

# ***HANG GLIDING FEDERATION***

*of*

***AUSTRALIA***



## ***TOWING PROCEDURES MANUAL***

Revised Edition - Issued June, 1999

## **CAUTION**

This Manual is approved by the Civil Aviation Safety Authority, and lays out 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 a 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.

The ground towing sections of this Manual were originally written by Mark Mitsos as separate manuals for hang gliding and paragliding. The aerotow section was originally written by Chris Brandon as part of the HGFA Powered Hang Gliding Operations Manual.

In 1995 these sections were reviewed and compiled into one Manual by Craig Worth with input from Lee Scott, Phil Pritchard, Charly Fellay, Ian Jarman and various other experienced HGFA tow pilots.

This edition was drafted by Craig Worth with assistance from members of the HGFA Safety and Operations Committee.

Thanks goes to all contributors.



## FOREWORD - A BRIEF HISTORY

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, 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 weight shift 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 cross winds 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.



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## SECTION 1 - INTRODUCTION

### 1.1 - 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. Not to adhere to the guidelines in this manual may result in pilot injury or death.**

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 experienced instructor or Senior Safety Officer.

Towing may only be carried out by tow endorsed pilots or pilots under the direct supervision of a Tow Instructor or Senior Safety Officer for the purpose of gaining a tow endorsement.

**NEVER TAKE A CHANCE WITH TOWING OF ANY FORM.**

**If At Any Time The Pilot In Command Of The Aircraft Being Towed Is Not Happy With The Progress Of The Tow, He/She Should Stop The Tow Immediately!!**



## 1.2 - Preliminary Recommendations

Criteria for safe and efficient towing:

1. **Constant Direction:** The direction of the towing force must remain constant throughout every phase of towed flight.
2. **Constant Tension:** The tension of the tow line must remain essentially constant throughout each phase of the towed flight, other than steady increases as the tow progresses in accordance with the recommendations in this manual.
3. **Reliable Tensionometer:** Other than when aerotowing, the system must have a reliable (electronic or hydraulic) load sensor to detect any changes happening to the hang glider or paraglider in towed flight.
4. **Centre of Mass Attachment:** The towing forces applied through the tow line and bridle must be attached 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.
5. **Gradual Transitions:** The graduations to and from tow, including any variations while on tow, must be of a gradual nature.
6. **Reliable Releases:** The release devices and their methods must be totally reliable.
7. **Weak Link:** The system must include a weak link which is infallible and will automatically release the glider from the tow whenever the tow line tension exceeds the limits of safe operation.
8. **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.
9. **Adequate Power:** The system must have a source of power adequate to maintain a safe mode of flight whilst under tow.
10. **Capable Crew:** The system must be operated by a crew which is adequate in number and competent in ability to see that the system functions properly.
11. **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.
12. **Suitable Environment:** The system must be operated only within the environment and under weather conditions conducive to safe towing.



## SECTION 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) he or she has been issued with a HGFA Ground Tow Endorsement; or
- (b) he or she is undergoing training under the direct supervision and control of an appropriately endorsed HGFA Instructor for the purpose of gaining a HGFA Restricted Pilot Certificate; or
- (c) he or she is undergoing training under the direct supervision and control of an appropriately endorsed HGFA Instructor or Senior Safety Officer for the purpose of gaining a Ground Tow Endorsement; and
- (d) all operations comply with the requirements of this Manual.

Note that a student pilot may undertake a towing course with a qualified instructor only. The course may be provided with training to gain a Pilot Certificate, though the Tow Endorsement cannot be issued prior to the issue of the Pilot Certificate.

Where endorsement training is being conducted by a Senior Safety Officer, all pilots must hold an HGFA Pilot Certificate for the aircraft type for which the endorsement is sought.

#### 2.1.2 - Aerotowing

The hang glider or glider pilot must hold an appropriate pilot certificate; and:

- a) hold an HGFA Aerotow Endorsement; or
- b) be under the direct supervision and instruction of an HGFA Instructor or Senior Safety Officer for the purpose of gaining an Aerotow Endorsement; and
- c) where the pilot holds a Restricted Certificate, aerotow endorsement training must be conducted by an instructor (not a Senior Safety Officer).

The tug pilot must hold an appropriate pilot certificate, and:

- a) hold an HGFA Tugmaster Endorsement; or
- b) be under the direct supervision and instruction of an HGFA Instructor for the purpose of gaining a Tugmaster Endorsement.



**Note: "appropriate pilot certificate"** means a pilot certificate, other than a student pilot certificate, applicable to the aircraft being flown (whether a hang glider, paraglider, lightweight glider, weight shift microlight or Ultralight). The pilot certificate must be issued in accordance with a CASA approved Operations Manual.

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

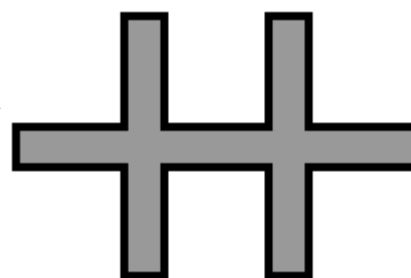
## 2.2 - Duty Pilot

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

The duty pilot's responsibilities are:

- (a) to establish and coordinate towing procedures; including the determination of an appropriate launch area, flight plans, circuits and landing patterns;
- (b) to ensure that all pilots and tow drivers are advised of the adopted procedures and endeavour to have all persons involved adhere to procedures;
- (c) 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;
- (d) to coordinate effectively with duty pilots or officers from other flying organizations 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
- (e) 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.

