TM 20

HANG GLIDING TOW MANUAL

The NZHGPA has developed a suite of Technical Manuals.

The number of Technical Manuals is growing.

These documents can be used as:

● Minimum Acceptable Standards ● Study material for students and other pilots

● Guidance on rules and compliance

FOREWORD

This manual is an update to and replaces the NZHGPA Hang Gliding Tow Manual, originally produced in 1994

This manual should not be used as the sole basis for the start-up of a new tow operation. New operators are directed to obtain instruction in the techniques and equipment of towing from experienced tow rated instructors.

It is intended that this manual, the NZHGPA Hang Gliding Tow Manual be a living, evolving document. Hang glider towing techniques and equipment are dynamic and subject to continuous development. Identification of errors and/or any submissions for changes to any part of it are welcome. The NZHGPA welcomes any advice, information, or assistance from members, to ensure programmes are established, that promote and maintain a high level of instruction and safety throughout our membership. Communication of such should be directed to the NZHGPA CEO, the CEO's contact details being detailed on the NZHGPA Web Site.

This update of the NZHGPA Tow manual acknowledges the support and contributions from the Hang Gliding and Paragliding Association of Canada (HPAC), the British Hang gliding and Paragliding Association (BHPA), and the Sports Aviation Federation of Australia (SAFA).
Much of the updated text and diagrams of the manual have been reprinted with permission from the Towing Procedures Manual of the HPAC. Refer to the appendices for relevant document citations.

Approved by CIVIL AVIATION AUTHORITY OF NEW ZEALAND **15 / 11 / 2021**

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1 Introduction

This manual has been compiled to establish minimum standards for tow launched hang gliding flight. It provides criteria for operators to establish adequate safety and training systems.

This manual is intended to be EQUIPMENT NON-SPECIFIC. Towing technology varies greatly, and each system enjoys its own philosophy. Equipment is required to be fit-for-purpose.

Aspects related to ground crew responsibilities must be taught and understood thoroughly, with emergency procedures in place at all times and practiced regularly.

Despite its complexities, towing can be safe and rewarding. Great care must always be taken, and responsibility must not be taken lightly

2 Personnel Requirements

2.1 Pilot and Crew Qualifications

The following qualifications relate specifically to tow launching hang gliders:

- OPMF20: Hang Glider Tow Certificate
- OPMF70: Tow Operator Pay in
- OPMF71: Tow Operator Pay-Out
- OPMF72: Hang Glider Tow Instructor Certificate

OPMF80 and 80b relate to aerotowing hang gliders. Aerotowing is beyond the scope of this document. Aerotowing operations are discussed in the Aerotow Manual.

2.2 Pilot Currency

If a tow rated pilot, operator or instructor does not meet NZHGPA currency requirements, the tow pilot must be directly supervised by a pilot that is current and rated in the discipline required.

2.3 Authorisation of Tow Operations

Where a tow rated pilot is under instruction, a HG Tow Instructor must authorise and directly supervise tow operations.

Where all pilots are tow rated and you have a tow operator to operate the tow, a Tow Instructor is not required.

3 Programme for Training Tow Pilots and Crew

An important principle of this manual is the separation between:

NOVICE TOW TRAINING as opposed to flight instruction of **AB INITIO** pilots. (Ab initio – a Latin term meaning "from the beginning")

1 The towing (and training) of **Flight Competent** pilots (already rated Novice to Advanced) are henceforth referred to as **NOVICE** pilots.
2 **New** (ab initio) pilots undertaking the basics of flight under instruction, (using tow). are henceforth referred to as **AB INITIO** pilots.

3.1 Ab-initio Training on Tow

While flying via tow has been proven as an efficient way of accelerating learning and achieving airtime, it does impose several extra layers of complexity. Reasons for towing accidents in the past have often been obvious, but also can come from the most inconsequential details. Systems must be robust, all contingencies must be considered and controlled.

A typical syllabus is not dissimilar to hill launch, but the pilot must demonstrate correct launch technique, relaxed pitch control and directional control of glider prior to introduction to any height on a tow system. This can be accomplished in several ways – by establishing the required skills on a training hill, by practice launching on the flat and guiding the glider round markers using roll control, by the use of a controlled simulator system such as the following - https://www.youtube.com/watch?v=WIr4VQ1o3_A a flatbed trailer set up for tethered flying, hand tow behind a small vehicle (quad bike etc) or a combination of the above. With good technique and conditions, it can also be accomplished on tow with hands-on assistance by the instructor.
Instruction of Beginners using surface tow does not negate the essential requirement to teach them competency and confidence in hill launch and associated flying skills.

3.1.1 Student Supervision

Training flights must be completed under the supervision of a hang glider Tow Instructor.

3.1.2 Minimum Requirements

Requirements and recommendations prescribed within this document for ab-initio training are intended to complement rather than contradict other NZHGPA and CAA requirements. There are many requirements of students and instructors which are not outlined here as they apply equally to both tow launched, and hill launched training.

3.1.3 Tow Equipment

The tow instructor must have prior experience with all equipment being used in an ab-initio training environment. This means experience with:

- The specific tow system.
- The hang glider and harness being used by the student.
- The bridle and release mechanism.

This experience is to be gained through personal use of equipment, or through observation of other experienced pilots' use of the equipment in question.

Irrespective of how this equipment is developed and utilised, the instructor is legally obligated to exercise professional judgement and practice in its selection, implementation and management. For quality assurance purposes, and to ensure objectivity of such judgement, it is strongly advised that all equipment and procedures are documented, then peer reviewed by other Tow rated Instructors, or by their OSO (NZHGPA Organisational Safety Officer) at the very least. In the absence of suitably experienced personnel, or perceived commercial sensitivity, the expertise of the NZHGPA Training Manager should be sought.

Additional to detailing of all equipment used, Equipment Logs should be kept, for the recording of use, maintenance issues and work required/performed.

3.1.4 Choice of Hang Glider

Glider types that would be recommended are any of the Floater family (Alpha, Falcon, Fun, Malibu).
Other gliders such as 30%ers can be used at the instructor's discretion.

3.1.5 Wheels

Ab-initio training flights require wheels to be fitted to the hang glider base bar.

