Hang Gliding Federation of Australia

www.hgfa.asn.au

TOWING PROCEDURES MANUAL

Revision: Dec. 2013
Ver: 20180409

Contents

1 Introduction 1

1.1.1 Legal 1
1.1.2 Background to Towing 1
1.1.3 General Guidelines 2
1.1.4 Preliminary Recommendations 2

2 Operational Requirements 3

2.1 Pilot Qualifications 3
2.1.1 Ground Towing 3
2.1.2 Aerotowing 3

2.2 Tow Pilot Qualifications 4
2.2.1 Tug Mirrors 4

2.3 Duty Pilot 4

3 Equipment 5

3.1 Towing Systems 6
3.1.1 Static Tow Line 6
3.1.2 Pay-out Winch and Platform Launch 6
3.1.3 Pull-in or Static Winch 6
3.1.4 Reflex Static Winch 7
3.1.5 Aerotow 7

3.2 Tow Bridles 7
3.2.2 Hang Gliding Bridles 7
3.2.3 Paragliding Bridles 10

3.3 Releases 12
3.3.1 Ring Release 12
3.3.2 Link Knife Releases 13
3.3.3 Barrel Release 13

3.4 Weak Links 13
3.4.1 Typical Weak link Set-ups 14

3.5 Rope Types 14

3.6 Launch Trolley (dolly) 15

3.7 Ancillary Safety Equipment 15
3.7.1 Protective Eye-wear 15
3.7.2 Hook Knife 15
3.7.3 Flotation 15
3.7.4 Emergency Parachutes 16

4 Procedures 16

4.1.1 Site Considerations 16
4.1.2 Weather Conditions 16
4.1.3 Training Considerations 16

4.2 Tow Tension 17
4.2.1 Line Tension - Hang Glider Ground Towing 17
4.2.2 Line Tension - Paragliding Towing 17

4.3 Launch Procedures 18
4.3.1 Procedures under Tow 18

4.4 Release Procedures 21
4.4.1 Ground towing 21
4.4.2 Aerotowing 21

5 Communications 22

5.1 Radio Procedures 22

5.2 Visual Signals 23
5.2.2 Signals – (Airborne) Aerotow Pilot 25

6 Emergency Procedures 26

6.1.1 Lockouts 26
6.1.2 Line and Weak link Breaks 26
6.1.3 Release Failure 26

7 Standard Glider Towing Installations 27

8 Tow Endorsement Theory Study Guide 29

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1 Introduction

1.1.1 Legal

This Manual is approved by the Civil Aviation Safety Authority (CASA), and specifies procedures, standards and guidelines under which the towing of hang gliders, paragliders and lightweight gliders may be legally conducted in Australia.

Under no circumstances should the reader, or anyone directly or indirectly associated with the reader, use this Manual as the sole reference on which to base towing operations of any kind.

Towing should not be attempted without first obtaining instruction in the techniques of towing; and without teaming with experienced tow pilots.

1.1.2 Background to Towing

Hang gliding first began with "flat kites" being towed behind motor boats and developed as purely a towing sport until foot launching became popular in the early seventies. Aerotowing of hang gliders was first attempted by Bill Moyes in 1970, when flying a standard Rogallo wing he was towed to 8610 feet behind a conventional aircraft to set a world altitude record. However, this was generally seen as merely a daredevil publicity stunt (which it probably was!) and Aerotowing of hang gliders was not attempted again for many years.

Some enthusiasts enjoyed boat towing until the early eighties when with the development of higher performance gliders this became difficult with the towing system used at the time. It was not until several years later with the advent of reliable tensionometers and centre of mass bridles that car towing became popular.

During the late seventies Aerotowing began behind powered Ultralight, aircraft, though the only gliders able to be towed were Class 2 hang gliders (using rudders to control roll - such as the Fledge). It was not possible to Aerotow class 1 hang gliders of that time as they did not have sufficient performance at the speed required by the tugs of that era.

With the improved performance of hang gliders in the eighties and the development of weightshift microlights (powered hang gliders) with sufficiently powerful engines and wings able to fly at lower speeds, hang gliders were able to be safely aerotowed. Microlights developed by Airborne Windsports incorporate a release system purpose built for Aerotow. These microlights were able to tow gliders at speeds as low as 30 knots and climb rates of around 800 feet per minute. Recently developed slower wings allow microlights to tow at speeds as slow as 25 knots.

In the early 1990s Bill Moyes developed the Dragonfly, an Ultralight purpose built for Aerotow. This machine was able to tow gliders at lower speeds than the microlights of the day and still achieve similar climb rates. Bill Moyes also developed a launch trolley or "dolly" for hang gliders which enables the pilot to launch prone and allows for safe launches in crosswinds or light tail winds.

With recently developed Aerotow tugs incorporating more powerful power plants, lightweight gliders can now be safely towed by microlight and Ultralight tugs.

All forms of towing are a more complex method of launching than foot launching from a mountain. If approached carefully with due regard for safe operational procedures, towing can be as safe as any form of glider launch.

Towing has shown a definite re-emergence in recent years, with static winches and pay-out winches allowing safe towing with good climb rates for hang gliders and paragliders.

1.1.3 General Guidelines

Due to the extra complexity of towing, great care must be taken at all times.

Crew and pilot rely heavily on the integrity of equipment, the towing system and safe procedures.

Responsibility must not be taken lightly. Failure to adhere to the guidelines in this manual may result in injury or death to the pilot or ground crew.

This Manual contains guidelines and procedures only. Competent instruction is essential.

All forms of towing require;

- AIRMANSHIP - safe procedures must be adhered to throughout all operations. This diminishes ambiguity and delegates responsibilities.
- KNOWLEDGE - the transition from hill foot launch to tow launch is a quantum leap. For the trainee tow pilot, a sound understanding of the systems and procedures to be used is imperative - prior to attempting towing.
- EXPERIENCE - it is essential that information is gained from an appropriately Tow endorsed HGFA Instructor.

Towing may only be carried out by tow endorsed pilots or, by non Tow endorsed pilots when under the direct supervision of an appropriately Tow endorsed HGFA Instructor.

1.1.4 Preliminary Recommendations

Criteria for safe and efficient towing;

- Constant Direction: The direction of the towing force must remain constant throughout every phase of towed flight.
- Constant Tension: The tension of the tow line must remain consistent throughout each phase of the towed flight, other than steady increases or decreases in tension as the tow progresses in accordance with the recommendations in this manual.
- Reliable Tensionometer: Other than when Aerotowing and launching paragliders using a stationary “reflex” layout, the system must have a reliable (electronic or hydraulic) load sensor to detect line tension.
- Centre of Mass Attachment: The towing forces applied through the tow line and bridle must be applied as closely as possible to the effective centre of mass of the system, i.e. harness or harness/glider for hang glider and harness to risers when paragliding.
- Gradual Transitions: The graduations to and from tow, including any variations while on tow, must be of a gradual nature.
- Reliable Releases: The release devices and their methods must be totally reliable.

- Weak Link: The system must include an infallible weak link that will automatically release the glider from the tow whenever the tow line tension exceeds the breaking limit of the weak link.
- Safe Learning Method: The system must include a safe method for learning and gradual advancement of the student from one level of experience to another.
- Adequate Power: The system must have a source of power adequate to maintain a sufficient line tension whilst under tow.
- Capable Crew: The system must be operated by a crew which is adequate in number and competent in ability to ensure that the system functions properly.
- Reliable Communication: The system must provide a means whereby the pilot can reliably communicate instructions to the rest of the crew, by way of either radio or signals.
- Suitable Environment: The system must be operated only at locations and within weather conditions which are considered by a pilot experienced in towing to be suitable for safe towing.

2 Operational Requirements

2.1 Pilot Qualifications

2.1.1 Ground Towing

No person shall pilot a hang glider or paraglider for the purpose of a ground tow launch unless:

a) they have been issued with a HGFA Ground Tow Endorsement; or

b) they are undergoing training under the direct supervision of an appropriately endorsed HGFA Instructor for the purpose of gaining a HGFA Restricted HG or PG2 Pilot Certificate; or

c) they are undergoing training under the direct supervision of an appropriately endorsed HGFA Instructor for the purpose of gaining a Ground Tow Endorsement;

d) they are undergoing training under the direct observation and control of an appropriately endorsed Senior Safety Officer for the purpose of gaining a Ground Tow Endorsement; and

e) all operations comply with the requirements of this Manual.