**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 a tow endorsement holder 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, hang gliders, paragliders and lightweight gliders 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;
- 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;
- and emergency landing zones (for use should a weak link break; engine failure or release failure occur).



## SECTION 3 - EQUIPMENT

### General

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 have proven to be a major cause of serious accident and injury. Use only approved bridles and releases as many accidents have resulted from the use of home built releases and unconventional bridle arrangements.

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

### 3.1 - Towing Systems

There are four types of towing systems currently used:

#### 3.1.1 - Static Tow Line

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 pilot's harness via a reliable hand operated release system. Because poly rope can be elastic, the tow bridle should be made from a pre-stretched rope to prevent the tow rope whipping back in the event of a weak link or rope break.

This system is popular due to its simplicity and low cost. However, it is not ideal for towing paragliders, 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. Because of a paragliders limited speed range, these wind fluctuations can place excessive loads on a paraglider under tow.

**It is therefore necessary that paraglider pilots gain experience to at least Tow Endorsement standard on a winch system prior to attempting static line towing.**

#### 3.1.2 - Pay-out Winch and Platform Launch

This winch system utilizes 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 preset 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 or "free wheels", thereby reducing line tension. There is often also a guillotine built into the system which can be operated from within the vehicle in an emergency situation. These systems usually use 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 is simple, reliable and reasonably inexpensive; and is therefore ideal for club or individual pilot use.

### 3.1.3a - 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. The winch is powered by an internal combustion engine and uses hydraulic technology to regulate drum speed and line tension. The line is laid out prior to the tow using a motorcycle or car and is wound back onto the drum during the tow. The system is usually fitted with a guillotine.

This system is a little more expensive than a pay-out system; though its fast turn-around and reliability make it an ideal tool for student training.

### 3.1.3b - 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 other 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.

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

### 3.1.4 - Aerotow

Aerotow utilizes 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 to be able to demonstrate a gradient of climb of not less than 10% under ideal conditions.

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 maximize soaring potential.

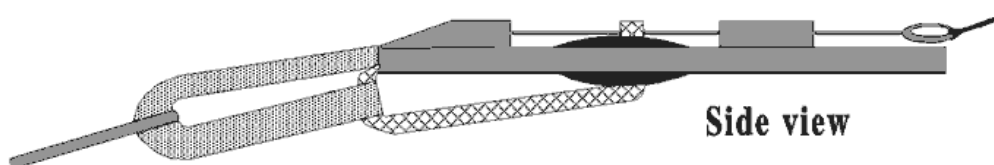
A release fitted at each end of the tow rope and a weak link is mandatory. The release fitted to the tug must comply with the HGFA Standard for Towing Installations (see Appendix 1 to this Manual). These releases must be tested to demonstrate compliance and be approved by the HGFA Operations Manager.

The aerotowing of intermediate standard hang gliders at speeds in excess of 30 mph is not recommended.

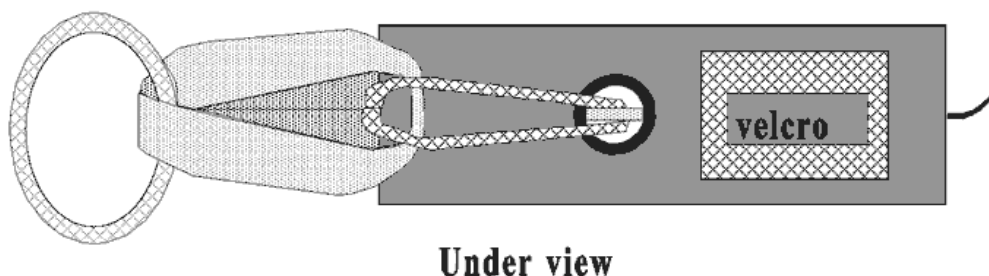
### 3.2 - Releases

All releases fitted to gliders must release at any angle and at any load that may be applied during tow. All releases must be infallible 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.

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 minimize 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**



#### **Other release systems available:**

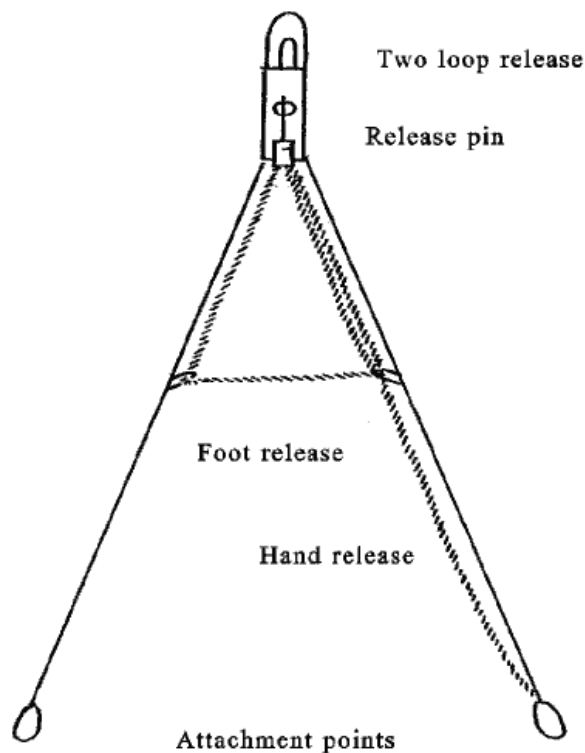
The "Moyes" type system - uses a motorcycle type lever fitted to the control frame of a hang glider which operates a remote release via a wire cable. These systems are suitable, though care must be taken to ensure the release is correctly adjusted and maintained.

