

Gliding Australia Training Manual

Trainer Guide



Unit 17

Stabilised Approach and Landing

Unit 17 - Stabilised Approach and Landing

AIM

The aim of this unit is to train the student with the skills and knowledge required to perform a safe stabilised approach and landing, for a wide range of environmental conditions.

Note that this unit has serious safety consideration due to students taking control at low level. The Trainer must review the safety aspects detailed in Flight Exercises and Threat and Error Management to ensure training is completed safely and effectively.

PREREQUISITE UNITS

- GPC Unit 16 Circuit Joining & Execution

COMPLEMENTARY UNITS

This unit should be read in conjunction with:

- Unit 19 Crosswind Take-off and Landing
- Unit 21 Radio Use & Endorsement

COMPETENCY ELEMENTS AND PERFORMANCE STANDARDS

ELEMENT	PERFORMANCE STANDARDS
1. Plan for approach and landing.	<ul style="list-style-type: none"> • Describe: <ul style="list-style-type: none"> ○ Obstacle and runway clearance requirements. ○ Threats from wind and other environmental factors. ○ Threats due to turbulence and wind shear, and corrective actions.
2. Conduct approach.	<ul style="list-style-type: none"> • Describe: <ul style="list-style-type: none"> ○ Illusions present when landing upslope or downslope. • Demonstrate: <ul style="list-style-type: none"> ○ Rollout from final turn to line up with intended landing path. ○ Identification of the landing area and aiming point. ○ Identification of overshoot and undershoot situations. ○ Establishing overshoot on the glide path before extending airbrakes. ○ Stabilised approaches with half airbrake clearing all obstacles by at least 50 feet. ○ Maintains constant airspeed ○ Use of elevator to control attitude to achieve and maintain safe approach airspeed. ○ Use of airbrakes to correct for undershoot or overshoot. ○ Adjusting heading to account for drift during approach, to achieve a flight path aligned with intended landing track. ○ Monitoring and adjusting approach for wind shear.

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<p>3. Conduct flare, hold-off and landing.</p>	<ul style="list-style-type: none"> ● Describe: <ul style="list-style-type: none"> ○ Recovery actions from incorrectly judged flares (late, bounce or balloon). ○ Changes to flare technique when landing up slope, down slope and cross slope. ● Demonstrate: <ul style="list-style-type: none"> ○ Hold off height is sustained to a minimum energy touchdown at the correct landing attitude. ○ Movement of gaze away from the aiming point towards the far end of the runway, to assist judgement of the correct flare attitude and height. ○ Commencement of flare at a correct height to arrest the rate of descent and achieve the hold off height, using elevator as the primary flight control. ○ Positive control of the aircraft during the ground roll. ○ Using elevator, rudder and ailerons to keep aircraft moving in a straight line until stationary. ○ Correct application of airbrake and wheel brakes as required to slow and stop the glider. ○ Achievement of planned end of roll within 10 metres.
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KEY MESSAGES

- Stabilised approach involves constant attitude/airspeed, descent rate and track.
- On approach, attitude/airspeed are controlled with elevator and rate of descent with airbrakes/spoilers.
- During flare and hold-off, the primary control is elevator, not airbrake. Speed will progressively reduce until the glider settles on the ground.
- If a landing is bounced or ballooned, reduce airbrakes, establish a safe approach attitude, then repeat flare for landing.
- Positive control must be maintained after touchdown.