2.1.2 Aerotowing

No person shall pilot a hang glider for the purpose of an Aerotow launch unless:

a) they have been issued with a HGFA Aerotow Endorsement; or

b) they are undergoing training under the direct supervision and control of an appropriately endorsed HGFA Instructor for the purpose of gaining an Aerotow Endorsement; or

c) they are undergoing training under the direct supervision of an appropriately endorsed HGFA Senior Safety Officer for the purpose of gaining an Aerotow Endorsement; and

d) all operations comply with the requirements of this Manual

2.2 Tow Pilot Qualifications.

A Tow Pilot must hold an appropriate HGFA or RAA pilot certificate, and;

a) hold a HGFA Tugmaster Endorsement; or

b) hold an equivalent RAA towing endorsement for the purpose of Aerotowing hang gliders or be operating under the conditions of CASA Instrument 770/02

c) be under the direct supervision and instruction of an Aerotow endorsed HGFA WSM Instructor for the purpose of gaining a Tugmaster Endorsement.

Note: **"direct supervision"** means detailed on site personal direction and supervision of the towing operations.

2.2.1 Tug Mirrors

Moyes-Bailey Dragonfly Aircraft (or similar 3–Axis craft) - If being used for training, Dragonfly aircraft should be equipped with four rear-view mirrors – two flat and two convex, to ensure visual location of the towed pilot. Tow Pilots must not rely solely on controls feedback.

2.3 Duty Pilot

Each towing operation must have a duty pilot (operations director).

a) The duty pilot's responsibilities are:

b) to establish and coordinate towing procedures; including the determination of an appropriate launch area, communication channels, flight plans, circuits and landing patterns and in Aerotowing operations, in consultation with the tug pilot;

c) to ensure that all pilots and tow drivers are advised of the adopted procedures and endeavour to have all persons involved adhere to procedures;

d) to ensure that procedures are in place to ensure the safety of any persons not associated with towing operations, particularly when aircraft are launching, landing or dropping tow ropes;

e) to coordinate effectively with duty pilots or officers from other flying organisations, if they are operating from the same site, to ensure that all mixed operations are carried out safely and with due regard for other airspace users; and

when operations are being conducted at an airport or airfield which may be used by general aviation aircraft, ensure that a gliding operations signal is in place and ensure

that the appropriate VHF radio frequency is monitored; and any incoming aircraft notified of the towing operations.

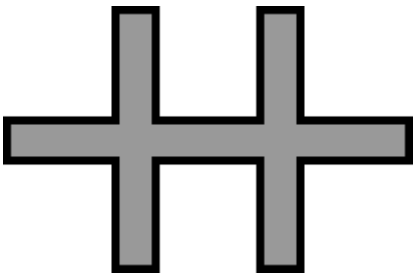


Figure 1 - Gliding Operations Signal

Note: A "gliding operations signal" is in the form of a white double cross placed flat on the ground adjacent to the primary wind indicator at the airfield. This signal is usually a minimum of five metres in length and two and a half metres in width, in the shape illustrated.

The duty pilot should be an appropriately tow endorsed for the type of operations being undertaken and be familiar with the tow site.

The flight plan and landing patterns should not be complicated but it is important that all pilots and ground crews using the site or strip are thoroughly briefed as to what procedures are adopted. When circuiting with larger aircraft, HGFA aircraft and tugs should either: circuit inside the established circuit pattern; or circuit on the opposite side of the runway to other aircraft (contra-rotating circuits); and should land on the verge of the active runway without crossing over the runway at low level.

Considerations for establishing operating procedures include:

- level of pilot skill,
- surface winds,
- wind gradient
- winds aloft,
- runway direction,
- areas of turbulence,
- lift and sink,
- separation between aircraft,
- obstacles and hazards,
- tow line length,
- the operations of other site users,
- emergency landing zones (in the event of weak link break; engine failure or release failure).

3 Equipment

The construction and maintenance of equipment used in any towing is critical to the overall level of safety of that operation. Equipment failures in towing can cause serious accident and injury. Only approved bridles and releases should be used.

Different bridle set-ups are required for different forms of towing.

3.1 Towing Systems

There are five types of towing system currently used.

3.1.1 Static Tow Line

This system is popular due to its simplicity and low cost. The static line system consists of a length of polypropylene rope attached via a tensionometer and quick release to the rear of a motor vehicle or motor boat. The rope is laid out and attached to the towing bridle via a reliable pilot-operated release system.

Due to the twisting tendency of polypropylene rope (laid rope) , it is recommended that a swivel mechanism be fitted to both ends of the rope.

It is strongly advised that static line towing is not used in paragliding operations as this system relies on the driver looking at a tow gauge and adjusting the speed of the tow vehicle to maintain constant tension. When any fluctuation in wind speed occurs due to wind shear, wind gusts or thermal conditions, it is not always possible to slow the vehicle quickly. These wind fluctuations can place dangerous and uncontrollable loads on a paraglider under tow.

An operator must ensure a serviceable and reliable quick release system is fitted to the vehicle.

Static line towing must not be used for initial Paragliding tow training. All paragliding pilots wishing to attempt Static Line towing must first gain a high degree of towing experience and competency on a winch system prior to attempting static line towing.

3.1.2 Pay-out Winch and Platform Launch

This winch system utilises a drum, usually attached to a vehicle tow bar, utility back or motor boat. A given length of rope, wire or cable is wound onto the drum which pays out at a pre-set line tension, using a hydraulic brake system to regulate the tension. Once the load rises above the set limit the drum pays out the tow line maintaining a constant line tension.

There must be a guillotine (tow-line cutter) built into the system which can be triggered by the towing operator in an emergency.

These systems optionally include a "beeping" system which indicates the speed of rotation of the drum which allows the tow vehicle speed to be adjusted to maintain a slow but steady pay-out of the tow line.

This system may be simple, reliable, reasonably inexpensive and ideal for club or individual pilot use.

3.1.3 Pull-in or Static Winch

This system does not require a moving vehicle. The winch is usually mounted on a car trailer to allow transportation and is fitted with one or two drums of lightweight steel cable or high strength, zero stretch synthetic line such as *Dyneema®.* The winch can be

powered by an internal combustion engine or an electrical motor and may use hydraulic technology to regulate drum speed and line tension. The line is laid out prior to the tow and is wound back onto the drum during the tow. The system must be fitted with a guillotine.

3.1.4 Reflex Static Winch

This is the same as the system outlined in 3.1.3a with the addition of a pulley which is secured at the end of the field through which the winch cable passes. This allows the glider to be launched near to the winch and allows the operator to be able to watch the take-off and early stages of the flight from nearer the glider. The system must be fitted with a guillotine.

Note: When using non-elastic cable with a winch system a shock leader of stretchy rope (up to 90 metres in length) is usually included to allow some "give" in the system.

Note: Guillotines must be checked for serviceability prior to each day of operation.

3.1.5 Aerotow

Aerotow utilises a microlight or ultralight aircraft (tug) to tow a hang glider or lightweight glider. The tug must be registered in accordance with a CASA approved manual and must be adequately powered.

Aerotow is basically a static line system without the need for the high angle of attack of the glider required by a ground based tow system. This system allows the glider to be released in a thermal to maximise soaring potential.

A release is fitted at each end of the tow rope and a weak link is mandatory. The release fitted to the tug must comply with the HGFA Standard for Towing Installations (see Appendix 1 to this Manual).

When Aerotowing floaters or intermediate gliders, care should be taken to set up tow bridles so that pitch pressures are not excessive. This is especially the case where tow speeds exceed 30mph.

