  - take off bank using coordinated aileron and rudder
  - relax the back pressure to maintain the attitude
  - when the wings are level, centralise the ailerons and rudder
  - re-trim if necessary.

Going into the turn

- before turning to the right, (eg), look out, first to the left and then round as far as possible in the direction of the intended turn, particularly behind the wing [see chapter 5 and chapter 24].
- if it is clear then:
  - look ahead over the nose
  - roll the glider using aileron and rudder together
  - as the bank increases, maintain the attitude with a slight backward pressure on the stick
  - when the desired bank angle has been reached, use the ailerons to prevent it increasing any further, and reduce the rudder deflection
  - the glider is now established in the turn
  - re-trim if the turn is going to continue.
- now, look out again.

The trainee's initial practice is to copy the demonstration, and establish the routine of when to lookout, when to look over the nose to check the attitude, what to look for, and to practice coordinating the controls.

Regaining a heading

This is a repeat of the straight glide exercise but includes a gentle turn to regain the original heading. Brief on the following:

- **regaining the heading** by choosing a feature to turn towards, using small angles of bank and coordinated controls
- **rolling the wings level** when the feature is ahead
- **continuing in straight flight**, using the scan cycle.

For trainee practice, prompt rather than demonstrate. Take control, identify a distant ground feature or cloud ahead, and then introduce a heading error. Hand back control to the trainee and ask them to return to the previous heading. The need for anticipation when straightening up soon becomes apparent, but the degree will depend on how quickly the glider is rolled wings level.

Continuous turns

Circuit turns are usually through angles of 45° or 90°. Practice in continuous turning prepares the trainee for thermalling, and brings out any difficulties they have in maintaining turns. Re-trim during continuous turns.

Slip and skid

The opportunity to point out when the glider is slipping or skidding in a turn, is usually while the trainee is flying. Demonstrate what is happening if the trainee seems unsure of what you are talking about.

Slip

- notice that;
  - there is a feeling of sliding into the turn
  - the yaw string is deflected towards the outside of the turn
  - the slip ball is deflected into the turn
  - the nose is higher than normal

Correcting slip

- the glider is slipping towards the lower wing, and needs more into-turn rudder
- apply sufficient to straighten the yaw string and/or centre the slip ball
- the bank angle and, indirectly, the attitude, are almost certain to be affected so make the necessary adjustments to keep the bank and attitude constant
- the turn is now balanced and there is no feeling of slipping into the turn.

Skid

- notice that there is a feeling of skidding and sliding out of the turn
- the yaw string is deflected into the turn
- the slip ball is deflected out of the turn
- note that the nose is lower than normal - looks safe, but isn't

Correcting skid

- the glider is skidding towards the raised wing, and needs less into-turn rudder
- reduce the amount of rudder to straighten the yaw string and/or centre the slip ball
- keep the bank and attitude constant using the ailerons and elevator respectively
- the turn is now balanced and there is no feeling of skidding out of the turn.

Varying angles of bank at constant speed

Further practice in the kind of coordination needed for thermal centring can be gained by trying to keep the speed constant while varying the bank angle.

Varying rates of roll

High, controlled rates of roll will be needed for thermalling, and for collision avoidance. Asking the trainee to roll quickly into turns will show up any poor coordination.

Turn reversals

Turn reversals improve coordination, use little height or sky, and can be practised on the downwind leg. As well as the aileron/rudder coordination required, there is the smooth relaxation and re-application of backward pressure on the stick to keep a constant speed.

Steeper turns to 40° of bank and above

This obvious extension of the basic exercise improves the trainee's skill and prepares him for the kind of manoeuvring needed to be able to thermal well. The trainee should understand that heavier loads are placed on the aircraft during a steep turn and consequently the stalling speed is increased.

- the speed to maintain the turn should be increased as the bank angle is increased.
- it is easier to stabilise the required speed before rolling into the turn.
- note the new attitude taken up by the glider.

- *look out* for other traffic in the direction of the intended turn.
- *look back over the nose*.
- roll the glider
- *more bank*
- *more bank!* (If appropriate!)
- considerable up elevator is needed to maintain the position of the nose in a steep turn.
- more 'in turn' rudder is usually needed when a turn of up to 45° of bank is established, but less beyond 45°
- if the nose is allowed to drop the speed will build up rapidly.
- if the speed is excessive, first reduce the angle of bank with aileron and rudder, then reduce the speed with the elevator. When the speed is correct, increase the angle of bank again.

Climbing turns

These are begun from a typical inter-thermal speed, say 70kt for a glass ship. Look out, and then pull up into at least a 30° climb. As the speed reduces through about 55kt, lower the nose into the appropriate attitude for a normal thermal turn at the same time as rolling on the bank. Stress;

- the importance of lookout, not merely in the direction of the turn, but upwards. From 70kt the glider will gain considerable height on the pull-up, so it is particularly important to look well ahead and up before entering the thermal
- since the airspeed is changing, the aim should be to set the glider's attitude correctly in the turn, and then wait for the speed to settle. Check the ASI.

DE-BRIEFING

The debriefing should cover the lookout sequence, the roll rate, the angle of bank and the coordination of the controls.

ADVICE TO INSTRUCTORS

Experienced glider pilots with hundreds of hours often come on soaring and/or cross country courses, only to find that their major problem is poor turning technique. Their instructors taught them to 'circuit standard', but not to the higher standard required for rapid progress into soaring and cross country flying. How many solo pilots, frustrated by their lack of progress, have given up? How many stall/spin accidents and incidents are due to poorly coordinated turns?

TURNING PRACTICE

The weather conditions (turbulence and/or convection) influence the value of the trainee practice. If the air is smooth there is little value in prolonged turns. The trainee should be encouraged to practice entering and leaving turns with the staying-in phase just long enough for the instructor to make sure that it isn't going to go wrong.