LESSON PLANNING AND CONDUCT

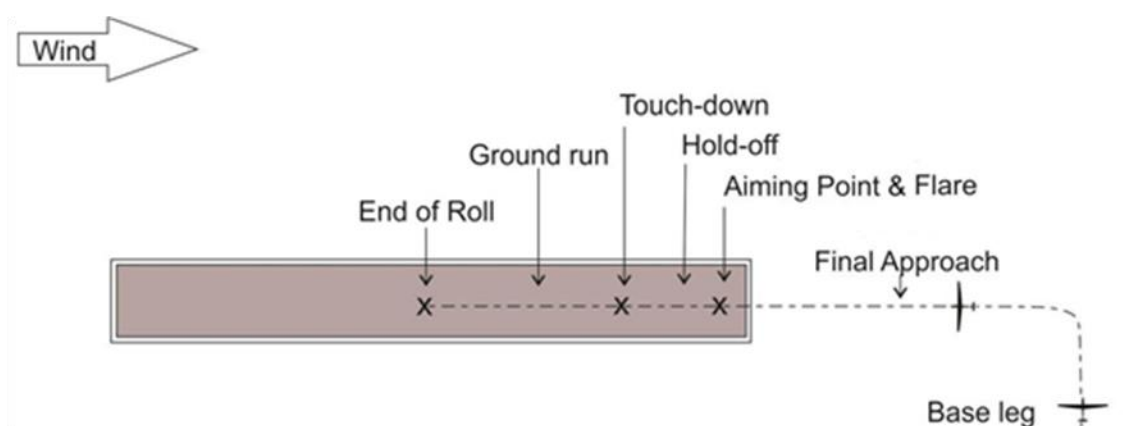
Classroom Briefing

Early in the Approach

- Once the turn from base-leg is completed and the glider is wings level on the approach path, check approach speed, flap setting and heading, and then maintain until the flare or round out.
- Start a work cycle that repeats through the approach – SPEED – DIRECTION – GLIDESLOPE.
- Identify the aiming point, locate and identify the airbrake handle (this should have been completed on the Base leg)

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- Airbrakes should not be used until the pilot has assessed that the aircraft is beginning to unmistakably overshoot the intended touchdown area and will clear all obstructions with a half airbrake approach.
- Once established, airbrakes/spoilers are then used as required to maintain the correct final stabilised approach path.
- Any tendency to undershoot or overshoot the aiming point should be corrected by appropriate fine adjustment of the airbrake/spoiler settings. Coarse movement is to be avoided at this stage of the flight.



Wind gradient

- The glider is now about to enter an air mass which is affected by ground friction, resulting in a phenomenon known as "wind gradient". This means that the wind speed decreases progressively closer to the ground. The effect this has on the glider is to cause a decrease in airspeed at a constant approach attitude.
- The reason it happens is related to the inertia of the glider and the fact that it cannot accelerate quickly enough to keep pace with the falling wind speed. This is the reason why the approach speed is set to $1.5V_s + \frac{1}{2}$ wind speed.
 - e.g. a glider with a safe speed near the ground of 50kts in nil wind, approaching into a 10 kt headwind, will set an Approach Speed of 55 kts in the pre-landing checks.

Use of Airbrakes

- Control the descent path with the airbrakes and the speed with the elevator. Be prepared to close the brakes and land long to clear obstructions. Emphasise to the student:
 - AIRBRAKES control rate of descent
 - ELEVATOR controls speed.
- Do not use large and unsafe elevator inputs, particularly close to the ground.
- Use of airbrakes must be introduced to the student at safe altitudes, long before any introduction to their use during approach and during flare and hold off. Emphasise smooth opening and "unlock then hold" until the effect is identified.
- The final glide path is based on a half to full airbrake setting; therefore, the airbrakes/spoilers will typically be used to a sufficient degree to maintain this glide path.

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- Note that when increasing the airbrakes, the nose may need to be lowered slightly with gentle forward elevator pressure as the brakes come out further, in order to prevent the speed from decaying due to the increased drag.

Approach – Using the Aiming Point to maintain glide slope

- The aiming point is an approach aid. It is a point (or to be more practical an area) on the ground which will appear stationary from the cockpit when the glider is stabilised on the selected final approach path.
- **OVERSHOOT**
 - When the glider is in an overshoot situation (i.e. it is above the final approach path), the aiming point moves downwards and tends to disappear out of view under the nose as the glider overshoots it. It becomes obvious that the glider will land well beyond the aiming point.
 - An **OVERSHOOT** requires further extension of the airbrakes to steepen the final approach path and restore the aiming point to a stationary position.
- **UNDERSHOOT**
 - If the glider is undershooting (i.e. it is below the final approach path), the aiming point moves upwards in the canopy towards the horizon. It becomes obvious that the glider will land before the aiming point is reached.
 - An **UNDERSHOOT** requires reducing the extension of airbrakes, in order to make the approach path less steep and once more restore the aiming point to a stationary position.
- Changes to the airbrake setting may result in changes to aircraft attitude and therefore light pressure on the elevator is required to return to the correct approach speed.