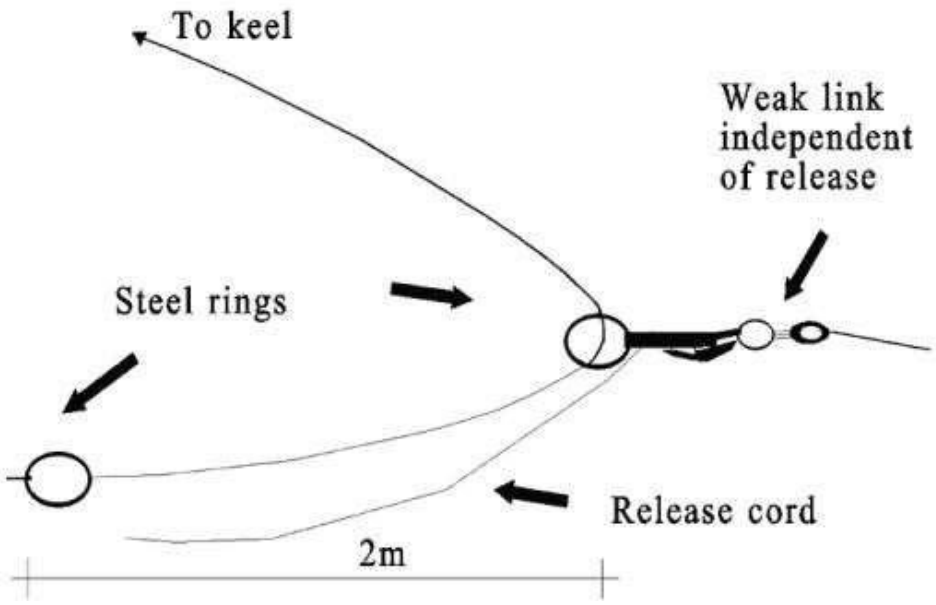
3.2 Tow Bridles

3.2.1.1 Bridle Construction

Bridles should be constructed from non-elastic rope (<1% stretch). This is necessary to avoid injury to the pilot in the event of a weak link break or release under tension. A bridle that can stretch under tow will spring back toward the pilot if the load is suddenly released. Seamless metal rings should be used, preferably of stainless steel. Bridles must suit the application, i.e. Aerotow bridle – Aerotow only; platform bridle - platform tow only.

3.2.2 Hang Gliding Bridles

The following diagram shows a typical "one to one" bridle set-up for towing



Do not use snap hook carabiners for towing

Accidents have occurred in the past due to pilots using snap-hooks (similar to key chain non-locking carabiners) on parts of their harness, tow bridle and or end of aerotow line.

These snap-hooks have proven to latch onto unintentional components of the flying equipment during unusual attitudes and or extreme flight situations. The exception to this is when snap-hooks are used on weaklinks at the apex of the long car-tow bridle.

When extremely "crossed-up" on aerotow with a normal (short) chest bridle, history has shown the non locking carabiner on the end of the tow line can latch onto the front wires of the hang glider. When aero-towing we mostly use pin-in-the-barrel release/s with built-in string weaklinks either end of the chest-mounted short V-bridle. This is so there are no clips on the pilot.

Frustratingly it is still common practice at competitions to see non-locking alloy carabiners on the glider end of the aerotow line. This is done to speed connection to the bridle of the pilot waiting in the dolly.

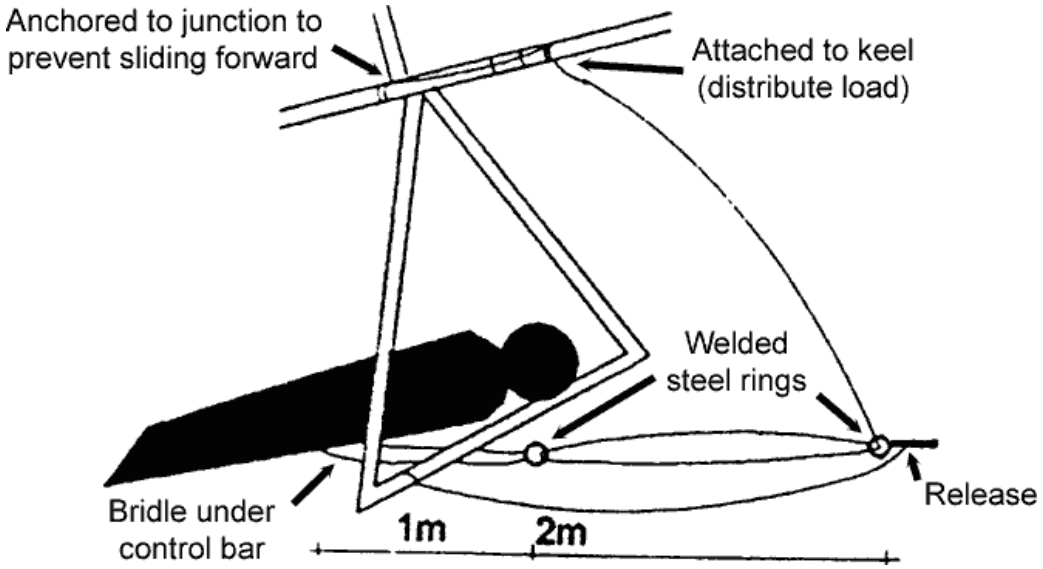
It is easy to demonstrate the hazard here, just pop a non-locking carabiner onto the bridle of a pilot waiting to be aero-towed from the dolly, walk to the side whilst holding the carabiner and touch the front wire. Click, you're now towing from the front wire, unable to release and will suffer structural failure before the weaklink on the tug end breaks!

3.2.2.1 Hang Gliding Bridle Attachment - Ground or Boat Tow

The hang gliding bridle is attached as shown in the following diagram.

The harness must have professionally sewn loops at the required positions.

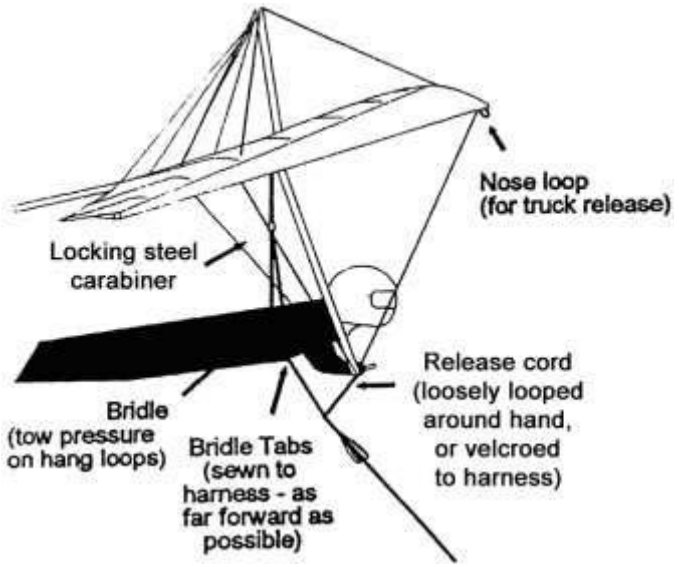
The bridle should be tied to the keel of the glider approximately one hand span (20-25 cm) forward of the pilot hang point.



Where a release system releases a tow bridle from the keel, a weak link must be attached to the pilot

3.2.2.2 Hang Gliding Bridle Attachment - Platform Launch System

The bridle should run through tabs on either side of the harness (about 10 cm below arm holes) then run up to a steel locking karabiner, as shown:



3.2.2.3 Aerotow Bridles

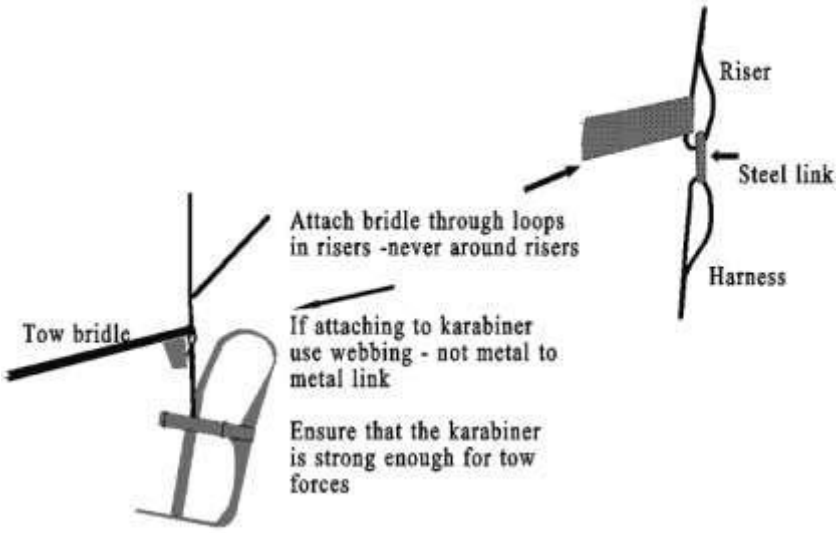
Bridles used for Aerotowing hang gliders are either "one to one" as shown previously, or may be a shorter bridle which is connected to the pilots harness only at the chest or shoulders.