Turning practice whilst soaring is of tremendous value, not only providing extra time on the controls, but fun. The trainee gains considerable satisfaction and confidence from having made the glider climb.

ANALYSING AND CORRECTING TURNING DIFFICULTIES

Turning requires considerable skill in coordinating all three controls together, and comes from repeated practice, combined with the ability to recognise mistakes, their causes, and what to do about them. The instructor's job is to provide both the handling practice and the necessary help in recognising and correcting poor coordination.

Neither you nor the trainee will recognise a poorly coordinated turn entry unless you look over the glider's nose as it enters the turn. The same applies to rolling out of a turn, as it does at any time when a rolling input is applied - even if it's only to prevent the glider rolling. The view over the nose provides continuous information about;

- the attitude, and therefore the speed
- the direction and rate of yaw
- the direction and rate of roll
- the bank angle
- any slip or skid.

In analysing what is going, or has gone wrong wrong with a turn, you may need occasionally to follow through lightly on the controls; to get a better feel for the way the controls are being used. Tell the trainee what you are doing. Prompting does not always immediately, or permanently correct a problem. With the trainee following through on the controls, demonstrate the correct method of turning, and follow it by making the same mistakes as the trainee.

Steeper Turns.

The wing has to do more work when a glider is turning steeply, and there is a consequent increase in the stalling speed. The speed to maintain the turn should be increased in proportion - see the table below. The formula for calculating the increase in stalling speed is nV_S, where n is the load factor (same as G) and V_S is the normal unaccelerated stalling speed.

Table of typical stalling speeds at given angles of bank

Bank angle °	G loading (n)	Stalling speed (kt)
0	1	36
10	1.02	36
20	1.06	37
30	1.15	39
40	1.31	41
45	1.41	43
50	1.56	45
60	2.0	51
70	2.92	62
80	5.75	86

COMMON DIFFICULTIES

Failure to lookout before rolling into the turn is extremely dangerous. Emphasise the importance of lookout by taking control immediately and preventing the turn.

Looking out as soon as the glider starts to roll is common, unnecessary, and often results in poor coordination and speed control. Lookout is completed before rolling into the turn, and checked again once the turn is established. The glider doesn't change direction until it is banked, and this only takes a few seconds.

Failure to look out before rolling out of the turn is no less dangerous than failing to look out before rolling in. Same remedy as before.

Very slow rates of roll and/or under-banked turns - can be achieved smoothly and with apparent accuracy even if the pilot's coordination is poor or non-existent. Don't accept slow rates of roll, or bank angles of less than 30°. Uncoordinated turns are both inefficient and potentially dangerous. Nervous trainees will require your patience and encouragement to help them overcome this problem.

Bank varying in the turn. In straight flight trainees have difficulty recognising when the wings aren't level, and while turning can find it difficult to perceive small changes in the bank angle, which may be partly or wholly the problem. Bank can also vary if the trainee is over-controlling (Common Difficulties, chapter 7 contains advice on how to deal with over-controlling), or, due to high workload, their attention has been 'eye-trapped' by the instruments; usually the ASI or the variometer.

Bank increases in the turn. During a turn the outer wing traces out a larger diameter circle than the inner wing, so its airspeed is greater and it produces more lift. For this reason the ailerons almost always need to be slightly 'out of turn' to prevent the bank increasing ('holding off bank'). If the bank becomes very steep, it may not be possible to check under the raised wing whether its clear to roll level, or not.

Bank reducing in the turn - may be due to holding off the bank too much, or a thermal core lifting the inner wing. In either case it is necessary to recognise what's happening, and then take action to prevent it. As the bank reduces, trainees may attempt to maintain a steady turn rate by ruddering the glider round. Allowing the bank to reduce, and over-ruddering can sometimes be a result of nervousness about steeper turns - look for the trainee leaning out of the turn.

Guessing with the rudder - indicates that the trainee doesn't understand what is required, or how it is achieved.

Under-ruddered turn entries - are recognised by the glider's nose yawing away from the direction of turn.

Over-ruddered turn entry - is recognised by the nose yawing in the direction of the turn before the glider is banked.

Incorrect rudder when established in the turn - is indicated by the glider slipping or skidding.

Over-active yaw string. Before assuming 'guessing with the rudder', try flying the glider yourself. The location of the yaw string on some canopies can make it incredibly over-sensitive. If it is, try moving it to a less critical position. Learning to ignore the yaw string is negative training.

Speed varying - is the result of poor elevator coordination and has several causes:

- the horizon not clear during part or all of the turn
- not appreciating the need to maintain the attitude when rolling into the turn, or when established in it
- not noticing the attitude change by failing to look over the nose during the roll into or out of the turn
- inadequate practice at the exercise
- failure to maintain the necessary back pressure on the stick when aileron input is required
- not re-trimming in a continuous turn
- chasing the ASI
- failure to monitor the speed sufficiently often, along with almost any of the other faults.

If the attitude remains constant the transition to stronger or weaker lift produces short term changes in speed. It's an advanced technique to maintain constant speed and milk the most energy from these surges. Be satisfied if the trainee is maintaining the attitude. Explain to them why the speed changes despite the fact that the attitude remains constant.

Speed and bank increasing in the turn is the start of a spiral dive. To recover, reduce the bank, bring the speed under control and then resume the turn. The initial cause of the problem may be over-banking, or a failure to correct a sideslip, either of which results in the glider weathercocking. A common reason for unwanted roll is leaving on too much in-turn rudder.

NOTE: At some point the effect of yaw on the indicated airspeed should be demonstrated. Not all gliders are affected by this.

