

Gliding Australia Training Manual

Trainer Guide



Unit 4

Orientation & Sailplane Stability

Unit 4 - Orientation & Sailplane Stability

AIM

The aim of this unit is for the student to:

- develop the knowledge and skills required to orient themselves in the three- dimensional flight environment in the local area;
- gain an awareness of the glider's inherent stability; and
- develop an understanding of terminology to be used in future training units.

PREREQUISITE UNITS

- GPC Unit 3 Pre-flight Preparation.

COMPLEMENTARY UNITS

- Theory course TL1 is required for this unit.

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COMPETENCY ELEMENTS AND PERFORMANCE STANDARDS

ELEMENT	PERFORMANCE STANDARDS
1. Orientation in the local area.	• Describe: ○ The local features, including the airfield, on the ground and in the air. ○ The airfield layout. ○ The boundaries of the local flying areas which can be identified by maps and charts if necessary / where appropriate. ○ The local flying operations briefs. ○ The distance/height/glide angle required to reach the aerodrome.
2. Sailplane stability.	• Describe: ○ The horizon as the primary attitude reference. ○ Stability in all 3 axes/planes. ○ Positive stability in Pitch and Yaw. ○ Neutral stability in Roll. ○ Hands off stability. ○ Lateral damping.
3. Knowledge of basic glider aerodynamics and components.	• Describe: ○ Basic glider aerodynamics. ○ The principles of Lift, Weight, Drag and Forward Flight. ○ Three axes: pitch, roll and yaw. ○ The aircraft's flying surfaces and ancillary equipment.

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KEY MESSAGES

- The aircraft should stay within safe glide angle of the airfield at all times when flying locally.
- Lookout and visual orientation in the air is an essential skill.
- The horizon is our primary attitude reference.
- The glider is a stable platform; it will fly hands off at a particular attitude, in a straight line or shallow bank angle.

LESSON PLANNING AND CONDUCT

Classroom Briefing

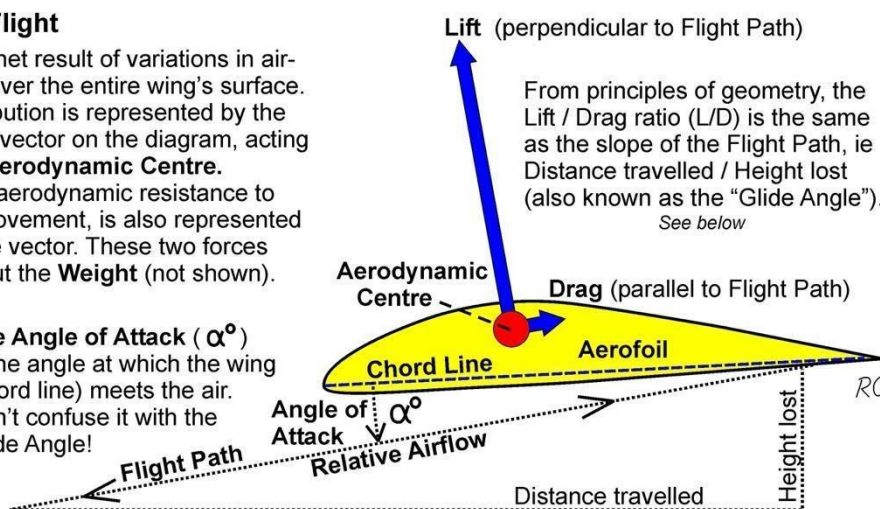
Theory course 1 is required for this unit. A brief overview of the Gliders components, terms and aerodynamics should be given to avoid confusion during flight. This could be presented with the aid of a model glider in the classroom or a real glider on the field.

Gliding Flight

Lift is the net result of variations in air-pressure over the entire wing's surface. This distribution is represented by the single **Lift** vector on the diagram, acting from the **Aerodynamic Centre**.

Drag, the aerodynamic resistance to forward movement, is also represented by a single vector. These two forces balance out the **Weight** (not shown).

The **Angle of Attack (α°)** is the angle at which the wing (chord line) meets the air. Don't confuse it with the **Glide Angle**!



The movement of a glider along its **Flight Path** results in the **Relative Airflow** past its wings. Thus the **Relative Airflow** is directly opposite to the **Flight Path**.

