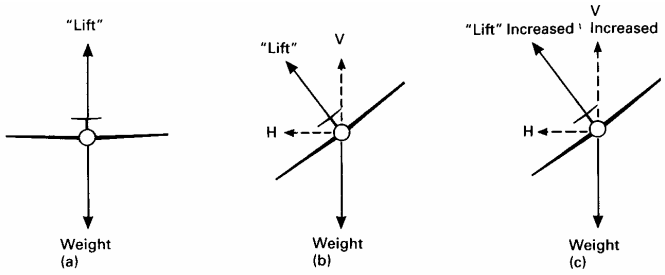
TURNS USING UP TO 30° ANGLE OF BANK

Aim: To learn how to change the direction of flight of the glider by turning.

There are numerous reasons for doing turns; from manoeuvering to change direction such as is required to follow the towplane or fly a circuit about our airfield, to thermalling in circling flight to take advantage of rising air… soaring. The ability to accurately turn a glider is a fundamental skill based on our understanding and application of the primary flight controls.

Principals of Turning Flight:
Lets look at the forces acting on a glider in a steady glide. Flying straight, wings level, the forces are in equilibrium. Applying control inputs to bank the glider produces the necessary force from the wing when it is banked. The lift force is tilted and the force vector can be divided into vertical and horizontal components. The horizontal force is is called the *centripetal force* and this is what turns the glider. The vertical component is left to balance the weight and must be increased to achieved this. This is achieved by increasing the tilted lift vector… this is done by increasing our angle of attack by easing back on the control column. This in turn increases the turning force even more. However, if we were not to apply the *back pressure* on the control column, the nose would pitch forward slightly and allow the glider to accelerate above the speed we are trying to maintain. Take a look at the diagram of the forces below:



(a) The vertical force of weight is normally balanced by the resultant of lift and drag.
(b) Banking the glider tilts the resultant and causes the glider to turn.
(c) In turns, it is necessary to increase the angle of attack to restore the vertical component to counter the glider's weight

That's the theory…now the real flying stuff…how we do it!

Air Exercise:
Your instructor will establish the glider in a steady glide at 45 knots. They will then demonstrate a turn, pointing out the sequence of actions and control inputs required to enter the turn, sustain the turn, then exit from the turn. Note the rate and amount of control inputs and the attitude selected once in the turn. Here is the sequence of events:

Entry:

- LOOKOUT ahead and in the direction you are going to turn to check it is clear
- Apply aileron and rudder together to roll the glider to the banked attitude in the direction you wish to turn
- Apply a small amount of back pressure on the control column to hold the desired nose attitude
- Centralize the aileron and rudder when you have the desired banked attitude

Sustaining:

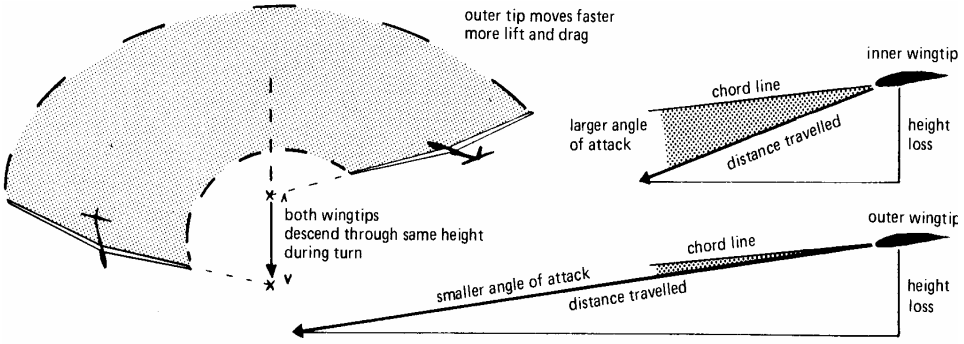
- Maintain a lookout in the area ahead you are turning into
- Keep the bank angle constant using small adjustments as necessary
- Maintain the nose attitude with small adjustments to the back pressure as required

Exit:

- LOOKOUT to ensure the are we are rolling out to fly straight through is clear
- Anticipate the direction we wish to roll out and fly to
- Apply aileron and rudder together to reduce the bank and get to a wings level attitude
- Relax the back pressure to achieve the desired pitch attitude for the normal gliding attitude

You will be given control when in a turn so you can feel the small amount of back pressure required to hold the desired nose attitude. You may notice that despite what was just said… the ailerons are not actually centred when in the turn…they are held a little out of the turn… if turning left, we have a little right aileron applied. Why is this so?… any ideas?

Take a look at this diagram which shows how the outer wing is going further and therefore faster in the turn… thereby generating more lift which tries to roll and increase the bank. Applying a little aileron away from the direction of turn hold the bank constant.



The influence of a large span and small turning circle on the handling of a glider. The outer wingtip travels further and faster but meets the airflow at a smaller angle. This results in extra lift and makes a glider tend to over-bank in turns. The inner wingtip will reach the stalling angle before the outer one, causing it to stall and drop if the glider is flown too slowly.

The Yaw String:

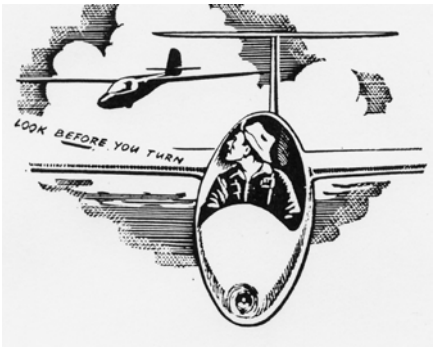
The yaw string can be used to check for slip or skid…our *balance.* If the string is straight, we are flying in balance and the airflow is coming over the glider from directly in front of us. If the string is out to one side, we are out of balance and this will create extra drag on the glider and increase our rate of descent… and mean we land sooner! We can use the string to help correct this situation. Imagine it to be an arrow, with the pointed head at the front of the string where it is taped on to the canopy. Using it as an arrow, it points to the rudder you need to apply to correct the slip or skid to get back into balanced flight.

Common Faults:

Inadequate lookout; this is dangerous and you must really lookout before and during the turn
Not looking out over the nose; this means you won't see any change in attitude so the speed changes
Too much or too little rudder; use the string to correct this and don't chase it or over control
Failing to reduce the rudder once established in the turn; do this when you *centralise* the ailerons
Lack of positive control; remember … you are the pilot so be decisive and positive in control
Jerky control; keep it smoooooth
Allowing the nose to drop; remember you need a little *back pressure* to hold the desired nose attitude
Varying the bank; again…set what you want and don't let it increase or change with turbulence etc
Tensing up on the controls; relax, wiggle your fingers every so often to check you aren't strangling the stick!
Chasing the ASI; forget the ASI…its only a reference and suffers a lot of *lag,* hold an attitude.

Airmanship:

We can't overstate the importance of a good lookout…its more important than the accuracy of your flying. Your instructor will want to see your head moving around in the directions you are looking and may prompt you about lookout if they don't see this.



Need To Know:

- The basic aerodynamics and forces on the glider in a turn.
- The control inputs required for a balanced / coordinated turn.

Further Reading:

- The Glider Pilot's Manual; by Ken Stewart. Pg 43. Turning.