Gliding Australia Training Manual

Pilot Guide

Unit 40
Cruising, speed to fly, height bands and thermal selection

Unit 40 – Cruising, speed to fly, height bands and thermal selection

WHAT THIS UNIT IS ABOUT

To develop your skills and ingrained habits in selecting a path through the air that improves achieved glide performance; selecting and maintaining an appropriate speed to fly; using height bands to manage risk in terms of locating the next thermal; and choosing which thermals to accept.

WHAT ARE THE PRE-REQUISITES FOR THIS UNIT?

- GPC Unit 39 Advanced soaring instruments and flight computers

KEY MESSAGES

- Aim to fly a track through rising (or less sinking) air to improve glide performance and maximise the chance of finding the best climbs.
- The speed to fly should be based on the expected conditions ahead, not the last thermal.
- Cruising strictly to MacCready speed to fly theory is inefficient and impossible to achieve - use block speeds (plus or minus 10 knots) that approximate MacCready speeds.
- Don't take every thermal unless necessary - be selective with thermal strength and avoid wasting time by centring too many thermals.
- Don't climb to the top of each thermal - leave when you think the next climb will be better (or to remain below cloud).
- Divide the convection height into three bands: in the top band cruise fastest and only take strong climbs; in the middle band cruise more conservatively and be prepared to take weaker climbs; below 2000 feet prepare for an outlanding and stay within reach of an appropriate landing site while searching for a climb.
- Transition from a soaring pilot to a landing pilot with sufficient height for a safe circuit.

PILOT GUIDE FOR THIS UNIT

This GPC unit introduces the final cross-country elements of the GPC syllabus. It covers appropriate track and speed for cruising, height bands and thermal selection, and a very basic introduction to final glides.

Cruising – Track selection

Cruising efficiently maximises your chances of finding the best thermals, reduces the number required and increases your average rate of climb. You'll be more efficient if you select a pathway that optimises the amount of time you fly through rising air.

This is most easily done when cumulus clouds can provide guidance to where lift will be – look to run along streets wherever possible as long as good progress is being made on task. On blue days the same pathways still exist but you have to rely on your feel for all of the improvement. This takes concentration and practice. Choose pathways that keep you generally on track – deviating more than 30 degrees is often a disadvantage. Always deviate upwind instead of downwind given an equal choice. (Ref GPC units 33/36/38)

Looking 20-60km ahead enables you to pick better lines of energy and identify if weather is improving or getting worse. Learn to recognise the best looking cumulus clouds, or feel for lines of rising air in the blue. The feel of the air will be assisted if you maintain a constant speed, the glider is trimmed, and you have a light grip on the stick. If required, fly a little slower in order to feel the air between thermals and identify lines of reduced sinking air.

Height Bands

Considering height bands is a way to determine when you can fly faster and when you should slow down so

as to avoid getting low. It is a way of determining risk and acting accordingly.

For simplicity, nominate 3 bands of 1/3 available convection height. You should fly faster in the top height band and slower in the lower bands.

You should stay in the top height band if possible, but extend the glide and only thermal when you find a suitable thermal or as you approach the bottom of the height band.

Note the bottom 2,000' of convection should always be in the bottom band. This is the height where you should be planning and preparing for an outlanding, selecting and staying within reach of an appropriate paddock – Transitioning from a soaring pilot to a landing pilot. (Ref GPC units 15/16/34)

