14 – ADVANCED TURNING

INTRODUCTION

The table below lists the Advanced Turning exercises on the SPL syllabus:

Exercise 14: Advanced turning	
(i)	steep turns (45° or more)
(ii)	stalling and spin avoidance in the turn and recovery
(iii)	recoveries from unusual attitudes, including spiral dives

The student will already have completed the exercises in Chapter 8, *"*Turning", to a reasonable standard. Now we introduce the skills needed to maintain steep turns, such as are needed for thermalling. In the past, pilots often had to pick up these skills for themselves, flying solo, and many never became expert enough to thermal efficiently.

Apart from thermalling, being able to turn tightly and accurately is a requirement for safety – perhaps to avoid a collision. So in this exercise we also explore the hazards associated with badly executed steep turns, and teach the trainee how to deal with them and avoid them.

Chapter 9b, "Stalling", includes recognition and recovery from stalls in straight flight and in turns. Chapter 10, "Recognition and avoidance of spins and spiral dives" covers recognition of spins and spiral dives and the appropriate recoveries. If possible, those exercises should have already been completed, so that spin avoidance can be concentrated on here. Part of the point of parts (ii) and (iii) of this exercise is to take the glider to departure and then recover with minimum loss of height.

THEORY BRIEFING

The student should understand that the stalling speed of the glider increases in the turn and that this increase is non-linear: at small bank angles it is negligible but as the bank increases beyond 45° or so, it becomes significant. If we want to turn tightly we must have the speed to do it.

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:

$$\sqrt{n} \times VS$$

where n is the load factor (same as G) and VS is the normal unaccelerated stalling speed.

Table of stalling speeds at given angles of bank

Bank angle °	G loading (n)	Stall speed kts
0	1.00	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	2.00	51
70	2.92	62
80	5.75	86

If the glider is allowed to stall in a steep turn it may depart abruptly into a spin if the turn was skidding, ie over-ruddered. Over-ruddering a turn yaws the nose downwards relative to the horizon and produces a false impression of the nose being low, and hence "safe".

This exercise provides an opportunity to point out that the radius of turn is related to both the airspeed and the angle of bank. It is obvious to most people that a steeper turn at the same airspeed will result in a smaller turn radius. It may not be so immediately obvious that allowing the airspeed to increase will increase the radius of turn and REDUCE the rate of turn. This is important when thermalling with others – if you are being "caught up" by a glider behind you in the circle then increasing airspeed will make it more likely they will disappear from view as they come close to your tail or even cut inside you. To "get away" you have to increase bank, and retain a reasonable speed.

AIR EXERCISE BRIEFINGS

This exercise will typically require more than one flight. Part (i) needs to be practised to a good standard before parts (ii) and (iii) can be fully appreciated by the student. The Air Exercise Briefing should cover what is actually about to be flown.

The aims of the exercise are to teach students to fly steep turns accurately, with good lookout and situational awareness, and secondly to ensure they understand the potential threats from mishandling. A busy thermal is one of the main situations where someone whose lookout is sub-standard and whose handling is not instinctively accurate will come to grief, endangering others as well. There are plenty of other situations where the pilot needs to be able to turn quickly and steeply.

TEM

Threats:	**Mitigation:**
Collision	Lookout!
Spin or spiral dive	HASSLL check first
Violent "flick" entry	String in middle, especially > 50°
Errors:	
Stalling in turn	Monitor airspeed
Running out of height for appropriate circuit	Monitor height & position

The first part of the exercise is to get the student used to turning more steeply than they have probably been used to. Most will need plenty of practice in order to reach a standard where they can maintain attitude (and hence airspeed) and bank angle and fly without slip or skid, ie with the string in the middle.

A 45° bank angle is good for thermalling and, conveniently, it is easy to judge the angle by picking any round instrument with screws at the four corners. When you are at 45° the diagonal will be parallel to the horizon. It is common for students to overestimate the angle they are at, without a tip like this.

Once they can maintain 45°, they should practise varying the bank angle whilst maintaining airspeed. This is a necessary skill for thermal centring.