3.1.6 Sites

An OPMF41 must be completed for all sites used for beginner instructing, this site rating form should identify any hazards and record the management/mitigation of any that exist on the site. The site should be appropriate to the level of competency of the pilot.

3.1.7 Wind

Ideally, wind conditions for early Ab-Initio student pilots will be directly into wind, laminar and without thermic influence. Wind strength parameters - maximum 12 knots. Gust no more than a 5 knot deviation of strength within a 5 second period. Cross wind must be no more than 30 degrees at the time of launching.

Limits may be exceeded with tethered training.

3.2 Novice Tow Training (teaching qualified HG pilots to tow)

This section relates specifically to the instruction of flight competent pilots (already rated at least Novice). This section is not to be used in relation to the use of Tow to instruct Ab Initio pilots (new pilots learning to fly from scratch).

This is a guide to flight competent pilots, as to what to expect for yourself and from the instructor whilst learning to surface tow. You should be aiming at a total understanding of all facets of towing including how to be towed safely, types of bridles and how they work, weak-links, releases and emergency procedures.

Although your instructor may use special equipment for the purposes of training, by the end of your tow course you should be towing with standard bridle, pressures etc. and be capable of making all necessary decisions.

If you have already learnt to aerotow, do not expect identical inputs in ground-based towing. Similarly, if transitioning to aero towing after learning to surface tow, you will be learning new inputs. Essentially the difference is that for surface towing, moving your body is required to effect control during tow. In aerotow, with towing from the glider keel and/or shoulder connections towards a horizontal source, weight shift is better achieved by maintaining the upper body near the control frame centre, at a neutral angle of attack, and moving the middle and lower body around the upper body axis.

3.2.1 Pilot Prerequisites

The minimum pilot rating must be at least NZHGPA HG Novice or NZHGPA Visitor License with approved international equivalency.

3.2.2 Training Programme Guidelines

Any pilot being towed without a tow rating must be under direct supervision of a Tow Instructor and is in training.

This section provides criteria for operators to establish adequate training systems. The suggested programme consists of four phases:

- Ground School (towing theory).
- Equipment familiarisation and skill demonstration.
- Practical training for tow pilots and operators.
- Theory examination.

3.2.3 Syllabus to be covered in tow pilot training

System Differences

- Fixed length line towing, pay-in winches, pay-out winches.
- Tow vehicles and boats.
- Different components and configurations

Tow Rigging Components and Configuration

- Hook Knife when and how to use it
- Tow bridle types and configurations
- Tow line, leader lengths, advantages, and disadvantages.
- Release mechanism differences, safety advantages of soft releases.
- Connection of tow bridle to risers or harness.
- Weak links; desired strength, material variability, weakening from knotting and tying.
- Recovery drogue chutes, differences.
- Line splicing

Glider Effect Of

- G loading: definition and increase from towing and banking.
- Air speed increases due to tow line loading.
- Wind, including cross wind.
- Control effects due loading and airspeed.
- Lockout; description, cause, prevention, recognition, and recovery.
- Angle of attack vs Pitch angle
- Low altitude separation and risk of diving into the ground either backward or forward.
- Two stage increase in towing tension (i.e. above or below 100ft ATO).

Pilot Responsibilities

- Adjustments for difference between hill and tow launching.
- Directing launch, depending on the system (except during instruction).
- Steering during lift off.
- Steering for heading relative to tow line (i.e. staying on-line).
- Release criteria: vehicle stops or confusion or discomfort or lock out.
- Tow line separation, timing, and glider surging.
- Lock out prevention, recognition, and recovery.
- Use of pre-launch checklists.
- Ensuring pilot to operator communication and signals.
- Pre-flight checks, including a check of tow bridal connection, weak link.

3.3 Key Points to Consider During Tow Pilot Training

For Platform launch, pilot must be familiar with prone flying

First tows should be conducted in mild conditions using lower than normal line tensions. Tension should be gradually increased too normal.

Higher aspect/flat/high performance gliders can cause even very experienced pilots considerable yaw problems during initial tows.

Observers are STRONGLY recommended in all towing operations and are mandatory for all pilots under instruction. Where the observation of the tow is satisfactory by the winch driver/Instructor, such as reflex winch tow, this is considered satisfactory without an Observer.

Observers must be briefed of their function and responsibilities.

4 Sites

4.1 Launch and Landing Area Suitability

Landowner permission is always required (even if council or public land).

In selecting launch and landing areas, considerations might include orientation with the wind, windsock placement, advertising or cautionary signage, hazards, as well as access, including for emergency services.

Suitable sites might include airstrips, fields and long private roads running parallel to the wind. The surface must be flat and easily driven upon, free of potential snagging of the tow line in the launch area, and there must be a suitably open area for take-off.

Landing areas should be appropriately sized given consideration to pilot experience. Risk to the public should be considered. Ensuring separation between pilots landing and any pilots on tow is important.

4.2 Structural and Natural Hazards

IMPORTANT – Power Lines are a significant danger that must not be ignored.

IDENTIFY THE LOCATION OF ALL POWER LINES AROUND YOUR TOW STRIP AND NEVER TOW PROXIMATE TO POWER LINES.

Specific hazards include other traffic, fences, or stock and these must be taken into consideration.

Both vehicles and winches can become hot. Fire risk must be considered in dry areas and areas of long grass. Some risk can be mitigated through the availability of a fire extinguisher.

Trees and buildings must be given similar respect to that of Power Lines. Tree lines proximate to the tow paddock may cause a wind shadow – beware.

Tows from farmland require pilots, drivers, and operators to carefully consider any nearby farm animals.

Significant hazards must be incorporated into any daily pilot briefing.

4.3 Launch Site Authorisation

For all training an OPMF41 - Site Rating Form must be completed, check the OPM for further information on site authorisation.

4.4 Flying Near Aerodromes

A controlled aerodrome is surrounded by controlled airspace which requires clearance to fly within.

There is no minimum distance that hang gliders or paragliders must fly from an uncontrolled aerodrome. However, you must remain clear of the circuit traffic or comply with standard circuit procedures. Complying with circuit procedures is generally difficult on a hang glider or paraglider, and therefore should only occur following contact with the aerodrome operator.