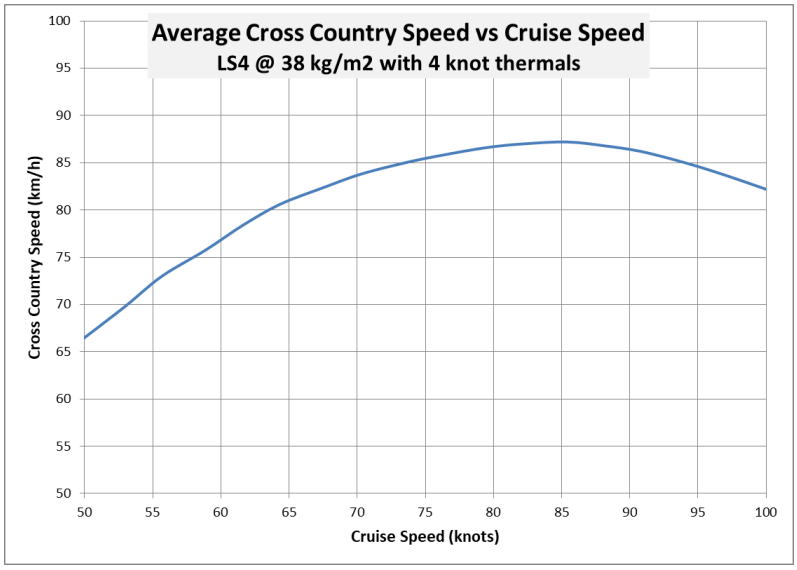
Speed to Fly

Cruise speed is important for achieving the best cross-country speed. Flying at minimum sinking speed makes your flight longer but you don't travel very far. Flying at the best glide speed gets you a little further, but it takes more time to get there. And if you fly too fast you'll lose too much height.

Generally you should maintain suitable speed (typically 60-80 knots without ballast) depending on height band and achieved rates of climb.

MacCready theory (developed by Paul MacCready in the 1950s) defines, based on the polar performance curve of the glider, an optimal cruise speed given the strength of the next thermal and the air the glider is cruising through. The theory states that your cruise speed should be faster with strong climbs and should vary based on the sink or lift that you fly through – faster in sink and slower in lift. MacCready theory is explained in many books and online resources – it's not essential that you understand the theory from first principles.

Based on MacCready theory a curve such as shown in the chart below can be derived to show average cross-country speed versus cruise speed. You can see in this typical case, for an unballasted LS4, that the cross-country speed achieved varies by only a small amount when cruising 10 knots faster or 10 knots slower than the theoretical optimum speed.



MacCready speed to fly theory is theoretically sound but is almost impossible to accurately fly, and constantly changing speed is inefficient. Since plus or minus 10 knots cruise speed does not make much difference 'block speeds' are used that approximate MacCready speeds. In the case of the unballasted LS4 the theoretical block speeds are approximately 70/85/90 knots if your next thermal is 2/4/6 knots respectively; however if you cruise at these speeds you'll find it hard to feel the air, it's much harder because everything happens faster, and you're likely to get low. The table below shows more appropriate LS4 cruising block speeds for typical weak, medium and strong thermals, and depending on the height band (see next section). As you become more experienced you can increase these speeds by up to 5 knots.

Block Speeds – Unballasted LS4		
Thermal strength (your average climb rate in the thermal)	Cruise Speed *Mid height band*	Cruise Speed *Upper height band*
2 knots	55 knots	65 knots
4 knots	70 knots	80 knots
6 knots	75 knots	85 knots

As a rule of thumb, cruise at 75 knots between thermals. You can vary this by plus or minus 10 knots depending on height and thermal strength. If you fly through an extended area sink you should increase your speed by up to 10 knots, similarly decrease your speed when flying through an extended area of lift.

Adjust these speeds a few knots slower if you fly a lower performance glider than the LS4 and faster if you fly a higher performance glider. Ballast has a large impact on cruise speed and will be discussed in the Advanced Training Syllabus.

Remember, the speed to fly is based on the expected conditions ahead, not the last thermal.

Thermal selection

You can fly though a number of thermals without stopping to thermal, just absorbing energy as you pass through rising air. Your aim is to stay in the top height band and only climb in the strongest thermals. You shouldn't get low and have to take a weak thermal.

Taking each thermal as you progress is not efficient because it takes time to centre the climb and your average rate of climb is therefore reduced.

On finding a thermal your decisions are:

- am I likely to hit a stronger thermal before falling out of the bottom of the height band if I keep going?
- If the answer is yes then keep flying, otherwise stop and thermal.

If you aren't sure, sample the thermal:

- if it builds as you start your turn then there is a good chance that you'll centre the thermal quickly with a better average climb rate;
- if it doesn't feel good consider moving on.

Once centred in a thermal stay with it until you reach cloud base (maintaining VMC), or you expect the bottom of the next climb to be stronger than your current climb rate. It's rarely appropriate to keep climbing in weak lift near the top.

Final Glides

Final glides are not covered in detail in the GPC syllabus. There's no problem in taking your last climb to the top so that it is obvious that you'll get home with plenty of height to spare. Be wary of final glide information from flight computers − configuration is error prone and there are many assumptions that can get you into trouble *(Ref GPC unit 39).*

There is an old rule of thumb for final glide height: allow 1000 feet per 10 km plus the safety height for you to do a circuit. This works for most gliders and slower cruise speeds as long there isn't significant headwind or sinking air. If in doubt, climb higher.