The rest of the exercise is about recognising when the glider is close to the stall. The student should see what happens if the glider is allowed to stall in the turn, and should practice recognising the situation and preventing the stall.

The outer wing is moving faster in a steep turn, and hence producing more lift, which tends to increase the bank if not "held off" with out of turn aileron. If you are over-ruddering at the same time then the controls will be crossed, with the stick well back as you reduce the airspeed. If the glider is allowed to reach the stall it will depart with very little warning.

MANOEUVRE DEMONSTRATION

For part (i) of the exercise you should demonstrate a steep turn. Starting at 45° is good.

- The speed to maintain the turn must be increased as the bank angle is increased.
- It is easier to stabilise the required speed before rolling into the turn, so demonstrate this.
- Note the new attitude taken up by the glider.
- Look out for other traffic, especially in the direction of the intended turn.
- Look back over the nose.
- Roll the glider to 45° bank. Round instrument screws are a useful reference.
- Considerable up elevator is needed to maintain the position of the nose in a steep turn.
- Out of turn aileron will be needed as the bank increases, to "hold off" bank.
- 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.

Demonstrate that the rate of roll can be varied, using larger control deflections.. There are situations where a rapid roll is essential.

For part (ii) of the exercise, allow the glider to come close to departure and demonstrate that the stall can be avoided by simply moving the stick forward.

Demonstrate the different effects of over-ruddering (skid) and under-ruddering (slip). In the latter case, you will add a little "top" rudder (ie out of turn rudder) and the string will be slightly out of the turn. Allow the student to feel that the glider is more "comfortable" like this, and contrast with how it feels if you change to bottom rudder. If you attempt to stall with even a small amount of side-slip, the nose will have to be high before the stall and the glider gives plenty of warning.

For part (iii), allow the glider to depart and start a spiral dive before recovering. Draw the student's attention to the loss of height and point out how dangerous such a loss of control would be if close to other gliders in a thermal or to terrain.

MANOEUVRE LESSON

Allow the student to practice each part of the exercise, over several flights if necessary.

Depending on your student, you may choose to start with "easy" turns, at about 30° of bank, and build up gradually to steep turns. You should re-demonstrate if you want them to try very steep turns, at say 60°. Draw attention to the G force they will feel (2G at 60° of bank).

When they can maintain a turn at a given angle of bank, get them to vary the bank angle during the turn.

For the stalling parts of the exercise it's important that students feel for themselves how the glider behaves when it's very close to the stall.

It may be sensible to do part (iii) first and then return to part (ii), allowing the student plenty of time to practice

avoiding a stall and feeling the sensations of being close to a departure.

DE-BRIEFING

The debriefing should emphasise the importance of lookout and situational awareness. The student's understanding of how stalling speed increases in a turn should be checked, along with their appreciation of the effect of slip or skid, and how to recover if the glider is near the stall.

This is a challenging exercise for the student and, if they have found it hard going, they should be reassured that that is normal, because it requires a high degree of co-ordination skills, whilst maintaining a really good lookout all the while. Remind them that mastering these skills will make them a much better thermal pilot, which is a reward worth striving for.

COMMON DIFFICULTIES

Failure to look out before rolling into the turn is extremely dangerous. Take control to prevent this happening.

In a thermalling situation the pilot must check it's safe before every change of bank angle. This requires a lot of practice. Aim to bring your student to the point where they *cannot* move the controls without looking out first.

Bank increases in the turn and the ailerons almost always need to be slightly "out of turn" to prevent the bank increasing. If the bank becomes very steep, it may not be possible to check under the raised wing whether its clear to roll level.

Varying the bank angle whilst maintaining airspeed takes patient practice and may produce basic co-ordination errors. Sometimes students are trying too hard. Rolling level, lifting off the controls and taking a breath may help.

If the student is having trouble maintaining the airspeed they may be focusing on the ASI instead of the horizon. Covering the ASI can work wonders.

Bear in mind, and point out to the student, that in a thermal, the airspeed will vary as the glider moves through differing rates of lift. This can be ignored if you are just trying to perfect turns, or it can be used to help you centre better. As a general rule, they should fly by attitude.