The "Link knife" type system - uses a blade located in a slotted cylinder to cut the string weak link to effect release. If using this system care must be taken to ensure that the release is securely located and that the rings used on either end of the weak link are of sufficient size to preclude the knife moving over a ring, thus causing the release to fail.

Winch, vehicle and tug releases are recommended and should be releasable at any tension. A hook knife, wire cutters or guillotine must be a standard feature for use with a ground tow vehicle, boat or winch.

Releases fitted to tugs and lightweight gliders must be HGFA approved and comply with the HGFA Standard for Towing Installations.

The following paraglider release / bridle is made by Silent Sky Sports and can be activated by hand or foot:



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 whilst reverse launching, 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.

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

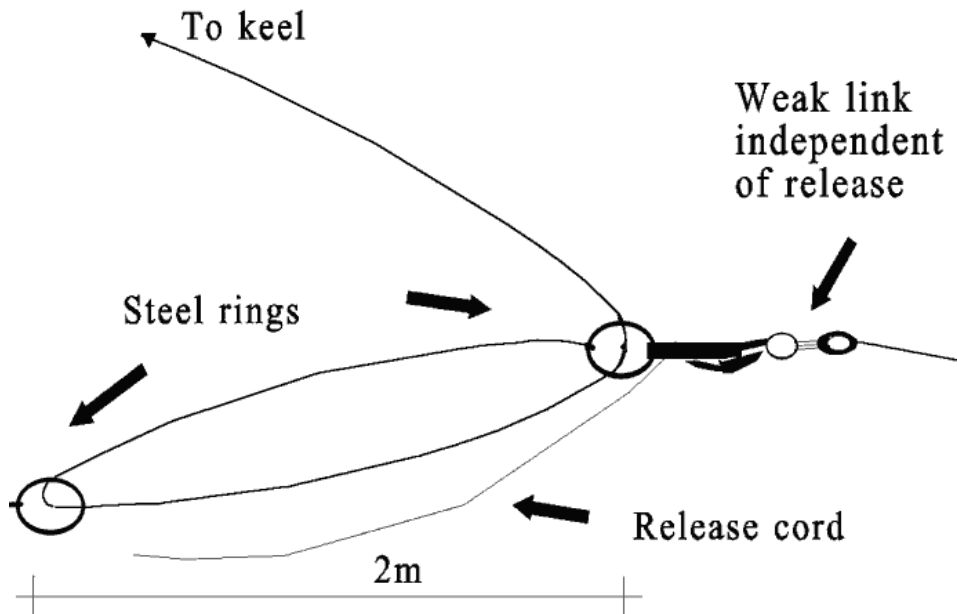
### 3.3 - Tow Bridles

#### 3.3.1 - Bridle Construction

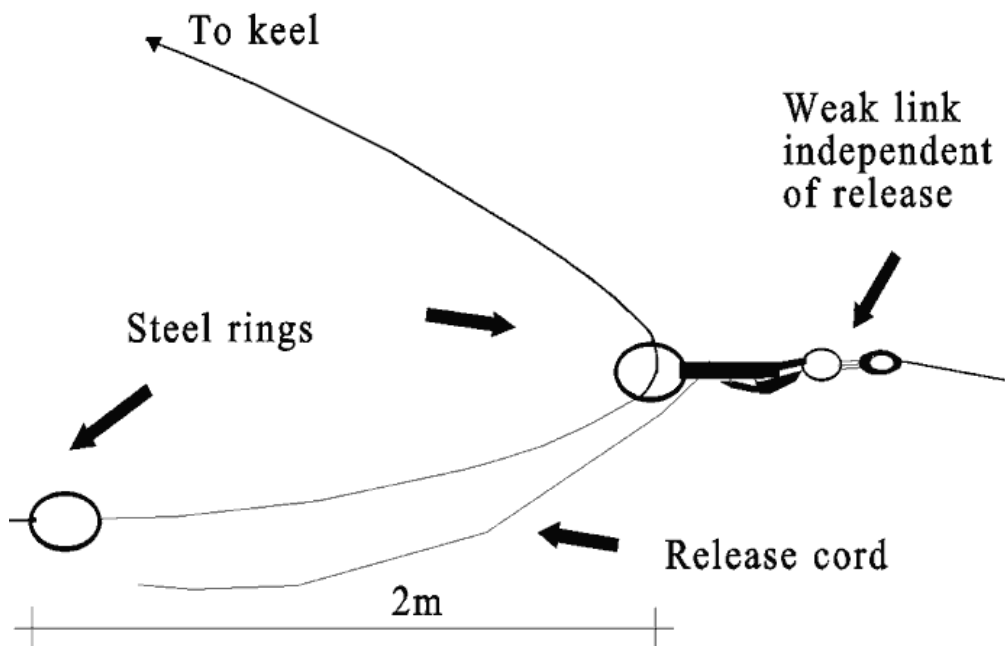
Bridles should be constructed from pre-stretched rope. This is necessary to avoid injury to the pilot in the event of a weak link break or release under tension. A bridle that can stretch under tow will spring back toward the pilot if the load is suddenly released. Seamless metal rings should be used,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

### 3.3.2 - Hang Gliding Bridles

The following diagram shows a typical "two to one" bridle set-up for ground towing (i.e. two ropes to the pilot and one rope to the glider's keel).