At a constant cruise speed you may be able to see your destination move on the canopy in the same way as an aiming point for final approach – if it moves up the canopy you are below glide. With a final glide computer it is useful to display the required L/D (glide ratio) to your destination (with the safety height). If this number decreases you are improving on the glide.

If you think you are falling below glide, take another thermal – simply slowing down to increase the glide angle rarely works. Allow yourself plenty of height to complete a safe circuit, hopefully at the home airfield but always be prepared to outland if you don't make it home.

Safety

Review the threats and mitigating actions identified in the Pilot Guides 'Soaring with other gliders', 'Outlanding planning, demonstration and execution' and 'Navigation and airspace'.

It is extremely important to transition at the appropriate time from a soaring pilot to a landing pilot and allow sufficient height for a full circuit. If you get low on final glide there is a temptation to try to stretch the glide to the airfield – don't do this! Make an early decision to find a thermal and plan for a possible outlanding. Pay attention to possible unlandable terrain when flight planning and select your track to avoid flying over it.

As always, maintain good lookout at all times.

FLIGHT EXERCISES FOR THIS UNIT

Your coach will demonstrate cruising and thermal selection. They will discuss their choice of track and cruise speed, and the height bands appropriate for the current conditions. Remember that the appropriate height bands will likely change during the flight as the conditions change.

You'll then have an opportunity to practice all the elements of this unit.

Key skills are flying in the direction of track, aiming for a good thermal or thermal source, and maintaining the set cruise speed. Monitor these three elements.

Make sure you maintain lookout and trim the glider appropriately.

You can then move onto feeling for better air in the cruise. Fly at a slower speed to get better feel if necessary.

Note the height lost in reaching the next thermal and monitor this for subsequent glides. As the glider descends to the next height band, reduce your cruise speed and put a greater focus on finding a thermal.

There is a lot to cover, and this is likely to take more than one flight to become reasonably proficient. The advanced training syllabus will cover all the elements in far more detail.

THINGS YOU MIGHT HAVE DIFFICULTY WITH

COMMON PROBLEMS	
Problem	**Probable Cause**
Losing too much height in the glide	Not selecting and following an appropriate track
Cruising speed too slow or too fast for the conditions	Incorrect understanding of appropriate cruise speed Not considering the height band and looking at the conditions ahead Inattention to cruising speed
Limited ability to feel the air	Cruising too fast
Taking every thermal regardless of strength	Not selecting thermals in accordance with the selection criteria (is the next thermal likely to be better?)
Climbing in weak rising air at the top of a thermal	Not leaving when the next thermal is likely to be better

HOW DO YOU DEMONSTRATE COMPETENCE?

- Demonstrate looking to the distance on track to identify several thermal sources and/or cumulus clouds and following a pathway through these to maximise the chance of finding thermals
- Demonstrate identifying and following a pathway through areas of rising air to extend glide performance whilst making progress on task
- Identify appropriate height bands for the conditions
- Demonstrate consistently determining and adjusting cruise speed based on height band and expected conditions
- Demonstrate maintaining the nominated speed throughout the flight +/- 5 knots
- Identify the thermal strength required appropriate to the height band and conditions
- Demonstrate selecting only thermals that meet criteria
- Identify sufficient height for final glide
- Demonstrate monitoring glide and taking appropriate actions

RESOURCES & REFERENCES

- G Dale. ‘The Soaring Engine – volume 1’, Chapter: Flatland soaring
- G Dale. ‘The Soaring Engine – volume 3’, Chapter: Flying

SELF-CHECK QUESTIONS

Use these questions to test your knowledge of the unit.

1. What is the maximum track deviation angle you should generally fly?
2. Why should you not closely follow the theoretical best cruise speed from MacCready theory?
3. If you are flying an LS4 at 3500 feet on a day when the top of the thermals is 6000 feet and you expect your next climb to average 5 knots, what would be an appropriate cruise speed?
4. What are the three key decisions when encountering a thermal? (Refer to GPC Unit 31)
5. When should you leave a thermal?
6. If you are 30km from your airfield and want to arrive at 1500 feet, approximately how high would you expect to need to be without significant wind?