To understand your ability to comply with the circuit procedures, you will first have to study the aerodrome traffic information in the Aeronautical Information Publication (AIP) – if you don't know local traffic rules, or how to do this, stay well clear!

Perhaps, one of the more understated risks associated with aerodromes, whether controlled or uncontrolled, is skydiving.

Airband radio is to be used whenever operating from or within the vicinity of an aerodrome. Use of an Airband radio includes maintaining a listening watch, and broadcasting activities at regular intervals. Refer to the Airband Radio section for further discussion on Airband radio use.

Notifying aerodrome (and nearby) operators of towing activity is encouraged. This can often be done collectively through airport user groups and increases the level of awareness should pilots fail to check for current NOTAMs (refer Notam's section).

4.4.1 Aerodrome Etiquette

Hang gliders can be limited in their ability to comply with general aerodrome etiquette compared to GA traffic due to the nature of our form of aviation. Before commencing tow operations other air users must be considered (especially when operating from an aerodrome). It is necessary to lay down some guidelines to introduce some degree of predictability to our movements both on the ground and in the airspace, this will also help with radio communications.

Ground Operations at Aerodromes

Certain areas on the tow strip must be designated as:

- Car park area - along the edge of the tow strip furthest away from the circuit pattern. Keep car's away from harm in case of a miscalculated approach.
- Rig-up area - away from the circuit pattern. Again, keep ground obstacles together to aid landing.
- Take-off area - pilots with gliders line up here when they are ready for launch. Makes it easy for the Launch Marshall to see who is next to go.
- Landing area - off to one side of the tow strip itself to enable launching to continue even if gliders are landing. Should be adjacent to and behind the take-off area and not require crossing of the tow line.

4.4.2 Ground Movements at Aerodromes

For all ground movements of people, cars, and gliders the following should be observed:

Do not cross the tow line. Towing may commence at any time.

Drive around the boundary of the tow strip. You may not always be able to see when an aircraft is landing or taking off, and this also reduces damage to the tow strip surface.

If you have landed up the strip from the take-off, carry the glider back to take-off away from the tow line so that it is free for the next pilot to launch.

4.4.3 Landing Circuits at Aerodromes

Hang glider circuit landing patterns will be inside the GA circuit (due to our slower speed) but we should still obey the circuit procedure designated by the airfield CFI or Duty Pilot (if there is one). Otherwise the Launch Marshall will specify the circuit direction for the day. This is to enable other aircraft approaching the airstrip to know what to expect from aircraft already within the circuit airspace. e.g. in which direction they are likely to be turning and what they may be about to do.

Do not cross the airstrip below a set minimum height (e.g. 1,500 ft). This leaves the airspace free for other towed craft.

Do not thermal over the tow path or active circuit pattern.

Be familiar with the relevant VNC when flying from aerodromes.

4.5 The Public

Everyone involved with towing needs to be mindful of the potential to endanger and upset the public. The consequence of dangerous or upsetting behaviour is not isolated to the pilot but worn by the entire community.

No operation should present danger to the public. Pilots and operators must conduct a risk assessment before commencing that includes possible risk to the public. Maintaining separation between tow operations and the public may help in reducing risk. Consideration should be given to how this can be achieved.

A pilot must not drop any object unless the pilot has taken reasonable precautions to ensure dropping the object does not endanger persons or property. The risk of dropping a tow line should be considered when selecting a tow location and making a flight plan.

4.6 NOTAMs

A NOTAM is a written notification available to pilots before a flight, advising them of circumstances relating to the state of flying. They are a way to promulgate urgent information about potential hazards to flight which may have missed the publishing deadline for inclusion as an AIP supplement. Towing will usually fall into this category of hazard.

NOTAMs, along with weather information, can be obtained via the IFIS Mobile app. You can also obtain NOTAMS, or request a NOTAM be issued, by logging in to www.ifis.airways.co.nz.

It is recommended that a NOTAM be issued whenever towing above 500 ft AGL or when operating from or near an aerodrome.

The only exception to the NOTAM recommendation (above) is when a towing operation is incorporated into the Visual navigation charts (VNC)

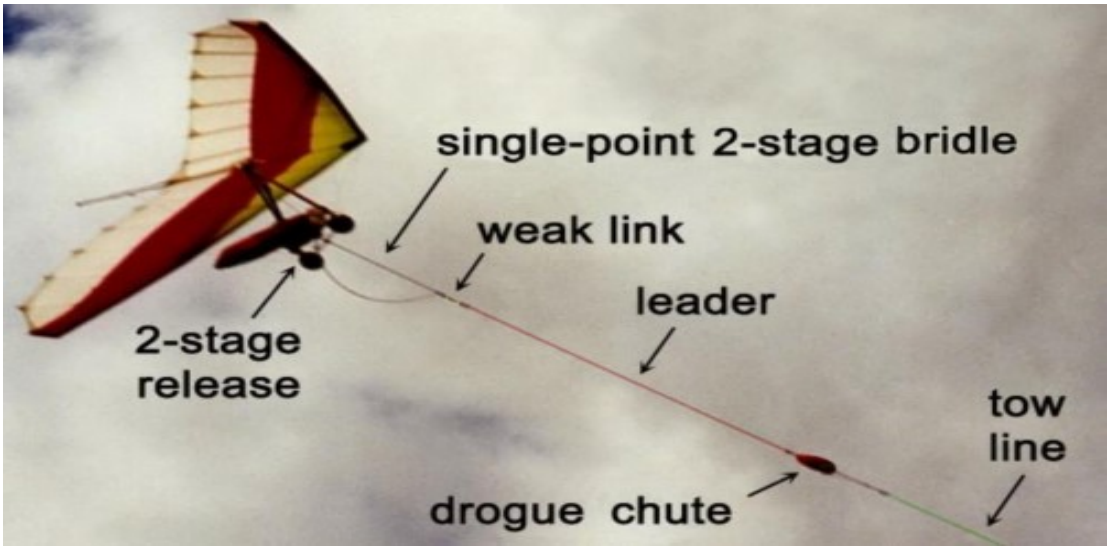
5 Equipment

5.1 General Description

The construction and maintenance of tow equipment is critical to the overall level of safety of any tow operation. Equipment failures in towing have caused serious accidents and injury.