Alternative to the above "two to one bridle", a "one to one" bridle may be preferred, with one rope to the pilot and one to the glider's keel, as follows:

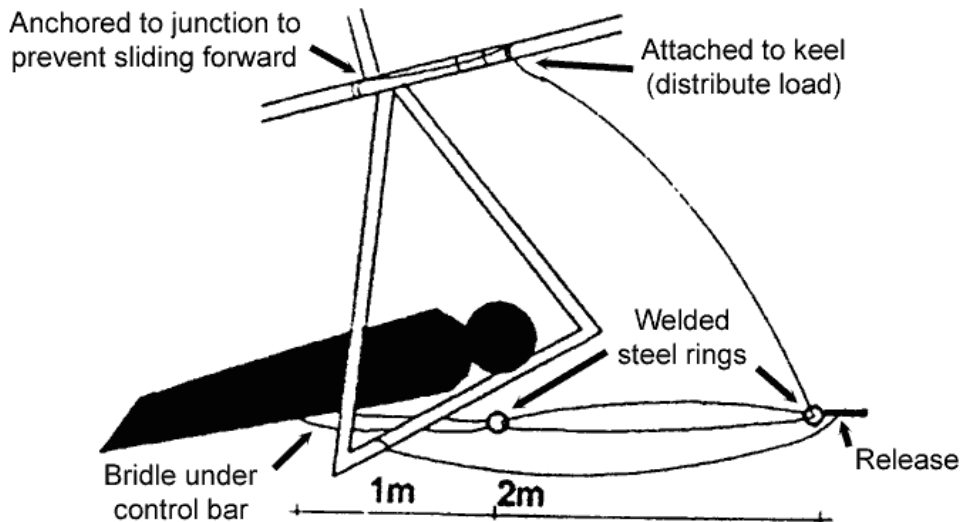


### 3.3.3 - Hang Gliding Bridle Attachment - Ground or Boat Tow

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

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

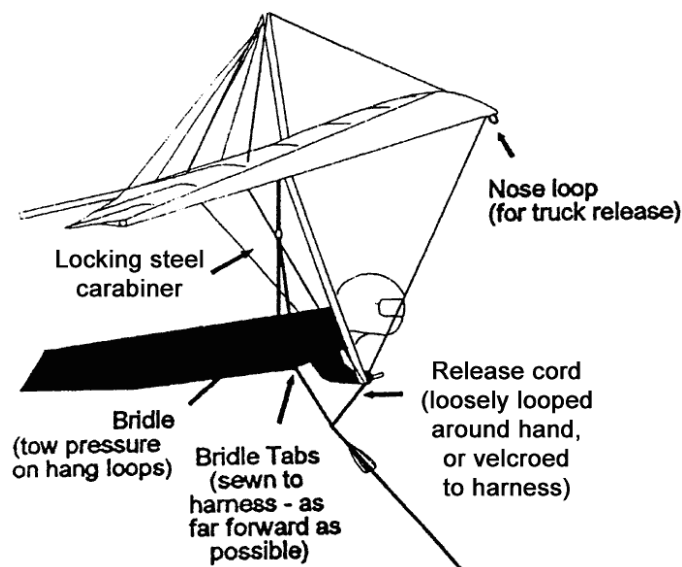
The bridle should be tied to the keel of the glider approximately one hand span (20-25 cm) forward of the pilot hang point.



**Note:** Instead of as shown above, when conducting low tows during student training, it is preferable to route the lower bridle ropes above rather than below the base bar.

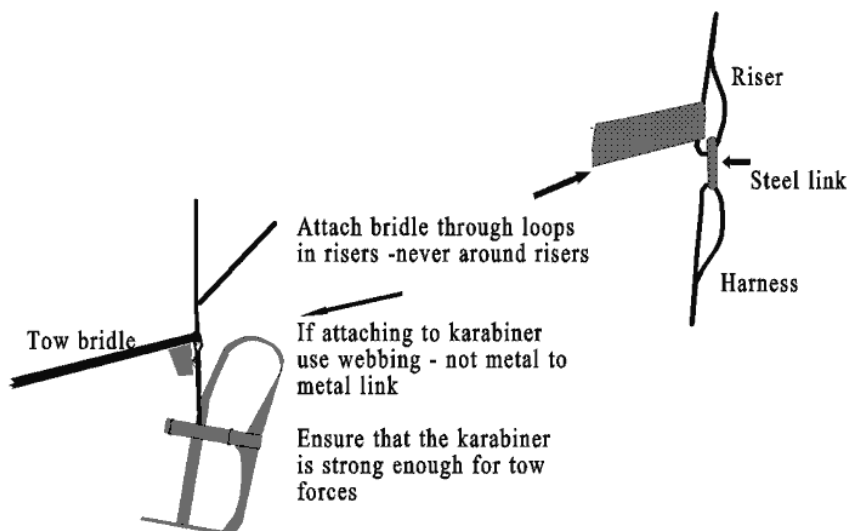
### 3.3.4 - Hang Gliding Bridle Attachment - Platform Launch System

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 carabiner, as shown:



### 3.3.5 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 carabiner providing the connection is by way of a webbing loop and care is taken to ensure that the carabiner is securely locked and of adequate strength to withstand lateral tow forces placed on it.

