

The Anatomy of a Steep Turn

Ron Ridenour, SSF Trustee and DPE

Steep Turns are a required maneuver for either the Private or Commercial pilot practical test in a glider. This maneuver requires the pilot to correlate many of the aerodynamic aspects that they have learned previously including load factor, increased stall speed and overbanking tendency. The most useful application of the steep turn is when thermaling in a small core thermal. Additionally, when necessary, a properly flown 45° degree banked turn can be used during the return back to the field after a low altitude emergency release or rope break maneuver. However, as defined by the airplane flying handbook (which can be applied equally to flying gliders), the objective of the steep turn maneuver is to develop the pilot's skill in flight control smoothness and coordination, an awareness of the aircraft's orientation to outside references and a division of attention between the flight control application and the constant need to scan for hazards around the aircraft.

Let's first discuss some of the aerodynamics of the steep turn. As you roll into a steep turn, in order to maintain the entry airspeed, the pilot must increase the back pressure on the stick to increase the angle of attack of the wing. Failure to increase back pressure on the stick will result in the glider pitching down and speeding up. This is sometimes referred to as the "diving tendency". Then, after establishing the required angle of bank, a small amount of "top" aileron must be held in order to counteract the "overbanking tendency". Correspondingly, a small amount of "bottom" rudder will be needed to overcome the "yawing against the direction of turn tendency". The Glider Flying Handbook makes reference to these aspects of performing the maneuver on page 7-31. These topics were also addressed in my article a few months ago.

The pilot must also understand the relationship between the load factor in a steep turn and the stall speed increase that the additional load factor will cause. Per the PTS, the required bank angle is 45° +/- 5° for this maneuver. Because of an increase in load factor to approximately 1.5g in a 50° bank turn (the maximum for this maneuver), the stall speed will increase about 22%. The stall speed increases in proportion to the square root of the load factor. This increase in stall speed requires the pilot to adjust his speed by the same amount for this maneuver so as to not stall. Normally, we want to perform thermaling turns at a minimum sink speed for the angle of bank being used. The increase in stall speed requires the pilot to increase this minimum sink speed by 22%. For a glider with a 40 Kt minimum sink speed in level flight this increase would require that the pilot perform a 50° banked steep (thermaling) turn at 49 Kts. In a 60° bank the load factor is 2.0 with an increase in stalling speed of 41%, nearly double that of a 50° banked turn! This would require a speed of 57 Kts for that thermaling turn maneuver.

As a pilot examiner I have observed the many different techniques used when demonstrating steep turns. Of course, before starting any maneuver one must clear the area and maintain that same outside visual scan throughout the maneuver. The most successful technique incorporates first establishing the correct pitch attitude (don't forget to trim) that will give you the correct airspeed. Once that pitch attitude is established, then using a smooth and gradual roll-in will make rudder coordination much easier. Abrupt movement of the controls is not necessary and in fact complicates the coordination of

the maneuver. This allows the pilot to apply a gradual and smooth but firm back pressure as the bank steepens to maintain the correct pitch attitude. Don't chase the airspeed! The airspeed indicator lags significantly from what the glider is really doing, monitor the pitch attitude instead and reference the airspeed as necessary to maintain the correct pitch attitude. Once established in the turn the pilot needs to maintain the bank angle, monitor the pitch attitude, maintain the proper coordination and continue to scan for traffic. At approximately 25° (about ½ the bank angle used) before the desired rollout heading, begin a smooth and gradual roll-out, similar to the roll-in technique, while gradually reducing the back pressure that was necessary during the maneuver. In a thermaling turn of more than 720° I would recommend that the elevator trim be used to maintain the correct pitch attitude since the constant back pressure on the stick does become tiring.

I usually ask for either a 360° or a 720° turn on the private pilot exam. The commercial pilot exam requires a 720° turn. Don't lose your orientation during the maneuver! To do this maneuver well requires practice. Some of the most common errors include poor coordination during the roll-in or roll-out. Not maintaining the correct pitch attitude during the maneuver and "chasing the airspeed". Becoming disoriented and rolling out on the wrong heading. Failing to clear the maneuver and maintain a visual scan during the maneuver. Becoming distracted and entering an unintentional stall, spin or spiral dive.

Performing steep turns competently is an essential part of flying gliders. Learning this skill is necessary to perform continuous thermaling turns and to be able to efficiently work thermal lift. With practice you will find it to come quite naturally and your ability to stay and climb in small thermals will be enhanced. Safe Soaring!