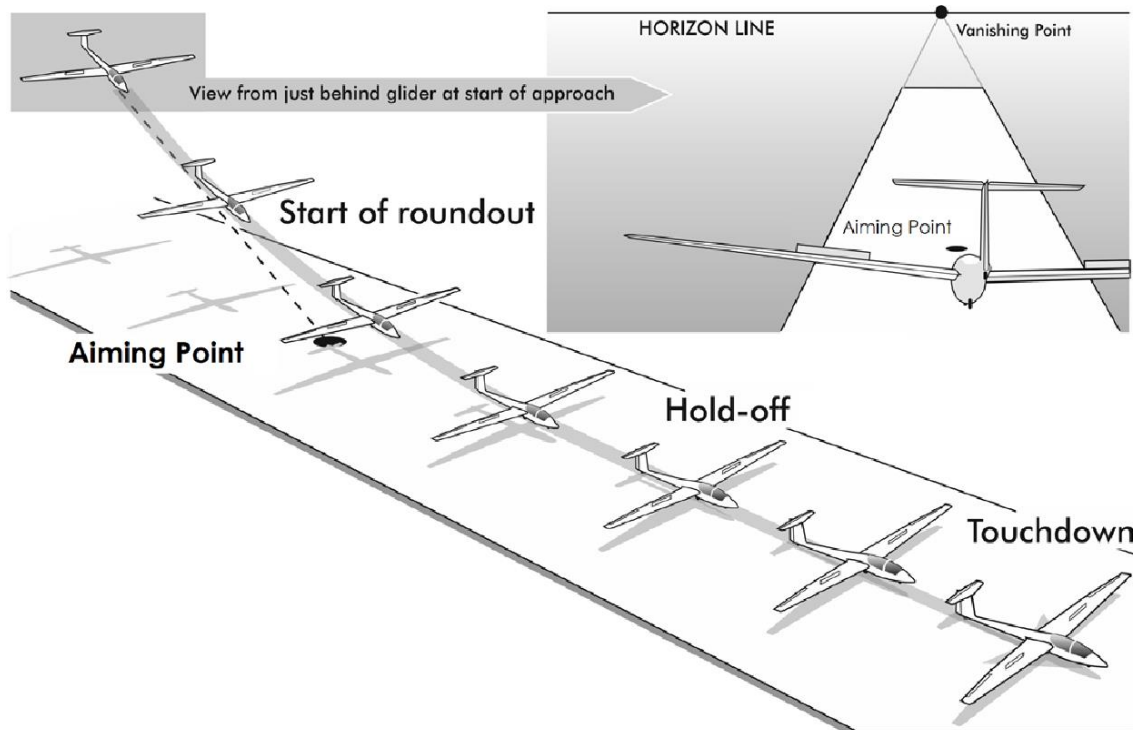
Lineup/Directional control

- There may be a need to adjust the lineup if the glider isn't lined up in the intended landing direction after turning finals too early or too late, not anticipating the rollout, not holding wings level on finals or cross-wind component. Small directional corrections are best made by "squeezing" small amounts of rudder to steer the nose in the intended direction. Trying to correct by turning the glider will be difficult for early students if they aren't perfectly coordinated (secondary effect of aileron will worsen the lineup problem) and difficulty in anticipating the desired aircraft heading.

Landing – Flare, Hold-Off and Ground Roll

- The landing phase covers the transition from the stabilised approach, through a flare and then a hold-off, then a ground roll, until stationary.

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- The aim in landing is to fly the glider just above the ground so that it will touch down gently at the minimal possible speed, for a smooth and safe ground roll clear of obstacles.
- The Flare changes the glider from a descending attitude at constant speed to a horizontal attitude with decreasing speed.



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- This is achieved by slowly moving the stick backwards until the 2-point landing attitude is achieved.
- If you move the stick back too early or too quickly then the glider will be too high when it stalls, and you get a heavy landing and damage.
- If you move the stick back too late or too slowly then the glider will strike the ground at too high a speed, and you get damage and a bounce.
- Judging when to flare is a key skill. A guide to the commencement of the flare is when the runway appears to the pilot to “zoom” in width or the ground appears to “rush” towards the pilot.
- Your gaze should be transferred towards the other end of the landing area, this will help you judging the landing.
- When you have the glider flying in the 2-point landing attitude, this “Hold-off” should be maintained with increasing back pressure on elevator (due to reduced airspeed) until the glider touches down at minimum energy.