For tandem operations the Pilot in command must ensure the passenger harness is fixed to their own.

When Aerotowing hang gliders, the bridle ropes pass through the control frame and over the base bar.

3.2.3 Paragliding Bridles

The tow bridles should be of sufficient length so as not to affect the angle that the risers make when they attach to the harness. (If this angle is changed the canopy may become more roll/yaw sensitive.) **The recommended length of the bridle is no less than 300 mm to a maximum of 1 metre.** The attachment points are as shown in the following diagram.



When the bridle is connected to the risers it is preferable to fit it to the loop in the riser to ensure that it cannot slide up the riser.

However, the tow bridle may be fitted to the karabiner providing the connection is by way of a webbing loop and care is taken to ensure that the karabiner is securely locked and of adequate strength to withstand lateral tow forces placed on it.

Never connect a metal clip to the karabiner as the metal to metal connection can damage and weaken the karabiner.

3.2.3.1 Hystek Bridle and Release

The following paraglider tow bridle and release was designed by Phil Hystek and can be activated by hand or foot.

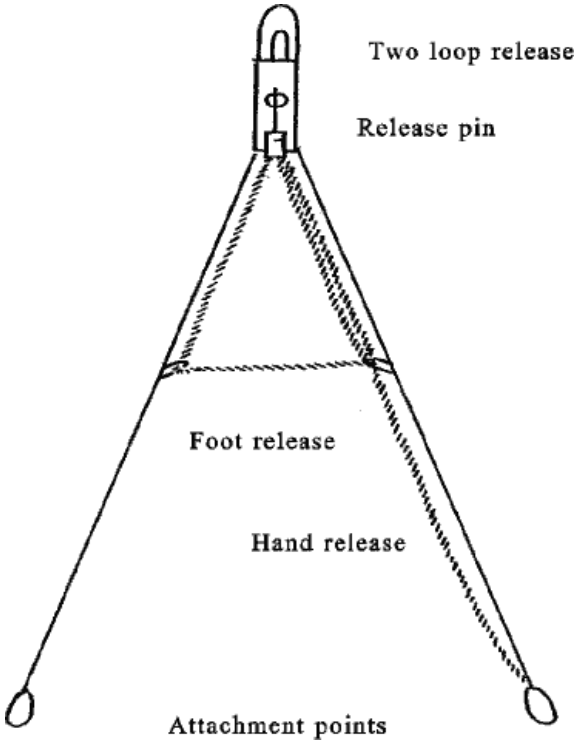


Figure 2 – "Hystek" Paraglider release and bridle - top elevation

This release/bridle set-up enables the pilot to keep the hands on the controls whilst releasing.

When using this system during reverse inflation, the hand release should be fitted to the same side as the pilot will turn following canopy inflation, i.e;

- right hand turn after inflation - fit hand release on right hand side;
- left turn after inflation - fit hand release on left side.

When activating this release during use, separation from the tow cable should be made while there is still tension on the cable.

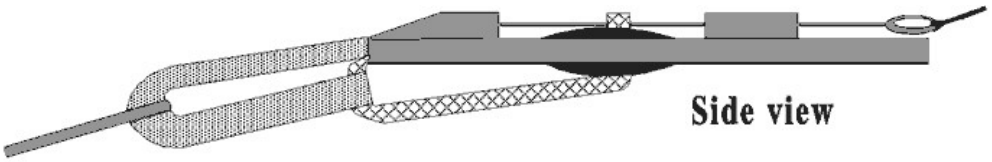
The foot release may require a good "jab" with the foot to activate the release.

3.3 Releases

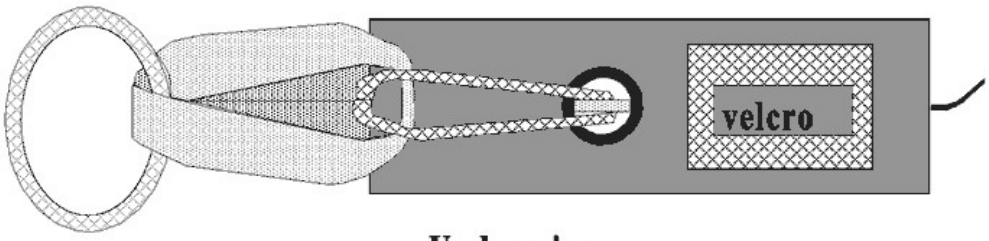
All releases fitted to gliders must release at any angle and at any load that may be applied during tow, or in a lock-out situation. All releases must be reliable and must only release upon pilot activation (with the exception of automatic release systems which are sometimes used when student training). **Weak links built into the bridle which trigger the release are not recommended.** Rope or string releases are not recommended. String loops used in these releases can twist and fail to release.

3.3.1 Ring Release

The following diagram shows a two ring release using webbing loops rather than string. The benefit of this type of release is its light weight and softer construction materials. These minimise the likelihood of injury should the release whip back and strike the pilot in the event of a weak link or line break.



Tow ring



Under view

3.3.2 Link Knife Releases

The "Link knife" type system - uses blades crossed over to form a “V” shape located in a slotted cylinder to cut the string weak link to affect release. The pilot simply pulls on the release cord which draws the blades into contact with the weak link. The more tension in the weak link, the easier it is to release.

When using this system care must be taken to ensure that the release is securely located and that the o-ring used to keep the blades away from the weak link are of sufficient grip to stop the blades contacting (and therefore cutting) the weak link prematurely.

Figure 3 - Link Knife. In this photo, the o-ring has been replaced by a bungy cord.

3.3.3 Barrel Release

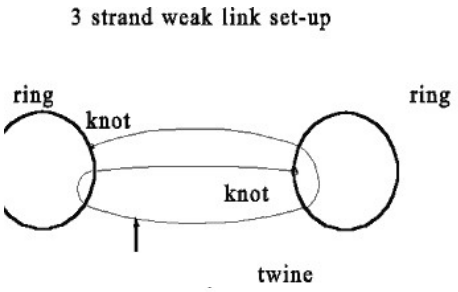
Barrel release - this uses an aluminium barrel which slides over a webbing loop which holds a curved pin to release the bridle line. Barrel releases are often installed on both ends of the bridle line (or sides of the harness).

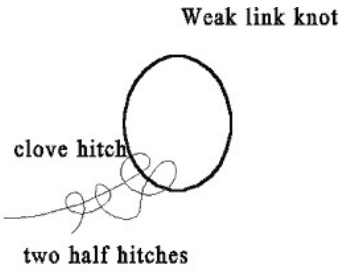
3.4 Weak Links

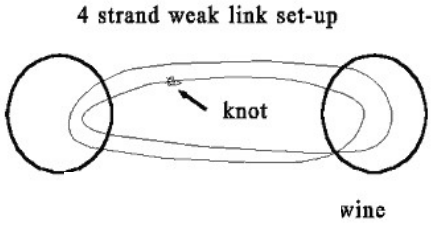
Weak link specifications;

- Recommended breaking load of a weak link is 1G. - i.e. the combined weight of pilot, harness and glider for ground towing and 0.8G for Aerotowing
- Each pilot should have his / her own weak link tested to the appropriate strength.
- It is recommended that a new weak link is used for every launch;
- Shear pin weak links can be unreliable and must not be used.
- Always test the breaking strain of the type of weak link being used and ensure that the weak link used when towing is identical to that tested.

3.4.1 Typical Weak link Set-ups







3.5 Rope Types

For car or platform tow training a monoplait or a plaited rope should be used. This rope exhibits zero twist characteristics and hence will not twist or wind up bridles making them un-releasable. For general towing, 4-5 mm polypropylene or polyester rope is suitable.

A line or cable with some stretch is preferable when car towing, using a payout winch or static line. This helps to prevent any slight bump in the road causing a small pulse force to be transmitted up the line resulting in a weak link break.