Pilots should fly on and with equipment they are familiar with whenever possible. They should not attempt a prone tow unless fully experienced in prone flying. As platform launch towing requires a prone position from the start, extra training of novice pilots may be required to achieve a safe standard before attempting a platform launch.

NOTE: ONLY equipment intended for a particular application is to be used, (Do not mix equipment i.e. Aero-tow bridle for aero-tow only; Platform bridle for platform tow only.)



Tow equipment in use *- photo by Linda Bonebrake courtesy of HPAC*

Stationary tow, foot launched, two stage bridle. The pilot is about to release the upper bridle and continue with the lower bridle. Note that in this technique the pilot is now in a prone position with hands on the base bar.

5.2 Hang Gliders

Generally high performance gliders require more skill to tow successfully, but glider familiarity is often more valuable than glider characteristics. If a pilot isn't current or is lacking tow experience, some flights on a floater glider or similar can be valuable.

5.3 Wheels & Dollies

Wheels are strongly recommended for all pilots and mandatory in the Ab-initio training phase.

Dolly design and construction is a topic in itself. Their use facilitates flight in a greater range of conditions, particularly where wind is light, variable and even in tailwind conditions. They combine an adjustable glider support platform (as described in the ATOL section below), with castoring, bearing assisted pneumatic wheels. It is important that the dolly be controllable through weight shifting of the hang glider over the entire required speed range for safe glider launch.

5.4 Launch Platform (ATOL)

Base bar mounts (approx. 1.5m apart) support the glider when sitting on the vehicle. They should not allow the glider to bounce out or fall from the vehicle but MUST allow the glider to release from launch smoothly and fully when desired. A smooth tow strip will help avoid this problem. Glider angle of attack should be slightly positive (approximately 5° above horizontal) and held by rope and ring to a nose-platform release. The nose rope must attach to the keel and not interfere with glider front wire catch or attachments.

The nose release is activated by the pilot and must be infallible. The release must be close to the pilot's hand whilst in prone ready for lift-off. For initial training this should be releasable by the instructor as well. (The nose rope will need to be rated to a minimum of 300kg). An AIR SPEED INDICATOR must be mounted so that it is easily seen by BOTH driver and pilot. A launch airspeed must be predetermined (45-55 Kph).

The pilot must be experienced in prone flight in the glider to be used.

If being used, VG (Variable geometry control) lines must be tied clear of platform and supports.

5.5 Reserve Parachutes

It is important that the tow bridle does not interfere with a pilot’s reserve parachute, if carried, and that deployment is not impeded either on tow or after release.

5.6 Hook Knives

All pilots on tow must be equipped with an easily accessible hook knife.

5.7 Radios and Communication Equipment

5.7.1 Communication

Communication between the pilot and tow crew is extremely important. Satisfactory communication often occurs using radios, but there are times where radio use is difficult or unnecessary. Radios, cell phones, arm and leg signals, voice, and tow vehicle positioning can all contribute to effective communication.

The style and level of communication is likely to be linked to the experience of the pilot and tow crew, the physical environment, and the intended altitude of the tow.

Both the pilot and tow crew are to be briefed on communication methods. This includes preferred signals and/or terminology. Refer further to the Communication procedures section.

5.7.2 Radio Equipment

All radios must be tested before the towing begins. The transmit and receive range of all radios to be used must extend beyond the perimeter of the field.

A headset and finger mounted PTT switch for both pilot and driver is recommended.

Other options for transmission switches are:

- Bungee cord on harness shoulder strap-mounted radio. Grab the tail of the bungee cord and slide the knot onto the transmit button during tow, slide it off after release
- VOX. (Voice activated transmission). This is not recommended as the pilot never knows with certainty whether they are transmitting or not.
- Constant transmit switch. Next best alternative to finger PTT switch.
- Be sure to unclip your microphone (mike) after the tow and be wary of mikes being clipped on accidentally during set up / pre-flighting / ground handling.

Note: TOT “Time Out Timer” can be set to a predetermined amount of time if available in the Menu. This prevents a bungy or locked mic from transmitting past this time setting.

5.7.3 Airband Radio

An Airband radio is to be used whenever operating from or within the vicinity of an aerodrome. Use of an Airband radio includes maintaining a listening watch and broadcasting flight details at regular intervals.

A broadcast should be made prior to each launch on the appropriate area or aerodrome frequency.

The person responsible for Airband radio communications needs to be appropriately licensed/rated (refer to NZHGPA Aviation Radio Training Manual TM01).

5.8 Tow Bridle

Tow bridles should be thoroughly tested to ensure compatibility and reliability. A release mechanism may form part of the bridle. All releases MUST release at any angle, and at any load. They are a critical component of the tow system and compromises must be avoided. All releases must be infallible and must only release upon pilot activation or when glider and tow line are dangerously out of alignment. Releases, their suitability, advantages, and disadvantages are discussed in Attachment points.

Some tow bridles are certified. Use of such bridles will provide a degree of confidence that they are fit-for-purpose, provided they are used correctly.

A tow bridle incorporating heavy components should not be used if it risks hitting the pilot in the event of a line or weak link break. The bridle is usually made with pre-stretched or zero stretch cord with minimal hard components.

It is important that once released from the tow that the tow bridle is positioned safely away from the pilot’s reserve handle and is unlikely to interfere with reserve deployment.

Different bridle set-ups are usually employed for the different forms of towing. Equipment is only to be used for its intended application. Do not mix equipment i.e. Aero-tow bridle… aero-tow only; Platform bridle... platform tow only.