Sloped Runways

- To simulate the visual illusions resulting from a sloping runway, hold your arm straight out from your shoulder, palm down with your hand flat. This is what a level runway looks like on a normal 3-5° approach.
- Now, tilt your hand up about 10°. This is the view you see when setting up for landing on an up-slope runway. The illusion tells you that you are too steep. The potential danger is that you will respond to the illusion and come in too shallow.
- Tilt your hand downwards to simulate the illusion of the down-slope runway. The illusion is that you are too shallow and, thus, the potential difficulties arise when you approach the runway too steep. Landing on a down-sloped runway is particularly difficult because, as you flare, the runway drops away and the glider will tend to “float” for a long distance.

PRE-FLIGHT BRIEFING

- A model aircraft is very useful to describe the approach and landing configuration and angles. The Theory lesson PowerPoint has diagrams and may be easier than the words in this guide.
- Emphasise the need for smooth control movements with both elevator and airbrakes.
- Monitor track down the landing path by looking well ahead to identify deviation.
- Explain the need to monitor airspeed (attitude), direction, glide-slope/rate of descent (with airbrakes).
- They must not make abrupt or large control movements as this can impact the safety of the flight.
- Trainer will demonstrate and student will be invited to follow through on the controls. When handing over to the student the trainer will be close to the controls and generally will explain what the student needs to do, but it is not unusual for the trainers to come back on the controls as there may be insufficient time to explain what to do next.

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FLIGHT EXERCISES

WARNING: Advice to trainers regarding their responsibility to maintain safe flight.

- Adopt a defensive posture, with hands close to or limiting position of both elevator and airbrake, to guard against controls being operated to an irrecoverable situation.
- The student pushing the stick forward or pulling the airbrake out without warning may not be recoverable at low height.
- If in doubt, take over especially if you are low in instructional experience.
- Do not over-progress the student on coordinating use of airbrakes and elevator close to the ground.
- This must first be practiced at higher altitudes, above the circuit area.
- Before the first flight where the student will operate the airbrakes, spend time in the cockpit discussing and demonstrating the airbrake corrections. Point out that a reasonable correction to a typical overshoot or undershoot is only a cm or so of airbrake handle travel,
- Watch for students with limited landing experience that have had a long break since their last flight, skills or response to abnormal situations in the landing sequence may be considerably degraded.
- Ground proximity wind shear should be compensated for by reducing airbrakes as necessary, and if energy reduces, with appropriate forward elevator pressure and fully closing airbrakes.
- Flying for this unit ideally requires benign weather conditions with little turbulence and wind effects for initial student exercises, building up to more demanding conditions as their experience and competency develop.

Approach

- Key point is the work cycle of SPEED – DIRECTION – GLIDESLOPE.
- Maintain safe approach speed through use of elevator. Note that attitude may start to look different due to the large amount of ground visible at lower heights.
- Direct student to look into the distance to determine and correct track to the aiming point. Adjustments require early intervention with coordinated controls.
- Once overshoot is identified announce this and invite the student to use airbrakes accordingly.
- Avoid this happening close to the ground, probably by setting up a higher approach for the first few landings.
- Guard the stick (to stop rapid forward elevator) and airbrakes (to ensure the opening is controlled).
- Regularly remind the student to monitor the work cycle of SPEED – DIRECTION – GLIDESLOPE.
- Monitor descent to aiming point and identify any indicators of undershoot or overshoot. Correct with airbrakes.
- Encourage student to make early small corrections and then only add controls movements when necessary.
- Minor deviations can be ignored in the early stages of practicing the approach and landing. These will be corrected in later flights.

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- Warn the student if you anticipate wind shear and either take over or direct them through the steps of easing the airbrakes and lowering the nose.