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

### 3.3.6 - 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 at the chest or shoulders.

When aerotowing intermediate hang gliders, a "one to one" bridle is essential.

When aerotowing hang gliders, the bridle ropes pass through the control frame (rather than the lower rope (or ropes) passing under it, as with ground towing).



When aerotowing lightweight gliders the tow line is attached to the release using a metal ring only (with a weak link between the ring and the tow rope).

### 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 (dependant on pilot weight - usually approximately 90 to 100 kg for solo operations; or approximately. 175 kg for tandem operations).

Each pilot should have his / her own weak link of appropriate strength.

It is recommended that a new weak link is used for every launch; or a fabric sheath is used to cover the weak link to protect it as it is dragged along the ground.

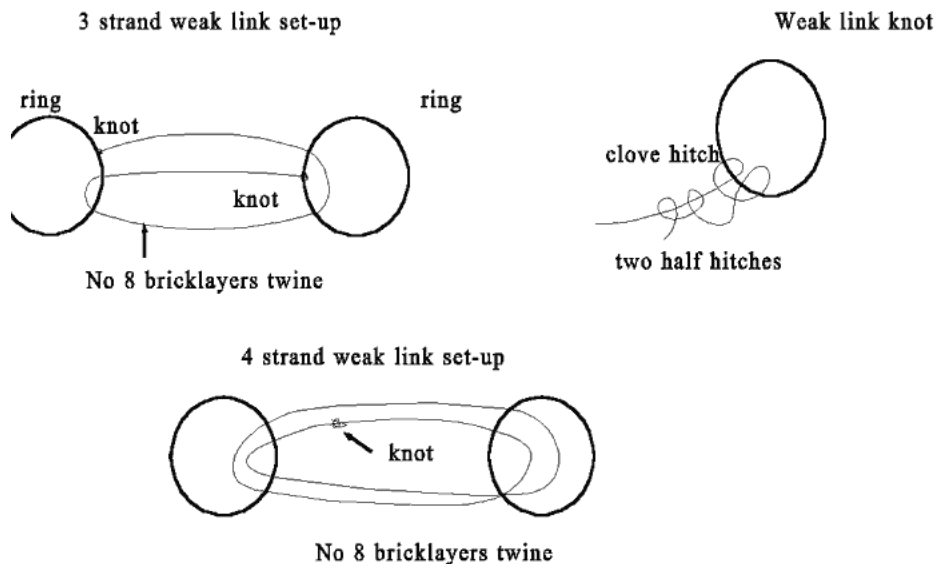
Testing weak links tied from "No 8" builders string line has shown that the type of knot used does not greatly affect the breaking strain of the weak link.

Shear pin weak links can be unreliable and are not recommended.

A problem with a string weak link will lessen its strength, where a problem with a shear pin weak link can greatly increase its breaking point. The metal components of the apparatus can corrode and fuse together. The strength of the shear pin material can also vary. If pilots are determined to use a shear pin weak link, it must be carefully maintained and the shear pin material must be monitored to ensure consistency.

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.

Typical weak link set-up:



### 3.5 - Rope Types

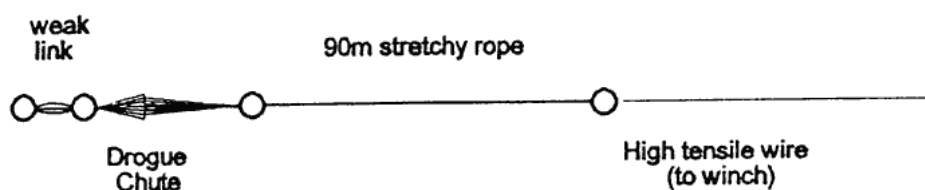
For car or platform tow training a monoplait or a plaited rope should be used. This rope exhibits zero twist characteristics and hence will not twist or wind up bridles making them un-releasable. For general towing, 4-5 mm polypropylene or polyester rope is suitable.

If a twisted rope is used swivels must be fitted at either end of the rope to prevent the rope twisting up the releases. Twisting a release or bridle may cause release failure. A heavy duty fisherman's "shark swivel" is a suitable swivel.

**ALWAYS USE RINGS AT ALL ROPE ENDS**

The minimum length of a rope used for aerotowing rope is 90 metres.

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 a type which allow the dolly to roll easily with as little drag resistance as possible.

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 at least twenty° 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. Where the rope or similar system is used by the pilot to hold onto the dolly, this must allow a failsafe release of the dolly on launch.

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



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## 3.7 - Ancillary Safety Equipment

### 3.7.1 - Protective Eye-wear

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

### 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.

### 3.7.3 - Flotation

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

When undertaking paraglider boat towing, flotation must be fitted to the pilot.

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 the Civil Aviation Safety Authority must be fitted with an appropriate ballistic deployed emergency parachute.