5.8.1 Hewett Bridle 2 to 1

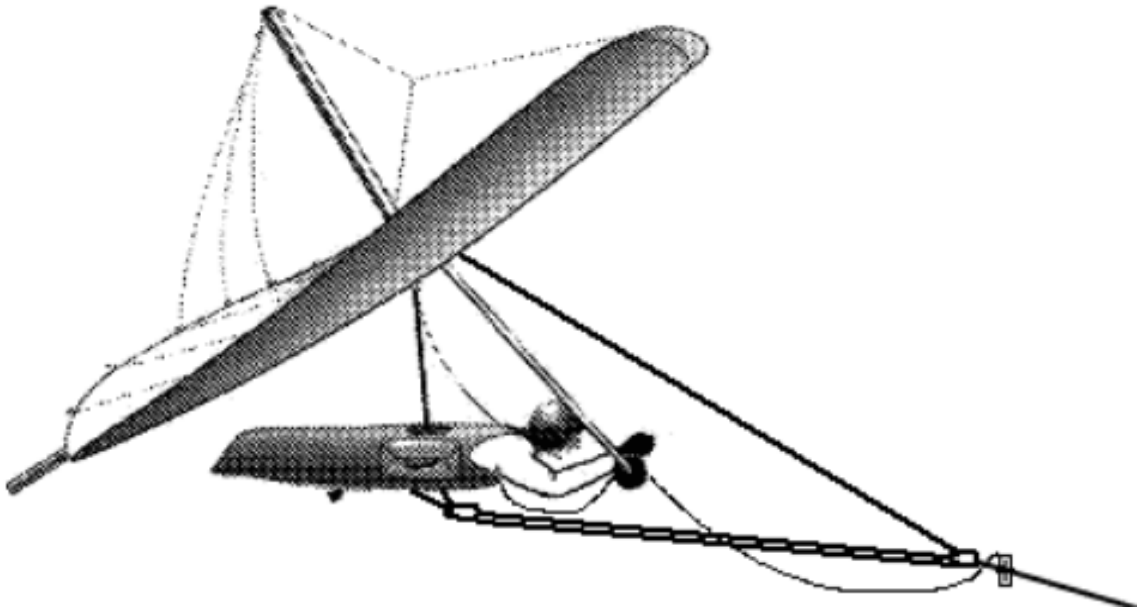
You will require at least 10 metres of non-stretch or pre-stretched) rope. 4mm Spectra/Dyneema is ideal because it is quite stiff and won't tangle as easily as others but Spectra-line or similar will do. 2m of 2 or 3mm cord should be used for a release line.

Two seamless metal rings (best is stainless steel). Or better still, two small pulley blocks.

A release. Recently designed and commercially available releases are recommended.

Note – while a 2 to 1 bridle can be used successfully, experience has shown a 1 to 1 bridle still achieves a reasonable center of mass distribution of forces and is much less likely to cause pilot induced oscillation or PIO.

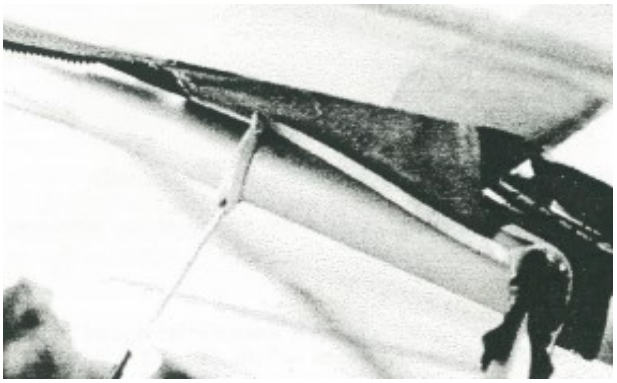
Note – If a 1 to 1 bridle is used, the release can potentially be positioned at the keel or at the harness. Be aware that if using a release at the harness end, it makes the carrying of a hook knife almost irrelevant because it will be impossible to reach the line to the keel in the case of a failure to release fully. This will lead to a potentially dangerous situation and is therefore not recommended.



Hewett Bridle
reproduced here with the permission of the HPAC

**Note: two lines are attached to the harness and go under the base bar. One line is attached to the keel and goes through the A-frame. The release line is attached to the centre of the base bar.*

5.8.2 Attachment Points



Keel attachment

The line should be securely fastened round the top of the A-frame or king-post and run along the keel to connect to the bridle approximately one hand width (15-20cm) forward of the hang point. This point can vary from glider to glider, so some experimentation is required.

Alternate harness attachment to leg straps

If no tow loops are sewn on the harness, then the bridle may be attached to the leg loops close to the harness.

Harness attachment for string chest release

Most harnesses have professionally sewn tow loops at the shoulder straps and the hips. and glider/bridle attachment points should be positioned as indicated.

Harness attachment two-stage chest release.

If no tow loops are sewn on the harness at the shoulder the release may be tied directly round the shoulder straps.

- "Moyes type" bike brake handle type release on DT (usually releases the attachment point at the keel)
- Barrel release,
- Three ring or 3 string circus release.

NOTE: Releases that are mounted at the harness end of the bridle are not recommended. While simple and mostly effective, if there were to be a failed release it may leave the towline attached to the keel, out of reach of any hook knife.

5.8.3 Pilot End Tow Bridle Release Examples

Get Off Release

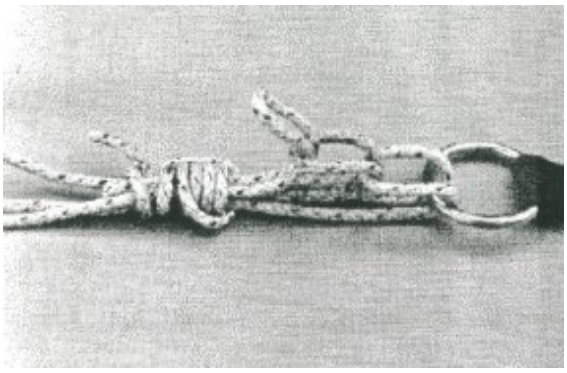
Get off release, Instinct Air Sport's. Cable operated, with a short cord that can be held in the hand. A small disc on the end of the cord prevents it slipping through the fingers. It allows the pilot to release positively in almost any situation without having to find the release. Designed to mount at the keel.
http://getoffrelease.com/

Three Ring Circus releases.

There are several variations on this design. It is preferable that round rings be used (not D-rings).