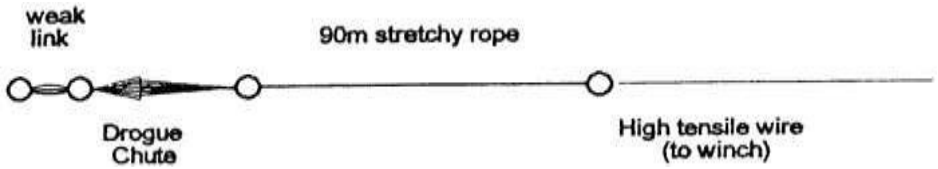
If a laid rope is used, swivels should be fitted at both ends of the rope to prevent the rope twisting up the releases. Twisting of a release or bridle may cause release failure. A heavy duty fisherman's "shark swivel" is a suitable swivel.

The length of a rope used for aero towing by a Weightshift aircraft is approximately 90 metres.

The length of a rope used for aero towing by a 3-axis aircraft is approximately 60 metres.

Static ground ropes are often 30% of runway length in still wind operations and up to 50% with a 10 knot head wind.

Example of winch wire and rope leader set-up:



Prior to use, ropes should be stretched out on the ground and inspected for knots and wear. Unnecessary knots should be removed and worn lines replaced.

3.6 Launch Trolley (dolly)

A launch dolly for used for hang glider launching should be designed with castering front wheels and a fixed rear wheel to allow the dolly to roll in any forward direction. The wheels should be of a type which allows the dolly to roll easily with as little drag resistance as possible.

It is the responsibility of the glider pilot to ensure the correct configuration of the dolly before launching.

- Wheels pointing forwards, and
- The cradle carrying the keel of the glider should be height adjustable to allow for variations in glider configuration. The cradle must be set to provide a glider angle of attack of approximately 20° above horizontal so that the glider does not "lock into" the dolly during launch. The angle of attack setting can be checked by the pilot lying in the harness and ensuring that the bar position (with no pilot input) is located at or forward of the normal trim position.

The dolly should be constructed with a minimum of bolts or ~~similar~~ protrusions which may snag any ropes or strings connected to the harness or glider. In a system where the pilot holds onto the rope or dolly, a failsafe release must allow for dolly release on launch.

The dolly must be regularly maintained to ensure that its operational and structural integrity is not reduced.

3.7 Ancillary Safety Equipment

3.7.1 Protective Eye-wear

Whilst towing, non-shatter protective eye-wear should be worn at all times by the pilot (and the passenger if applicable). This is to prevent eye injury in the event of a rope or weak link break or pilot distraction by an insect strike in the eye during launch.

3.7.2 Hook Knife

A suitable hook knife (similar to those used in parachuting operations) should be carried by the glider pilot at all times when towing. The hook knife should be located to be readily accessible in the event of a release failure. Care must be taken to select an appropriate knife with a narrow opening that is incapable of cutting any part of the pilot's body.

3.7.3 Flotation

When undertaking hang glider boat towing, flotation equipment must be fitted to the glider. This is usually in the form polystyrene foam fitted to extensions on either end of the control frame base bar and the rear end of the keel. Flotation may also be located within the sail's double surface.

When undertaking paraglider boat towing, flotation must be fitted to the pilot/passenger and it is recommended that foam back protection be removed.

Sufficient flotation must be fitted to ensure that the pilot (and passenger if applicable) remain afloat in the event of a water landing.

3.7.4 Emergency Parachutes

Emergency parachutes are recommended for all towing operations in excess of 300' above ground level.

Aerotow tugs which have not demonstrated compliance with an airworthiness design standard which is acceptable to CASA must be fitted with an appropriate ballistic deployed emergency parachute.

4 Procedures

4.1.1 Site Considerations

Sites used for towing must have an open area free of obstacles and hazards on either side of the tow strip. As a guide, hazards should be at least 30% of the length of the tow line distant from the tow strip (i.e. 1000' rope - 300' clear of obstacles).

Where Aerotowing operations are carried out, the strip must be of adequate length for the performance of the tug.

4.1.2 Weather Conditions

Initial tow flights, must be conducted in light winds without significant thermal influence or turbulence. Only as towing experience is gained should towing in stronger winds and/or thermal conditions be attempted.

Crosswind launches should only be attempted by experienced tow pilots, due to the increased tendency to lock-out in the direction of the crosswind.

When launching from a dolly in a crosswind the pilot should take care to ensure that the upwind wing does not lift up prematurely. This may necessitate shifting pilot weight to the upwind side during the launch roll.

4.1.3 Training Considerations

At no time should any form of towing be conducted with both an inexperienced glider pilot and an inexperienced tow driver, winch operator or tug pilot.

Before attempting towing, trainee pilots must be thoroughly briefed on procedures and techniques.

Pilots must gain an understanding of the following:

- the flight plan and predetermined circuit procedures,
- emergency procedures,
- any signals that may be required (signals must be learnt whether radio communication is being used or not), and
- pilot actions and input required whilst launching, towing and releasing.

Prior to attempting a first tow, the pilot must witness at least one demonstrated tow.

Initial tows should be at low tension, with gradual progression from low to higher tension tows as the pilot gains experience. Once high tension tows are attempted, weak link breaks should be simulated by quickly removing tow pressure.

The trainee tow pilot should never learn to tow on a borrowed glider or harness and should never attempt prone tow unless fully experienced in prone flight prior to the course. As platform launch towing requires prone position from launch, extra training of novice pilots is required to bring them up to a safe standard before attempting platform launch.

Observers are strongly recommended for all towing operations.

Observers are mandatory for training operations; unless a specific exemption is granted in writing by the HGFA Operations Manager. Such an exemption may be granted where tow training is being carried out by an experienced instructor in a vast open area which allows the instructor to be able to continually watch the trainee pilot.

When training car and winch drivers, the trainee should be fully briefed in the operational requirements of the system being used, and should observe several tows in company with an experienced driver/operator. When first operating the tow system the new driver must be accompanied by an experienced operator.

4.2 Tow Tension

Tensionometer calibration is mandatory for all operations except aerotowing and reflex operations involving paragliding

4.2.1 Line Tension - Hang Glider Ground Towing

It is essential that the tow tension for take-off and the first 100' of climb be reduced to prevent the glider climbing at a high angle of attack near the ground. The amount of reduction in tension should vary depending on the wind strength and gradient as follows:

- in strong winds - apply one third of maximum tension
- in moderate winds - apply one half of maximum tension;
- in light winds - apply two thirds of maximum tension.

Once the glider has climbed above 100', tow tension can be increased to two-thirds to three-quarters of maximum tension, dependent on conditions.

Only after the glider has reached a height of at least 500' should maximum recommended tow tension be applied.

Note: Maximum tow tension is the tension that under average towing conditions causes the glider to climb at an acceptable rate in a controllable manner. This tension will vary dependant on the weight of the pilot and size/model of the glider.

Maximum tow tension for solo operations should not exceed weak link breaking strain.

A general principle is “Low altitude – low tension; High altitude – high tension”.

4.2.2 Line Tension - Paragliding Towing

When using a payout winch, there should be a minimum of 100m of line between the pilot and the tow vehicle before starting the tow to give some dampening effect to the tow.

Prior to commencement of each tow, sufficient tension should be applied to cable/rope to remove all slack.

During towing, tension must be relative to total in-flight weight (TIW).

During the initial phase of the tow (up to 100' AGL) tow tension should be kept below 60% of TIW.

Above 100' AGL tow tension can be smoothly increased up to a maximum of 90% of TIW.

Maximum tow tension must not exceed 100% of TIW

- High tension can only be used at high altitude.
- Low altitude - low tension; high altitude - high tension.

4.3 Launch Procedures

To avoid delays, pilots should carry out all pre-flight checks before being connected to the tow rope. These checks should include the standard pre-flight checks as well as checks to ensure that radio, bridle, release and weak link are in order.

Slack rope launches must be avoided. The one exception is for reverse inflations used in paraglider towing. Enough slack must be supplied in the tow line to avoid the line becoming tight until the pilot has completed the inflation and has turned.

Once the pilot is connected to the tow line, a final radio check with the driver/tugmaster is made, followed by the commands "take up slack" and "take up tension".