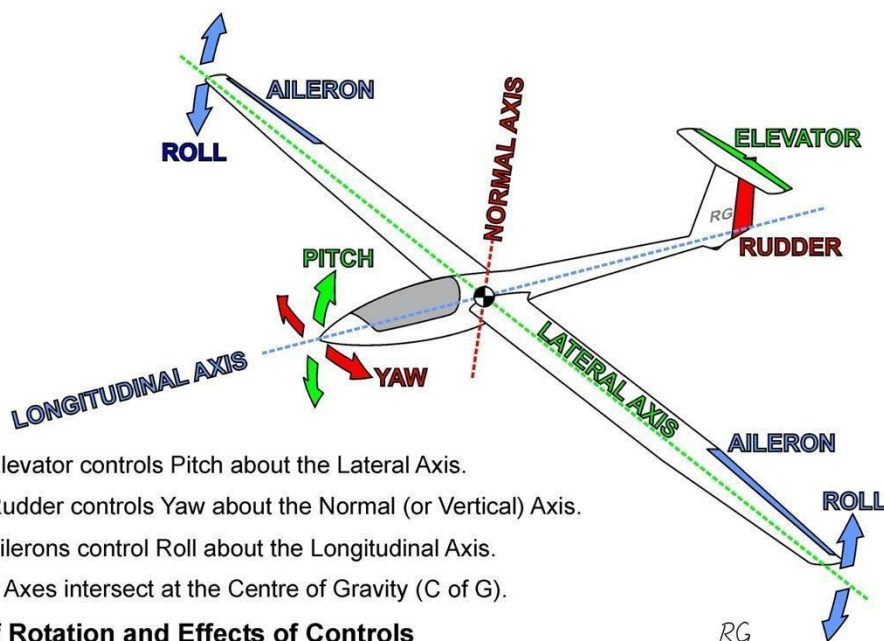
$$\frac{\text{Distance travelled}}{\text{Height lost}} = \frac{\text{Lift}}{\text{Drag}}$$

Eg a glider with a L/D of 40:1, glides 40 km from a height of 1 km (in still air).

Axes of Control

- There are three axes of control. We can control the glider in the pitching plane, about the lateral axis between the wingtips, where the nose goes up and down. We can control the glider in the rolling plane, about the longitudinal axis between the nose and tail, where the wings are banked left or right. We can control the glider in the yawing plane, about the vertical axis up and down, where the nose moves left or right.

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Stability

- The glider has a little positive stability in pitch; the nose will gradually return to a normal flying attitude.
- The glider has neutral or positive stability in roll; the wings will tend to remain at a constant bank angle until disturbed.
- The glider has strong yaw stability; the nose will move quickly back to the direction of flight.
- The glider is controlled in the pitching plane with elevator, in the rolling plane with aileron, and in the yawing plane with rudder.

Lateral Damping

- When the glider is rolling, the down going wing has a higher angle of attack, generating more lift. This dampens the rolling motion. This is called lateral damping.
- If the wing stalls, lateral damping is lost. The glider is then unstable in roll, and may spin. When we unstall the wings, lateral damping is renewed.

PRE-FLIGHT BRIEFING

- Before take-off give the student a realistic appraisal of the launch. In the case of a winch or auto-tow launch, advise the student that they may find the climb attitude steep or strange, but that this is quite normal.
- For winch launches mention the possibility of a cable break and tell the student that if this occurs the nose of the glider will be lowered rapidly. Talk informally on the climb, perhaps about conditions at the time...normal, calmer than usual, etc. Near top, mention that releasing the cable will make a noise, and that they will feel a change of attitude and sensation.

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FLIGHT EXERCISES

Orientation

- The orientation flight is intended to reinforce the points made on the air experience flight. In addition, the opportunity is taken to emphasise the three-dimensional nature of gliding and how to adapt to this from the two-dimensional world that the student has become accustomed to.
- Walk round the glider with the student, show them where things are, answer any questions, but do not go into any great detail. Provide orientation as follows: have them look at the landing area in use, tell them that the glider will be landing back there and “We can reach this area from the air at any time during the flight.”
- Point out some prominent landmarks in the vicinity of the strip, and suggest they should identify this during the flight and see how it looks from the air.
- At this stage, start introducing the fact that you are doing particular checks before flight, without necessarily bothering the student with too much detail.
- Point out key features in the local area, and in particular get them to locate the airfield at various stages during the flight. Show the student how to locate ground features starting using large features to lead into smaller features. Ask them to point to specific landmarks.
- On the base leg tell the student that you will be using the airbrakes after the next turn, that these may make a noise and change the attitude of the glider, and that this is normal.