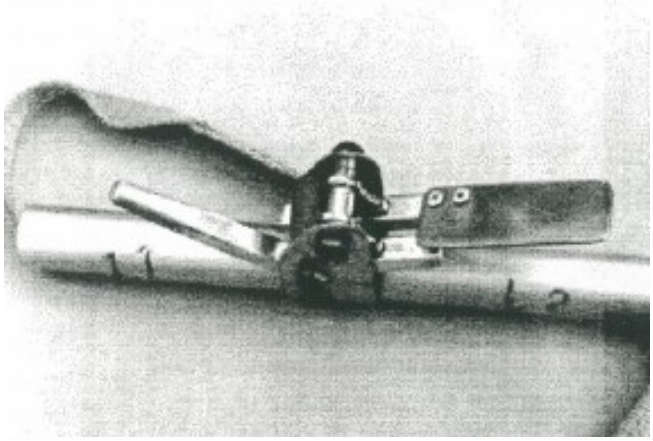
In line spinnaker snap shackle

* Be advised that this version of release does not actuate under light or no tension and therefore is not to be used unless as part of an approved system that overcomes these constraints e.g. The Bailey/Moyes Brake Lever Tow Release.



Three string release

This is an example only of how they look as no real string releases were available. The diameter of the string used is critical for safe operation.



Two stage chest release.

These are commonly used in Britain and Europe.

Shoulder Attached Barrel Release Example

Bailey/Moyes Brake Lever Tow Release

NOTE: **<u>Not recommended</u> is** any design of single ring release or horse panic snap release.

5.9 Weak Link

The use of a weak link in the tow line is mandatory in all tow systems.

It is essential to note however, that a weak link may not prevent 'Locking Out', where divergence and banking away from the direction of tow, may result in the glider 'down planing'.

The purpose of a weak link is to provide a maximum limit to the possible tow line tension that can be exerted on the glider. It prevents overloading of all tow elements including the pilot and is designed to break before forces on the glider become excessive.

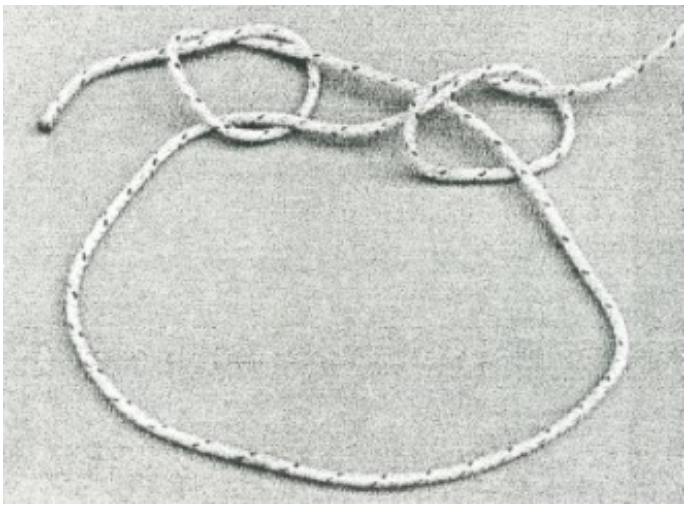
Weak links should be made from material that consistently breaks at a predictable load. They must be infallible. The strength of a weak link needs to be known by the tow pilot and the operator.

A weak link may be weakened by repeated use. Regular inspection and/or replacement is recommended to reduce the likelihood of an accidental break. An accidental weak link break in the early stages of a tow can be dangerous.

Weak link strength needs to be carefully considered by both the pilot and tow operator. A weak link must be installed between the point of attachment of the towline to the glider with

A) Not less than 100 percent of the AUW of the pilot and his equipment, and
B) Must be the weakest link in the tow system e.g. not stronger than the tow line or equipment being used.

No matter what you use it must be tested to break consistently at a predictable load, and its strength needs to be appropriate for the pilot, glider and the tow system being used.



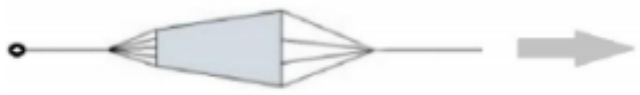
Recommended knot for weak link string

Note: knotting reduces line strength. This must be taken into consideration when testing and choosing a weak link line.

5.10 Drogue Chute

A drogue chute is intended to control how the tow line falls once the pilot has released. It is usually brightly coloured to be obvious to other air traffic.

It must collapse while under tow and inflate on pilot release. One danger is of the drogue spinning and wrapping up the bridle.



Tow Line Drogue

If a drogue chute is used on a winch line, it must not be capable of tangling around glider, bridle or release mechanisms.

5.11 Tow Line

The best line to use with most towing systems (except Static Line towing) is one with very little stretch (though some "give" can be required), small diameter for low wind resistance, light weight, high wear resistance, low abrasion, high ultraviolet resistance, and braided.

Spectra or Dyneema is preferred, breaking strength of the line must be known.

Mon plait or plaited rope should be used. Do not use twisted rope because of its tendency to twist.

Steel cable with a stretchy leader has been used but is not recommended.

Any join in a tow line should be done by splicing rather than knotting the line. Knots can create an increased risk of the tow line getting caught as it is released or rewound. They also weaken the line.

5.11.1 Static Towline

Static line tow systems require a rope of adequate strength for the intended purpose.

Using a line length one third the length of the available tow strip is standard practice for static tow systems.

Too much stretch tends to make it difficult for the driver to keep a steady pressure on the towline.

5.11.2 Pay out towline

In the case of a pay-out winch operation, the line can be marked in a way to inform the tow operator that they are at the end of the tow line. For example, the last 200m of line could be a different colour.

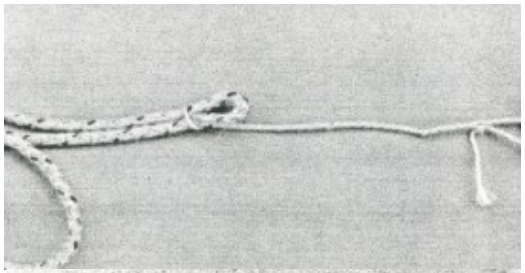
The only way a towline should be tied off to a pay-out winch is via a weak link, otherwise it should not be attached.

5.12 Attachment Ring

ALWAYS USE A STEEL RING AT BRIDLE RELEASE END OF THE TOW LINE.