Once the glider is balanced and launch conditions are suitable, the pilot should initiate the launch by giving the appropriate launch command or signal. As the tow begins the pilot should allow the rope to pull pilot and glider, taking quick, short steps whilst offering very slight resistance to the tow force.

Hang glider pilots, as with any launch, must concentrate on keeping the wings level and holding an appropriate angle of attack, approximately 20°. Too little angle of attack can lead to a "nose in"; and too high an angle of attack may quickly lead to a lock-out or weak link break.

Paraglider pilots first call "go slow" to enable the canopy to be inflated; and once the wing is inflated and aligned, call "go, go, go". Tow tension is then gradually increased, though full tension is not applied until the glider reaches at least 100'.

Dolly launches and platform launches require an additional pre-flight check to ensure that all harness and glider ropes such as VG cords are located or contained to prevent them snagging on the dolly.

When using a dolly launch the pilots should pull him/herself through the control frame to trim position (bearing in mind the "trim" will be at tow speed) and locking the elbows as the launch roll is commenced to get the dolly rolling. Care must be taken to ensure that the glider does not rise from the dolly prematurely by holding rearward pressure on the control frame once the launch roll is commenced and easing the bar forward to lift off only once sufficient flying speed is attained.

When platform launching, an airspeed indicator must be mounted so it can be seen by pilot and driver and marked to a predetermined launch speed (usually around 30 mph).

4.3.1 Procedures under Tow

With all forms of towing it is important to keep the glider pointed in the direction of the towing aircraft or vehicle. Pilot input under tow should be minimised, allowing the centre of mass bridle to function.

Whilst ground towing, if the glider begins to yaw significantly or turn off line, the pilot should ask the driver to "slow down" to enable station to be regained by slowing the glider, turning on line and centering the body in the control frame until any oscillation stops.

If the wind aloft is crossed to the line of the tow, after launch the hang glider or paraglider will drift with the crosswind.

If at any time the Pilot In Command of the aircraft being towed is not confident that the tow is proceeding normally, he/she should abort the tow immediately by releasing.

Note: See Section 6.1.1, Lockouts

4.3.1.1 Hang Gliders

Hang glider pilots should remain in the hang position with hands on the uprights whilst ground towing, though a smooth transition to prone may be made by experienced pilots once significant height is gained.

The rate of climb whilst ground towing is determined by the tow line tension, the pilot should allow the glider to fly at trim with minimal pitch input.

All Aerotow pilots should initially fly level at about 20 feet above the ground to avoid tug prop wash once the glider lifts off (the glider will usually lift off before the tug).

When foot launching under Aerotow, a hang glider pilot must quickly and smoothly transfer the hands from the control frame uprights to the base bar to allow flying speed to be increased. The transfer should be achieved by moving one hand at a time to ensure sufficient pitch control is maintained.

Because of the horizontal forces on the harness and pilot whilst Aerotowing, the position of the pilot relative to the control frame is different than when in free flight. When under tow, the bar position moves backward as the pilot is being towed by the harness, as shown in the following diagram. This fact, coupled with the need to fly faster than trim speed, means that the bar is positioned considerably further back from normal trim position. This still applies, though to a lesser degree when a "one to one" bridle is used.

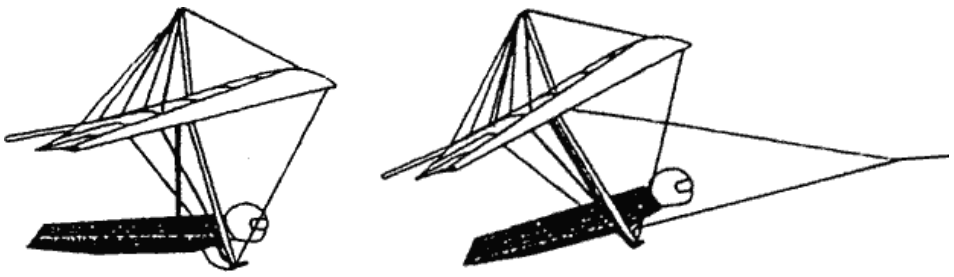


Figure 4 - Free-flight at 35 mph, and under tow at 35 mph.

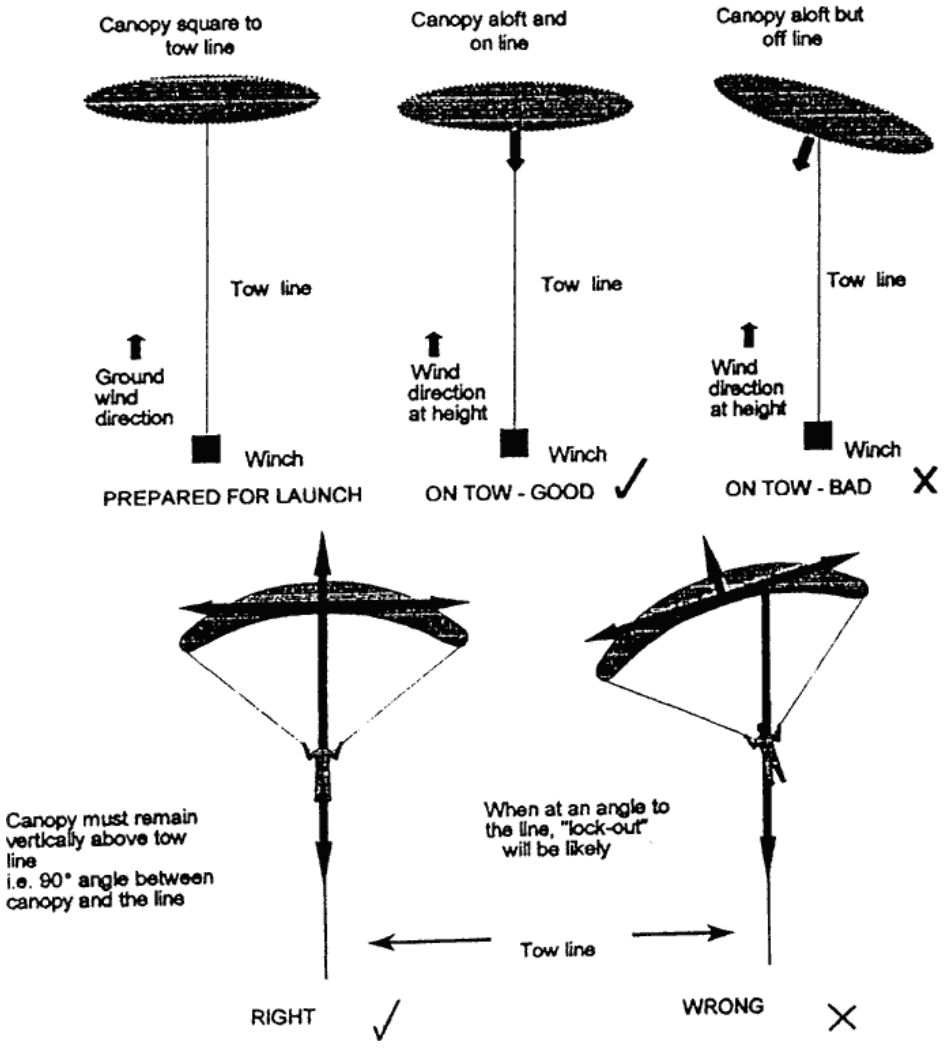
As soon as the tug lifts off and starts climbing, the glider will also climb and should remain in a position recommended by the tug pilot; this is usually slightly lower and directly behind the tug. As a guide, the glider pilot can maintain correct station by keeping the main wheels of the tug level with the horizon.

If the glider is too high the glider pilot should pull in to increase speed; conversely the bar is eased out and speed reduced to move to a higher position behind the tug. The tug pilot may request that the glider alter station by giving the appropriate radio command or hand signal (as illustrated in Section 5, Communications).

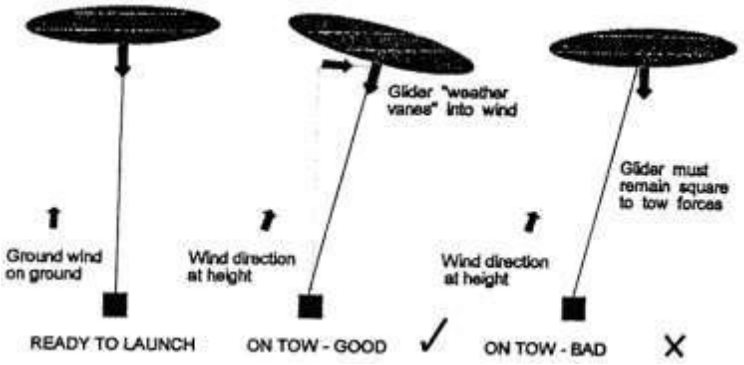
When a lightweight glider is being towed it is critical that the pilot ensures that the glider remains positioned slightly below the tug.