## SECTION 4 - COMMUNICATION

### 4.1 - Radio Procedures

The use of radios is 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 when towing in the vicinity of other tow groups and the driver / tugmaster should be addressed by name or callsign.
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. The following signals are recommended:

Pilot **"Take up slack"** then **"Take up tension"**

Driver **"Tension on"**

Pilot **"Clipping on (mike)"**

Pilot **"Picking up glider"** this indicates that the pilot is ready

Pilot **"Wind strength ....."** wind strength at launch so the driver knows how much tension to apply

Pilot **"Go, go, go"** to start tow

When towing paragliders the additional call of **"go slow"** is used to enable canopy inflation - once the canopy is inflated and aligned - "go, go, go" is then used.

In an emergency or at the top of the tow the signal **"stop, stop"** is used.

Whilst under tow **"slow down"** or **"faster"** may be used as required.



It is advisable to notify the driver when airborne and regularly advise how the tow is progressing by calling the height of the glider.

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

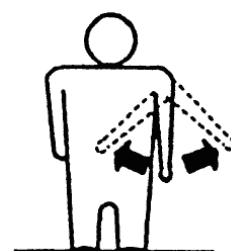
## 4.2 - Signals

The following signals are recommended.

Prior to launch:

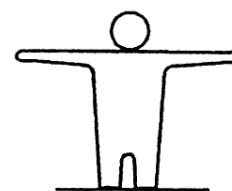
### Take up Slack

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

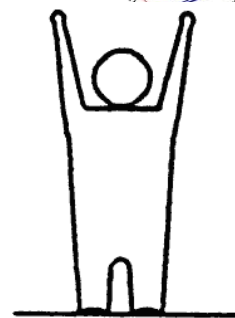
**Either:** Two outstretched arms are used by the duty pilot or tugmaster to indicate that there will be some delay before the next phase of the towing operations can proceed, **or:** when a hang glider pilot is foot launching, "wait" can also be indicate by merely placing the glider back on the ground.

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 !**

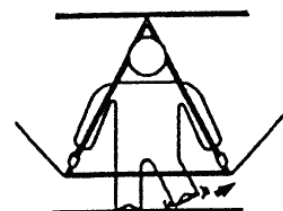
At any time, two arms held vertically above the head indicates "stop!"



**Go !**

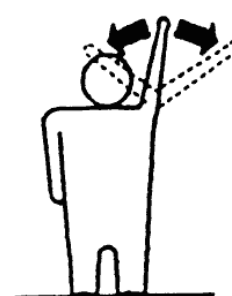
To initiate the launch, one of two signals are used, **either:**

- 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.



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

**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.

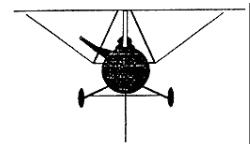
When signals are being used whilst under tow, the pilot must keep his / her legs together whilst not signaling to ensure that no unintentional signals are given.



**The following signals are used by the tugmaster whilst aerotowing.**

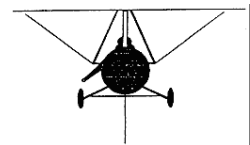
**Tow higher!**

A stationary arm pointed up means the glider should climb to a higher flight path relative to the tug.



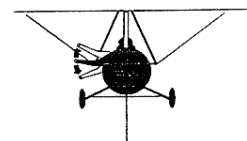
**Tow lower!**

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 glider pilot should release.



the



## SECTION 5 - PROCEDURES

### 5.1 - 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 and not less than 320 metres in length.

### 5.2 - Weather Conditions

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

Cross wind launches should only be attempted by experienced tow pilots, due to the increased tendency to lock-out in the direction of the crosswind. Launches in a light cross wind may be conducted by inexperienced tow pilots using the dolly launch method.

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

### 5.3 - Training Considerations

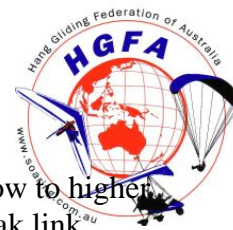
**At no time should any form of towing be conducted with both an inexperienced glider pilot and an inexperienced tow driver, winch operator or tug pilot.**

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 have at least one tow demonstrated.



Initial tows should be at low tension, with gradual progression from low to higher tows as the pilot gains experience. Once high 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.

## 5.4 - Tow Tension

### 5.4.1 - 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 "zooming" up at a high angle of attack near the ground. The amount of reduction in tension should vary dependent on the wind strength, as follows: in strong winds - apply one third of maximum tension; in moderate winds - apply one half of maximum tension; 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. Low altitude - low tension; high altitude - high tension.**

**Maximum tow tension for solo operations should not exceed 95 kg.**



#### 5.4.2 - Line Tension - Paragliding Towing

For solo paraglider towing, line tension should not exceed 25 kg when tension is being taken up to remove line slack prior to launch. This is increased to 50 kg as launch begins and until a height of at least 100' has been gained before gradually increasing tension to the optimum of between 75 and 90 kg for solo operations, dependant on pilot weight.

**High tension can only be used at high altitude.**

**Low altitude - low tension; high altitude - high tension.**

Maximum tow tension for solo operations should not exceed 95 kg.

For tandem operations these forces are increased dependant on the combined weight of the pilot, passenger, harness and glider.