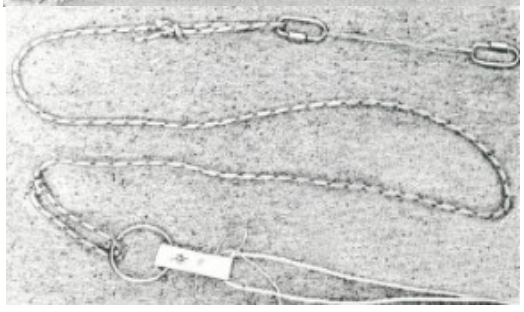
Depending on the release type used, a suitably sized ring must be attached at each end of the tow rope, for connection to the release and tow gauge. The size is vital for Three-Ring releases, where the tow rope ring must be large enough for the release to function correctly. The smaller the size of ring able to be used, the less the drag when the tow rope is dragged back through the grass to the start position.

Rings must always be used when connecting the release to the tow rope, never connect the tow rope directly to the release, or weak link to the release. This is because the smaller diameter of the weak link cord makes it possible to twist to the point where it could bind with the release and prevent separation from the tow rope. String releases are particularly vulnerable to this problem.



Non release failure

All tow lines seem to twist, even wire rope. This is what can happen if rings are not used at the release end.



Rope and leader set up.

Quick links at the weak link simplify changing the weak link.

5.13 Rope Swivels

If twisted or laid synthetic rope is used, then swivels incorporated in the tow rope length alleviate problems with excessive stored rope twist after repeated use. Twists in the rope cause wear and make it susceptible to breakages. If using a swivel, it must be tested to be strong enough or rated appropriately.

5.14 Guillotine

All winch operations are required to have an infallible method of cutting the tow line where the line leaves the winch. This usually means a mechanical guillotine forming part of the winch.

The system used must be immediately accessible to the winch operator and within arm's reach. The winch operator must be able to cut the line without the need to stop the boat or vehicle as this delay may prove too significant.

The system must work reliably irrespective of whether the line is under tension or not.

The presence of hook knives can be used as backup but are not acceptable as an alternative to a guillotine.

5.15 Tow Systems

All tow systems (except certain low power scooter-tows, see section on Pay-in Winch) must have a reliable tensiometer to accurately determine line tension. Good communication from the pilot is recommended and tension applied according to input from the meter and the pilot. Observers must also be able to give input during the tow.

It is important that a winch system has a high-speed rewind. The presence of other aircraft is not uncommon (i.e. planes, helicopters or other paragliders or hang gliders) and they may not be aware of the tow line. The tow should be terminated and the line rewound if another aircraft gets too close. In some cases, the rewind speed needs to be high to ensure the line is retrieved before it touches down.

5.15.1 Pay-out Winch

This system basically comprises a braking system and a drum of tow line mounted on a trailer or the back of a vehicle. The pilot begins close to the winch during launch. The line is paid-out as the vehicle or boat moves forward and the hang glider climbs.

This system uses the brake system to regulate the towing tension, and therefore rate of climb. Once the load rises above the set limit, the drum pays out. This is a good safety feature.

Alternatively, the glider and pilot lift off the back of the moving vehicle. This is known as a platform launch or ATOL. Wind direction is less important than with some other systems.

Having the pilot close to the winch is beneficial as the winch operator can observe the pilot during launch. The winch operator remains close so can help in the event of an aborted launch.

5.15.2 Pay-in Winch

The winch itself is stationary. The line is pulled in as the hang glider climbs. The pilot and winch operator may be a long way apart (1,000m or more) at the crucial take off phase. However, with good communications and a suitable site, pay-in winches are perfectly serviceable.

Pay-in winches are often mounted on trailers and are fitted with one or two drums containing the tow line. Most have a brake system as well as a clutch system for smooth take-off. Some systems use automatic transmissions, while others rely on a hydraulic system.

Scooter towing is a variation to the traditional pay-in winch. Where the scooter is of sufficiently low power (50cc), the need for a tension meter may be removed. This must follow testing to ensure it is impossible for the winch to exert an unacceptably high tension under any circumstances.

NOTE: Pay-in winches must have the ability to drop all tension and pay-out if necessary.

Scooter Winch

5.15.3 Static Tow Line

A static tow line system consists of a fixed length of rope [usually polypropylene] attached via a tension meter and a release system to the vehicle. The rope is laid out, then attached to the pilot's harness via a weak link, pilot operated release and bridle. An appropriate tow bridle must be attached between the pilot and tow rope.

Preferable strip length 800m+. Line length approximately one third strip length.

The ideal vehicle is light, 4WD and automatic.

Towing by quad or ute etc where the towline is held by hand satisfies both release and tension meter requirements.

Static line tow systems are required to have an infallible method of releasing the tow line where the line attaches to the vehicle. This usually means a mechanical sailplane type release that can be triggered from the driver position or the observer position.

NOTE: It is important to have an observer to alert the driver/operator to any possible issue with the tow in progress. Radios or a tension meter should not be relied upon to give immediate alert status that there is a safety critical event happening.

5.15.4 Reflex Systems

The main advantage of a reflex winch system is that it allows the winch operator and instructor to supervise towing pilots from directly behind. This allows the winch operator an uninterrupted view of the pre-flight, tension on, and launch phases. as well as being able to view the glider going up the line in front of them.

Reflex Static Line

Pulley at the upwind end of the paddock with the car pulling downwind towards the glider.

Reflex Pay-In Winch

This is the same as the reflex static line system, with the exception that the winch is stationed adjacent to the launch site. This allows good observation of the glider launch by the winch operator.

5.15.5 Aero Tow

The hang glider is towed up behind a trike or microlight. Aerotowing is beyond the scope of this manual. Refer to the NZHGPA's Aerotow Manual for further information:

5.16 Pulleys

One or more pulleys can be used when static line or pay-in towing. The use of a pulley can allow the tow operator to be closer to the pilot enabling closer observation during the critical launching phase.

The pulley needs to be adequately secured to the ground to withstand force in a variety of directions in case the pilot deviates off-line. The pulley must function reliably and minimise friction.

Any pulley used for reflex towing must mitigate risk of the tow line jamming and be suitable for its purpose. The thickness of the tow line versus the size of the pulley must be compatible to avoid any potential of jamming in the pulley.