When turning whilst under Aerotow, the glider pilot should maintain a position slightly inside the track of the tug, so that the glider can fly at an acceptable speed. Glider speed varies with tow position when turning; faster when positioned outside the track of the tug and slower when positioned inside the track. The glider pilot will tend to point at the tug because of the tow tension and should fly the glider so that the chord line of the glider points directly at the tug.

4.3.1.2 Paragliders



The glider must still remain square to the tow line.



4.4 Release Procedures

4.4.1 Ground towing

Whilst ground towing, and when the pilot wishes to release, the driver is requested to stop, either via radio or signal. Once the tow rope starts to go slack the pilot should lower the angle of attack of the glider and activate the release.

Releasing before the pressure is reduced is not recommended. A release under load will cause a hang glider to pitch up suddenly, causing the glider to stall unless the nose is quickly lowered.

A paraglider releasing under load will pitch-over (or "surge"). Brakes must be smoothly applied to slow the pitch-over action. However, paraglider pilots should avoid excessive, rapid or premature application of the brakes following a weak link or line break as this has the real possibility of stalling the wing once release is achieved, inform the driver of your release and **switch off the radio transmitter**.

ALWAYS WATCH THE ROPE FALL AWAY FROM THE GLIDER to ensure that release has been successful and to check that the rope has not become snagged on the glider or harness.

4.4.2 Aerotowing

When Aerotowing it is not necessary to reduce line tension prior to release. The pilot should check for traffic to the right and release.

After release the glider pilot must turn right.

The tug will accelerate after release and should fly straight ahead until well clear of the glider, then turn left and descend to achieve maximum separation from the glider as quickly as possible.

If a tow bridle is used which is positioned out in front of the glider pilot, it is possible that the release will whip back and hit the pilot on release. The pilot should therefore turn his/her face to minimise the likelihood of facial injury.

A site with a lot of clear area and a non-abrasive surface may allow the tug to land with the rope still attached. Some sites will require the tug pilot to drop the rope during a pass over the launch area, then complete a circuit to land.

When landing with the rope attached the tug pilot should be careful not to overfly trees, fences or any other hazard on which the rope may snag.

The tug pilot must ensure that he / she does not fly low over people or gliders on the ground whilst landing with a rope attached.

When dropping the tow rope, extreme care must be taken to ensure that the rope does not fall near any people on the ground. Allowance must be made for any wind drift. When a rope is being dropped, the duty pilot must ensure that persons on the ground are made aware of the intention to drop the rope and ensure that they are well clear of the area where the rope will land.

Care must be taken by the glider pilot when landing with a bridle attached to the harness as snagging or tripping on the bridle is a possibility.

Most releases will have a small piece of Velcro fitted for the purpose of stowing the bridle up and on the harness after the tow line is released.

5 Communications

5.1 Radio Procedures

The use of radios is strongly recommended for all towing operations, particularly when training.

As radios can be unreliable, pilots and drivers must be familiar with appropriate signals and procedures to be used in the event of radio failure.

When using radios, the following guidelines should be followed:

1. When a tow is under way care should be taken not to transmit on the channel being used.
2. Chatter on tow channels should be kept to a minimum.
3. Different frequencies should be used by the tow operation to that used by other pilots, ground crew and retrieve driver.
4. Care must be taken to ensure that any microphone that is clipped on to allow constant transmission is unclipped on completion of the tow.
5. A duty officer or observer should man a radio on the same channel as that being used for the tow to allow commands to be passed to the driver/tugmaster in the event of radio failure.
6. In training, the Instructor must have constant and effective communication with the student and driver/tugmaster.

5.1.1.1 Standard Launch Sequence

The following signals are recommended as a standard sequence:

Driver	Hooked on, ready to take up tension.	Tow vehicle is ready.
Pilot	Take up tension	
Driver	Taking up tension-.... tension on & standing by.	
Pilot	Locking on mic’	Establish one way hands free communication to the driver/operator.
Pilot	"Picking up glider"	
Pilot	"Wind strength ....."	Wind strength at launch so the driver knows how hard to accelerate the tow vehicle / force.

Pilot	My bridle is free and clear... wings are level	After checking.
Pilot	"Go, go, go"	To start tow.
Pilot	Walking, walking…	Feedback for driver.
Pilot	Running, running…	Feedback for driver.
Pilot	Airborne	Feedback for driver.
Pilot	Climbing nicely, altitude is …	Feedback for driver.
Pilot	Preparing to release	At top of climb.
Pilot	Safe release	When rope is seen to fall clear.

The additional call of **"go slow"** is used to enable paraglider canopy inflation - Once the canopy is inflated and aligned - "**go, go, go**" is then used or, for hang gliders as required.

In an emergency the signal **"stop, stop, stop"** is used.

The command **"stop"** may be used at the top of a tow.

Whilst under tow **"less tension"** or **"more tension"** may be used as required.

It is advisable that the pilot notify the driver when airborne and regularly advise how the tow is progressing by calling the height of the glider and the comfort level (in relation to the tow tension).

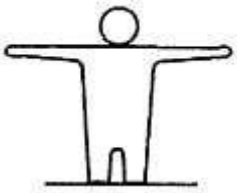
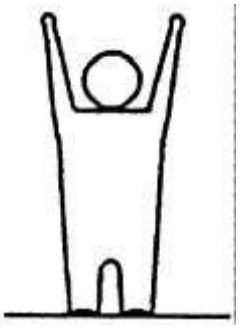
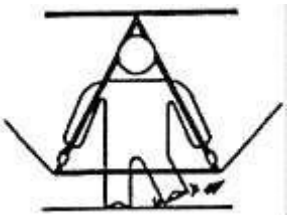
Many pilots use **"thank you driver"** after release to remind them to **un-clip the microphone**.

5.2 Visual Signals

5.2.1.1 Signals – Launch Phase

The following signals are recommended prior to launch.

Take up Slack	A one arm underarm wave from side to side across the body whilst facing the car, winch or tug indicates "take up slack" in the tow rope.	

Ready	One outstretched arm is used by the glider pilot, duty pilot, winch driver and/or Tugmaster to indicate that he or she is ready to start the tow	
Wait	**Either:** Two outstretched arms are used by the duty pilot or Tugmaster to indicate that there will be some delay before the next phase of the towing operations can proceed, **or:** when a hang glider pilot is foot launching, "wait" can also be indicate by merely placing the glider back on the ground. Once either of these signals to "wait" are given, procedures are recommenced with the ready signal (or by picking up the glider) and then giving the "go" signal.	
Stop!	At any time, two arms held vertically above the head indicates "stop!"	
Go!	To initiate the launch, one of two signals are used, **either:** a single sideways kick by a hang glider or paragliding pilot. (This signal can only be delivered if the pilot has the glider balanced) **or:** when a duty pilot is giving the signal, an over-arm wave with a straight arm above the shoulder.	 

Note: In all cases the glider pilot initiates launch, either directly or through the duty pilot.

5.2.1.2 Signals – Airborne (Ground Tow)

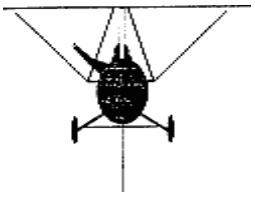
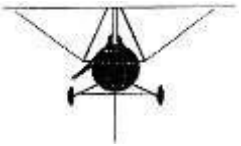
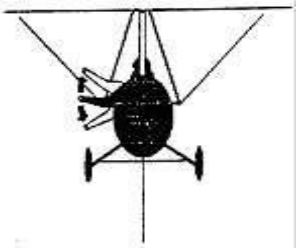
When signals are being used whilst under tow, the pilot must keep his/her legs together whilst not signalling to ensure that no unintentional signals are given.