Flare and Hold-off

- State that we now need to ease the stick back to change the flight path to the landing attitude instead of the approach attitude. Your peripheral vision will identify when the glider is no longer descending and flying parallel to the ground.
- After the flare the glider is flown parallel to and just above the ground.
- This non-descending path of the glider after the flare is called the hold-off.
- Failure to hold-off will often result in either a heavy or ballooned landing.
- The hold-off phase should be sustained at a steady height just above the ground.
- As the speed decays the glider will inevitably sink and increasing elevator back pressure will be required to prevent this.
- Eventually the glider will 'land itself', settling onto the ground in the touchdown attitude at MINIMUM ENERGY with no tendency to bounce or resume flying.
- Maintain the landing attitude until the end of roll, not just touchdown.
- Failure to look far enough ahead during the final approach is the prime cause of early students being unable to judge the flare/round out.
- Incorrectly judged flares/round outs generally lead to ballooning in cases where up elevator is excessive, or to bounced landings where the flare/round out is left too late.
- The right way to fix any mishandled glider landing is by a combination of attitude and airbrake control.

Touch Down and Ground Roll

- Once the glider has touched down, direct the student to progressively open the airbrakes fully (watch out for any coupled wheel brake!) and bring the stick progressively back to the stop if it is not there already.
- Aircraft with wheel brakes at the end of airbrake adjust travel so that we do not deploy brakes too quickly and damage the aircraft nose.
- The pilot's priorities are to keep the glider on the ground in the touch down attitude, wings level with aileron and travelling in a straight line using rudder until it rolls to a stop.
- As the speed decays, progressively larger control movements will be required to keep the wings level and/or steer the glider.
- Like the ground run on take-off, this is another occasion where independent use of the ailerons and rudder may be required.
- Wheel brake should be applied as necessary.

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Notes:

- Develop safe landings first, then develop "spot" landings.
- It is very important that students are coached in the correct use of airbrakes at height prior to use on final.
- Do not accept consistently high, steep approaches during training, as this encourages "automatic" opening of the airbrakes/spoilers as soon as the final turn is completed.
- Trainees should be shown the undershoot situation and trained in the necessary techniques to correct it.
- Once a stabilised approach is established the airbrake setting should ideally remain unaltered until touchdown.
- A "long float" landing with a trainer is a useful training exercise.
- If the glider is rounded out too high with safe speed, a level attitude and moderate brake setting, then hold everything still and let the glider sink. Do not open the airbrakes further to reduce height.
- Cross wind landings are the subject of GPC Unit 19 Crosswind Take Off and Landing.
- It is a good idea to get the student to self-analyse how the circuit and landing went immediately following each flight at debriefing, as often deterioration in performance can be identified early and remedial actions taken.
- Stress to the student that a stabilised approach is a pre-requisite for a good landing. For the initial few circuit attempts, the trainer can set up a deliberately high/wide circuit which will give the student appreciably more time on finals to master a stabilised approach.

Training Notes and Lesson Planning for Powered Sailplane Pilots.

COMMON PROBLEMS

Problem	Probable Cause
<ul style="list-style-type: none"> • Turning final too close to the aiming point which requires immediate and excessive use of airbrake. 	<p>Circuit plan has been too conservative or poorly executed.</p> <p>Encourage the student to extend downwind more so that they have time on final to assess the situation before having to use airbrakes.</p>
<ul style="list-style-type: none"> • Use of elevator to 'point at the aiming point' instead of using airbrake to control descent to the aiming point. 	<p>Student may be confusing the role of the controls.</p> <p>Emphasise the different role of the elevator and the airbrakes.</p>
<ul style="list-style-type: none"> • Incorrect under/overshoot identification. 	<p>Student is not monitoring movement of aiming point on approach, or student has not identified fixed aiming point on runway.</p> <p>Coach UNDERSHOOT identified – less airbrake, OVERSHOOT identified - more airbrake.</p> <p>Emphasis work cycle including GLIDESLOPE.</p>

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<ul style="list-style-type: none"> Failure to identify and correct for wind shear. 	<p>Student is not monitoring airspeed on approach.</p> <p>Reduce Airbrakes and ease stick forward if height permits. If unsure, take over, close airbrakes and land.</p> <p>Emphasise work cycle including AIRSPEED.</p>
<ul style="list-style-type: none"> Early or late flare. 	<p>Excessive or slow reaction to ground rush by student.</p> <p>Have hands in defensive posture adjacent to dive airbrakes and elevator control if student fails to correct and especially guard against student pushing stick forward, or excessive use of airbrake.</p>
<ul style="list-style-type: none"> difficulty maintaining directional control after landing 	<p>Typically due to overcontrolling with rudder. Tell them when to centralise the rudder or they will keep the rudder on too long and weave down the runway. When the student applies the rudder to straighten the glider, as soon as the nose starts to respond in the desired direction, centralise the rudder."</p>