#### 5.5 - Launch Procedures

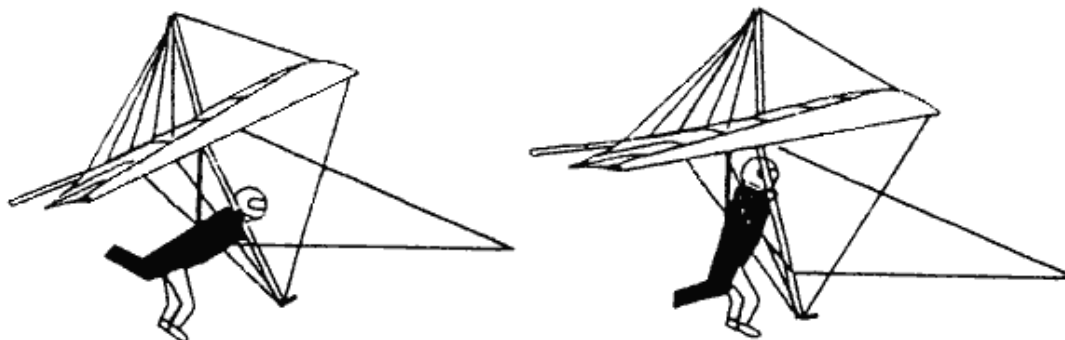
To avoid delays, pilots should carry out all pre-flight checks before being connected to the tow rope. These checks should include the standard pre-flight checks as well as checks to ensure that radio, bridle, release and weak link are in order.

**Slack rope launches must be avoided.** The one exception is when launching a paraglider in strong wind, when a reverse launch with an anchorman is recommended, keeping a slack line to ensure that the paraglider does not "kite up" in the wind.

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. 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.



### Too high an angle of attack can lead to a lockout

**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 preflight check to ensure that all harness and glider ropes are located 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 launch only once ample 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).

## 5.6 - Procedures under Tow

With all forms of towing it is important to maintain directional control directly down the line of the tow. Pilot input under tow should be minimized, 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.

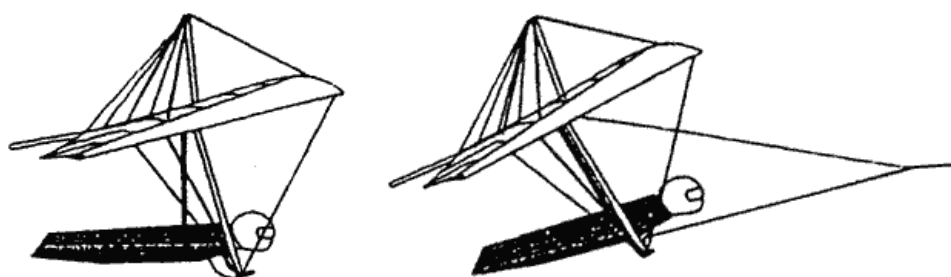
**Hang glider pilots** should remain in the hang position with hands on the uprights whilst ground towing, though a smooth transition to prone may be made by experienced pilots once significant height is gained.

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

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

When foot launching a hang glider, the 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 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.



**Free flight at 35 mph**

**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 rear wheels of the tug level with the horizon.

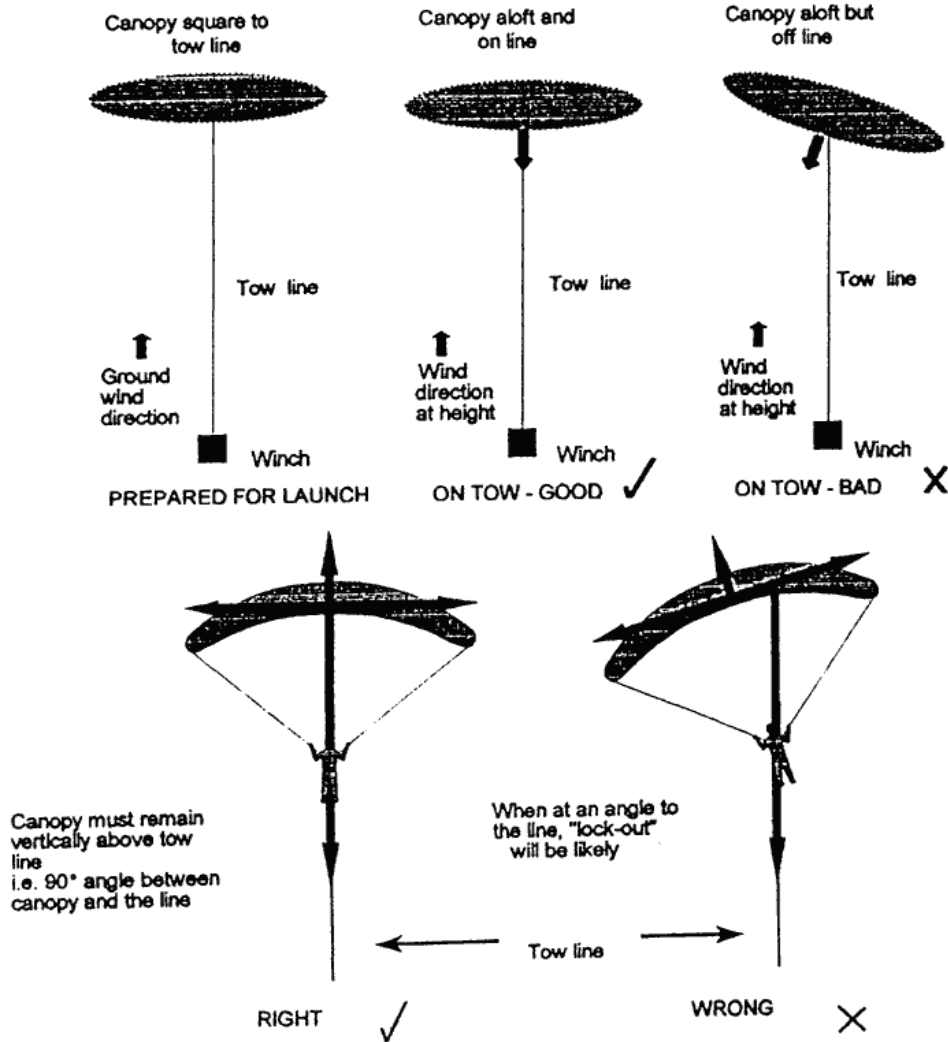
If the glider is too high the glider pilot should increase speed; conversely speed is reduced to move to a higher position behind the tug. The tug pilot may request that the glider alter station by giving the appropriate radio command or hand signal (as illustrated in Section 4.2).