The following signals are used by a hang glider or paraglider pilot whilst under tow;

More Power	The pilot extends one leg to the side and kicks the lower leg several times. There may not necessarily be a response from the winch driver if the maximum safe tow pressure has already been applied.	
Reduce Power	The pilot extends one leg to the side and holds it straight.	
Stop!	The pilot holds the legs apart.	

5.2.2 Signals – (Airborne) Aerotow Pilot

The following signals are used by the Aerotow pilot whilst Aerotowing.

Tow higher!	A stationary arm pointed up means the glider should climb to a higher flight path relative to the tug.	
Tow lower!	A stationary arm pointed down means the glider should maintain a lower flight path relative to the tug.	
Release!	A waving arm with a clenched fist means the glider pilot should release.	

6 Emergency Procedures

6.1.1 Lockouts

A lockout occurs when the glider being towed diverges laterally from the direction of the tow, This causes a rapid increase in tow tension and bank and nose angle. The lockout will quickly worsen unless the tow tension is rapidly reduced to enable the glider pilot to regain station.

If a glider enters a lock-out situation the tow tension must be removed immediately by disconnecting the tow line to allow the pilot to regain control.

Most lockouts occur shortly after take-off as a result of the Pilot In Command allowing the glider to become airborne and not flying in the direction of the tow, or not controlling a deviation of the glider from the direction of the tow as it transitions the wind gradient or shear close to the ground.

It is imperative that the glider flies in the direction it is being towed. If directional control along the line of the tow cannot be established and maintained, the pilot must release immediately.

Further information “Lockouts - Taming the Beast” available www.dynamicflight.com.au

6.1.1.1 Paraglider Pilots - Lockout

Lockout is an exceptionally dangerous and real possibility during paraglider towing operations. It is imperative that the canopy is kept in line with the tow direction. If the canopy begins to move off line, tow tension MUST be reduced until the pilot brings the canopy back in line.

When reducing line tension, it is important to not suddenly drop line tension but rather lower tension in a rapid but smooth fashion.

Pilots must keep the canopy positioned square to the tow line and vertically above the pilot. This applies whilst launching, when under tow, and in a crosswind.

6.1.2 Line and Weak link Breaks

Due to the high angle of attack during a ground or boat tow, a line break will cause a hang glider to pitch-up and stall quickly, or a paraglider to pendulum and pitch-over, due to the rapid loss in tow tension. The pilot must act quickly to regain control of the glider.

When a weak link or line break occurs at low level, the pilot should land in the direction of the tow. Only when ample height is available should the pilot attempt to return to the launch area to land.

In the event of a line break, the pilot must release the rope (or the part thereof) remaining attached to the bridle before landing. If the line break occurs at low level, the pilot may not have time to release the rope and will need to avoid snagging or tripping on the rope when landing.

6.1.3 Release Failure

In the event of a release failing to operate, the pilot must inform the driver and endeavour to get rid of the rope. It may be possible to pull in the bridle to free the rope (taking care to maintain control of the glider). The pilot may need to use the hook knife to cut the bridle free.

IT IS VITAL THAT CONTROL OF THE GLIDER IS MAINTAINED DURING THESE PROCEDURES

If the rope cannot be freed when ground towing in light wind, the pilot should fly in descending circles and land virtually in the circle of the tow line. In windy conditions, a series of "S" turns should be flown to maintain a position above the line, landing on top of it.

During Aerotowing the rope may be pulled up by the pilot, time permitting. If not able to do so, the pilot should fly normally but allow a longer and higher final on approach, so the rope remains free of possible obstructions.

Care must be taken not to snare the tow line on any obstacles in the vicinity, such as trees and fences, etc.

7 Standard Glider Towing Installations

a) The requirements of this standard are applicable where approval for Aerotowing of a single hang glider as defined in CAO 95.8 is desired.

b) The maximum all up take-off weight of the hang glider to be Aerotowed, including pilot and all equipment, shall be selected by the applicant but shall not exceed the certified capacity of the glider.

c) The maximum hang glider towing speed VT shall be selected by the applicant. VT shall be at least 1.3 VS1, where VS1 is the stalling speed of the airplane in the cruising configuration without a hang glider in tow.

d) The airplane shall have proof and ultimate factors of safety of not less than 1.0 and 1.5 respectively, when loads equal to 1.2 of the nominal strength of the weak link (see (g)) are applied through the tow hook installations in the condition shown below, simultaneously with the loads arising from the most critical normal accelerations at the speed VT.

The conditions applicable are;

a) The speed is assumed initially to be at the maximum glider towing speed VT; and

b) The load at the towing hook installation is assumed to be acting in each of the following directions, relative to the longitudinal centre line of the airplane;

c) horizontally backwards;

d) backwards and upwards at 40° to the horizontal;

e) backwards and downwards at 20° to the horizontal;

f) horizontally backwards and 25° sideways in both directions.

g) The towing hook shall be of a quick release type. It shall be established that with loads equal to 10% and 180% of the nominal strength of the weak link (see (i)) is applied to the towing hook in each direction prescribed in (d) and the release control is operated;

i. the tow cable will be released;

ii. the release cable will be unlikely to cause damage to or become entangled with any part of the airplane;

iii. the pilot effort required shall not be less than 20 Newtons or greater than 100 Newtons.

h) The release control shall be so located that it can be operated by the pilot without having to release any of the primary controls.

i) The maximum strength of any weak link which may be interposed in the towing cable shall be established. For the determination of loads to be applied for the purpose of this sub-section the strength of the weak link shall not be less than 900 Newtons.

j) 2. The gradient of climb after take-off shall be not less than 10% under ideal conditions.

k) 3. The pilot in command of the tug is responsible for the suitability of the tug for the proposed operations, tow bridle weak link and tow rope attachment to the tug.

l) 4. The tug must have a minimum of 1 convex and 1 flat mirror so that the tug pilot can view the pilot undertow at all times.

m) 5. For Dragonfly tug aircraft

   i. a. The tow bridle is to be 4-8mm braided synthetic cord approximately 6 meters long.

   ii. b. A weak link is installed 1 meter from the top of the tow post mounted above the rudder post end.

8 Tow Endorsement Theory Study Guide

These questions are a guide to the theoretical knowledge required to gain an HGFA tow endorsement.

1. Why do we use a weak link on the tow line?
2. What is the recommended breaking load of a weak link?
3. As well as a weak link, what other devices are you recommended to use when towing?
4. What are the 2 most common causes of emergencies whilst towing?
5. What are line breakages most commonly caused by?
6. What is the primary cause of lock-out?
7. During a lock-out what happens to the glider's roll response?
8. What would you do if you suffered a line break at 50 feet?
9. What would you do if you suffered a line break at 300 feet?
10. Why is it recommended to wear non-glass eye protection whilst towing?
11. Describe the effect of too much pilot input whilst under tow.
12. When towing at an airport, what considerations must be made?
13. What is the accepted standard approach and landing pattern for a hang glider and a paraglider at a general aviation aerodrome?
14. Some bridle systems incorporate a weak link which activates the release on breaking. Why are these releases not recommended?
15. Why are string weak links preferred over shear pin weak links?
16. On reaching the top of your tow, your release fails to operate, what is your most appropriate course of action?
17. What are the last pre-flight checks before launching prior to a tow?
18. What factors must be considered when launching from a dolly?
19. What is the best way to stop the glider from oscillating whilst under tow?
20. When static winch towing without radio, what signal does the glider pilot use to stop the tow?
21. Describe the effect of wind gradient on a glider being towed.
22. Is it true that during a lock out situation with a pull-in winch or pay-out winch that to free wheel the winch will stop the lock out from increasing?
23. What is the maximum line tension that should be applied whilst towing?
24. When should you release and what procedures would you use to release from the tow?
25. What is the best speed to fly under tow for your wing type? Why?
26. What is the most important consideration when landing with a bridle or rope hanging below the glider?

27. Whilst under Aerotow the Tugmaster signals by holding out a stationary arm up at an angle, what would this signal mean?
28. When Aerotowing, in which direction are you required to turn the glider immediately after release?
29. What sighting method is used to determine the correct tow position and what track is taken when turning under Aerotow?
30. What is the recommended launch procedure when foot launching whilst Aerotowing?
31. What added factors must be considered when using a dolly in a strong (10+ kt) crosswind?

[End of Document]