Notes:

1. Trainers should add nothing to the above procedure except informal conversation. They will check throughout the flight on orientation, relaxation and enjoyment, and will make their initial assessment of the student.
2. During the flight, as in the air-experience flight, make all manoeuvres gently. Check on orientation several times by having the student point to the landing area and chosen landmarks.

Stability:

- The object of this exercise is to demonstrate that the glider is a stable platform, which will fly itself without the assistance of the pilot. To make this demonstration effective, reasonably calm conditions are required. Trim is used but not stressed to the student.
- Here we need to introduce the student pilot to new terminology in three dimensions. Emphasise the three types of motion: pitch, roll, and yaw, with reference to points on the horizon. Then emphasise that the glider can continue flying safely in a stable attitude without control inputs.
- Demonstrate the stability of the aircraft, ‘hands off’ several times, and further demonstrate that it will recover from displacement in the pitching plane keeping the degree of displacement within the stability characteristics of the aircraft.
- Give the student some experience in handling the controls and feeling the stability under direction from the trainer.
- Reinforce the need to look out and identify specific landmarks such as the airfield and nearby features.

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- During the flight, relaxation and orientation are checked, and a further assessment of the student's level of comfort and confidence is made. Do not proceed until this is established.
- More sensation of movement may be provided if the student seems receptive.
- Clarity, patience and repetition is needed to explain pitch in the vertical pitching plane about the lateral axis, roll in the rolling plane about the longitudinal axis, and yaw in the yawing plane about the vertical axis. Post flight debriefings can help the pilot visualise these axes and movements. This can then be linked to the concepts of lift and control surfaces.
- If the student is comfortable you can let them operate the controls under guidance, the start of Primary effects, but to help them understand the Stability of the glider, so only small movements should be allowed.

Lateral Damping:

- This is a very important factor affecting the glider's stability in the rolling plane. It is very simply explained.
- If the glider rolls, either because of a pilot input or because it is tipped by turbulence, the down going wing will start to produce more lift than the up going wing. This is because of the difference in the angles of attack of the two wings during the rolling manoeuvre. The increase in lift on the down going wing tends to resist any attempt to make the glider roll; in other words, it dampens the rolling tendency. Hence the name "Lateral Damping".
- Lateral damping is a powerful force that profoundly affects the behaviour of the glider in straight flight and during manoeuvres. It can, however, be destroyed, in which case the glider will become very unstable in the rolling plane and will roll uncontrollably until action is taken to restore the damping force.
- Lateral damping can be destroyed simply by stalling the glider. This can cause the glider to roll indiscriminately, a rolling motion which can become autorotation, the breeding ground for the spin manoeuvre. It can be restored just as simply by unstalling the wings, whereupon lateral damping reappears and provides the glider with the roll stability it had before.

Notes:

1. Post-flight debriefing and reference to the glider should be used to reinforce learning of these new terms.
2. Do not overload the student; demonstrate the motions and stability in-flight and then reinforce on the ground.
3. Further reinforcement should be done in later flights.
4. It is self-evident that if shorter winch flights are undertaken, this unit will need to be covered in several flights.
5. Even with an aerotow launch and longer flight times, it may take multiple launches for the student to absorb the concepts of stability.

Caution:

Do not demonstrate the stall or spin in this early unit; the student must understand later units on control, and stalling, and gain some familiarity and comfort with normal in-flight sensations.

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COMMON PROBLEMS

Problem	Probable Cause
Failure to recognise the aircraft's stability.	Atmospheric disturbances or incorrect flying by trainer.
Over-control	Lack of understanding of the stability, small control movements required, and inertia -

THREAT AND ERROR MANAGEMENT

- Handing over/taking over, briefed and demonstrated to the student.
- Maintain an effective lookout.
- Ensure the student is looking out and can identify other traffic and prominent features when indicated by the trainer.
- Over control.
- Emphasise a relaxed grip on the controls and smooth but positive operation.
- Make control column inputs using wrist action and not the entire arm to avoid PIOs.

TRAINING MATERIALS AND REFERENCES

- Model or Real Glider
- GPC Pilot Guide Unit 4
- Theory Lesson 1