**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.

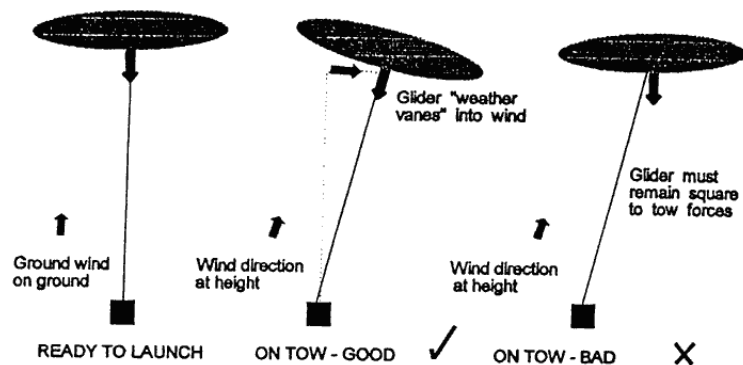


**Paraglider pilots** must keep the canopy positioned square to the tow line and vertically above the pilot. This applies whilst launching, when under tow, and in a crosswind.



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

**The glider must still remain square to the tow line:**





## 5.7 – Release Procedures

### Ground towing

Whilst ground towing, 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 quickly applied to slow the pitch-over action. 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.**

### Aerotowing

When aerotowing the release procedure is for the glider pilot to increase speed to reduce line tension, check for traffic to the right and release. After release the glider pilot should 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 minimize 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 when landing with a bridle attached to the harness.**

A low approach over a fence or similar object must be avoided to remove the possibility of the bridle snagging. When running out a landing, care must be taken to avoid tripping over the bridle.

## 5.8 - Emergency Procedures

### 5.8.1 - Line and Weak Link Breaks

Due to the high angle of attack whilst under ground or boat tow, a line break will cause a hang glider to pitch up quickly, or a paraglider to 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.

### 5.8.2 - 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 rope free.

If the rope cannot be freed, 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.

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

### 5.8.3 - Lockouts

A lockout occurs when the glider being towed moves off the direction of the tow, and is coupled with rapidly increasing tow tension; and increasing bank and nose angle. The lockout will quickly worsen unless tow tension is reduced to enable the glider pilot to regain station.



Immediately directional control down the line of the tow cannot be maintained, the pilot must signal "stop" to allow tow tension to be gradually reduced and the angle of attack lowered to regain control.

**Once a lockout has developed the glider will accelerate and quickly pitch up, a sudden and total reduction in tow pressure can cause the glider to stall.**



## APPENDIX 1 - STANDARD for GLIDER TOWING INSTALLATIONS

1. (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 250 kg.
  - (c) The maximum hang glider towing speed  $V_T$  shall be selected by the applicant.  $V_T$  shall be at least  $1.3 V_{SI}$ , where  $V_{SI}$  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  $V_T$ .

The conditions applicable are:

- (i) The speed is assumed initially to be at the maximum glider towing speed  $V_T$ ; and
- (ii) 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:-
  - (1) horizontally backwards;
  - (2) backwards and upwards at  $40^\circ$  to the horizontal;
  - (3) backwards and downwards at  $20^\circ$  to the horizontal;
  - (4) horizontally backwards and  $25^\circ$  sideways in both directions.
- (e) 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 (g)) 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.



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

(g) 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.

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



## APPENDIX 2 - 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 are the primary causes 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 sheer 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. On reaching the top of your tow, your release fails to operate, what is your most appropriate course of action?
26. What is the best speed to fly under tow?
27. What is the most important consideration when landing with a bridle or rope hanging below the glider?
28. Whilst under aerotow the tugmaster signals by holding out a stationary arm up at an angle, what would this signal mean?
29. When aerotowing, in which direction are you required to turn the glider immediately after release?
30. What sighting method is used to determine the correct tow position and what track is taken when turning under aerotow?
31. What is the recommended launch procedure when foot launching whilst aerotowing?
32. What added factors must be considered when using a dolly in a strong (10+ kt) crosswind?