THREAT AND ERROR MANAGEMENT

- Ensure Handover-Takeover protocols are followed.
- Stay alert. Unprompted rapid control and airbrake movement can cause significant dangers when close to the ground. Always adopt a defensive posture, with hands close to or limiting position of both elevator (forward and backward movement) and airbrake.
- Lack of attention may result in undershoot problems. Trainer must ensure not to let this progress beyond their own abilities to correct.
- Heavy landing accidents, and accidents involving an apparent loss of control during final approach, have been too frequent since gliding began. Many of these involved two-seat aircraft on training flights involving students with a relatively low time and/or minimal launch experience being directed or monitored through the landing by a trainer.
- Many of these accidents involved an unexpected and inappropriate control input by the student, usually involving the elevator control, leading to either an abrupt nose down pitch and dive, or a nose up pitch and stall, from which the trainer was unable to recover sufficiently or not at all.
- Students must not be progressed through their training into being directed by the traier through the final approach and landing, until they have demonstrated a high level of control co-ordination during upper air work training sequences.
- Before being allowed onto the controls at low level (i.e. circuit height), the student will be benefitting from trainer demonstrations with the student following on the controls. Remember the demonstrate-direct-monitor training sequence and be clear where the student is on this sequence once landing training is to be introduced. Do not 'over progress' the student through this phase!
- Above circuit altitude the trainer must demonstrate the primary effect of elevator at lower airspeed to show stick movement, and also at approach speed so that the student appreciates the reduced stick movement and increased effectiveness of the elevator at these higher speeds.. It is important the student understands the range of stick movement at various speeds before handling the aircraft close to the ground (i.e. below the spin recovery height for the aircraft). This emphasises a need to ensure that the student has gained the fine motor skills to manipulate the

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controls appropriately, particularly the elevator, and the student appreciates the relatively small elevator control inputs that are required at approach speeds.

- When conducting an actual approach, any tendency for the student to make frequent adjustments to the airbrake setting must be discouraged, especially if it is not possible to detect the effect of one change before the next one is made. Failure to maintain a near-constant setting may be due to lack of familiarity with the forces and changes involved.
- Caution: Even though the trainer may be guarding the stick, this will not prevent the stick moving in response to a student applied input. This is because the trainer's hand and arm will be relaxed. It takes about 1-2 seconds for the trainer to then react where discrimination and judgment are involved. Remember, 60 knots is 100 feet per second – so a trainer will have very little time to react to a steep push-over at heights below 200ft.

Threshold of Intervention and Defensive posture

- The trainer must be ready to take over during the approach and particularly close to the ground if the student becomes unresponsive to directions or responds inappropriately. The trainer should “guard” (i.e. lightly grasp) the stick against the student over-controlling the elevator in both directions. This requires maintaining a light hold on the stick and be aware that a “negative G” bunt manoeuvre might lift the trainer's hand off the control column!
- During the first few occasions when the student is being directed through the approach and landing sequence, allow the student to control the glider with the control column (with the trainer “guarding” the elevator with the right hand), while the trainer retains control of the airbrake. This allows the student to concentrate on maintaining direction and speed control while the trainer controls the aiming point.
- The trainer must monitor the student's workload on final approach. If the student stops responding to the trainer's directions, this is a sign that the student is becoming overloaded and the trainer must take over for safety and training benefit.
- In the event of a high ballooned landing or serious bounce, the trainer must respond immediately by taking over control, closing the airbrakes and stabilising the aircraft off the ground, before resuming the landing with an appropriate airbrake setting. At this stage, lower the nose if necessary to stabilise the aircraft, with care.

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TRAINING MATERIALS AND REFERENCES

- Australian Gliding Knowledge (AGK) pages 114 - 140
- BGA Instructors Manual 2017
- GFA MoSP 2 Operations
- Theory Lessons