Caution should be given to tensiometer readings given the friction associated with the pulley and the line running over the ground. Increasing the distance between the winch and the pulley will increase the friction present.

It can be possible for a pilot to lock out by flying beyond the pulley. Procedures should be in place to minimise this risk, which the pilot and winch operator needs to be aware of and mitigate.

Be aware of the limitations of the guillotine when using a pulley. While the line may be freed from the winch or car, it is still secured to a degree to the pulley.
A very dangerous situation arises when a release failure happens over the pulley and there is minimal height to work with.

NOTE: The complexities associated with pulleys should not be combined with step towing.

5.17 Tension Gauge

The use of a reliable and accurate tension gauge is mandatory unless the system is accurately limited. This is so that the driver or winch operator can control the tow force on the glider being towed and provide a more constant tension on the line.

The driver can compensate for variations in tow pressure caused by wind gradient, thermic or turbulent conditions, or to tailor the tow to the pilot's ability and weight.

5.17.1 Gauge Types

Tension devices may be electronic, hydraulic or mechanical gauges that are mounted either in-line with the tow rope (as with static tow lines) or as part of the reel and brake control mechanism.

Static car tow systems use a separate tension gauge (mounted on the driver's dashboard) which does not directly control the tension. The driver varies the speed of the vehicle to control the tension.

Pay-out and pull-in winches have the tension gauge built into the mechanism and the tension is automatically regulated. This type of system usually also requires a governor to dampen the on-off effect on the line.

Platform launch systems may have the tension regulation built into the reel or a manual brake on the reel operated by an observer.

5.18 Streamers or Windsocks

Streamers or windsocks should be placed appropriately to provide the pilot and tow crew with a clear understanding of the wind strength and direction. This is most important during the launch phase to minimise the impact of cross wind.

It can be beneficial to place wind indicators at both ends of a runway.

5.19 Airspeed Indicator

Required to platform launch but useful for all operations to assess conditions when operating.

5.20 First Aid Kit

A first aid kit should be available during all tow operations this makes up only part of your emergency response plan (ERP).

6 Towing Procedures, Principles and Requirements

6.1 Principles for Safe Towing

All forms of towing require:

- **Airmanship** – safe procedures through all operations must be adhered to. This diminishes ambiguity and delegates responsibilities.
- **Knowledge** – the transition from hill/foot launch to tow launching involves quite different methods. For the first time tow pilot, information gathering is important; not only for knowledge learnt, but also questions raised.
- **Experience** – Beginners are advised to glean as much knowledge as possible from a variety of experienced tow instructors and pilots, especially by watching and helping.

The following, known as **Skyting Criteria**, are essential for safe and efficient towing:

Constant Direction	Direction of the tow force must remain constant relative to the glider throughout every phase of the towed flight (i.e. staying on-line).
Constant Tension	The tension of the tow line should remain essentially constant throughout every phase of the towed flight.
Reliable Tensiometer	The system must have a reliable sensor to accurately determine line tension.
Centre-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.
Gradual Transitions	The graduation to, and from the tow, as well as any variations while on tow, must be of a gradual nature.
Reliable Releases	The release devices must be sturdy, rapid, and reliable.
Weak Link	The system must include a weak link, which will infallibly and automatically release the glider from tow, whenever the tow line tension exceeds safe operating limits.
Safe Learning Method	The system must include a safe method for learning and gradually advance the student from one level of experience to the next.
Adequate Power	The system must have a source of power adequate to maintain a safe mode of flight whilst under tow.
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.
Reliable Communication	The system must provide a means of reliable communication between the winch operator and pilot, using signals and/or radios.
Suitable Environment	The system must be operated only within an appropriate environment and under conditions conducive to safe operations.

6.2 Minimum Pre-flight Checklist

Tow launching is a team activity. All crew members should be familiar with their own and other crew members responsibilities, as defined by the tow supervisor.

1) Flight plan briefing.
2) Safety equipment.
3) Hang glider rigging and management.
4) Significant Hazards
5) Crew briefing (tension, flight plan).
6) Weak link check.
7) Release mechanism correctly assembled.
8) Tow bridle attached correctly.
9) Tow line drogue chute attached (if part of the system)
10) Radio check.
11) Vehicle positioned for take-off.
12) Check for traffic.
13) Airband radio call.
14) Wind speed and direction acceptable to the pilot.
15) Pilot signals to tow vehicle “commence tow”.

6.3 Communication Procedures

The pilot, winch operator, and all assistants need to be familiar with the radio communication and/or signals to be used.

When required or preferred that Airband radio transmission is also used, this should follow the protocols as described in the Aviation Radio Technical Manual (TM 01) located in the NZHGPA Manuals section. Radio procedures listed below are for communications on frequencies and equipment authorised for civilian use.

6.3.1 Radio Procedures

Common communications used are:

- All Out, All Out, All Out.
- Stop, Stop, Stop.
- Weak link break.
- Release failure.
- End of tow.

Accuracy, brevity, and speed. Speak clearly. The word “no” should never be used. It can easily be misconstrued as ‘go’. “Negative” can be used as an alternative to “no” and “affirmative” for “yes”.

Be careful to avoid transmitting over the top of a tow in progress. Do not chat unnecessarily on the radio. A blocked frequency means that towing operations may need to cease. If you cannot raise anyone on the radio, there is a good chance you may be “locked on”.

It can be helpful to identify your driver by name or call sign prior to each command when towing in the vicinity of the other tow groups. Ensure a different frequency is used (to avoid confusion) if you are about to start a tow and a near-by team is also towing.

It is a good idea to prearrange an alternate frequency everyone can use if the primary frequency is blocked. In any instance of confusion or the driver not understanding a command then the driver MUST NOT PROCEED with tow.

Try to use positive commands like ‘take up tension’ as opposed to ‘take up slack’. Then if only some of the words are heard clearly it is obvious what is wanted, in this case tension.

NOTE: The driver should only react to critical commands that are heard clearly. For the driver to hear the “all out” command twice the pilot should repeat it 3 times because so often the first command is said at the same time as the transmit button is pushed and therefore is lost.

It is important to consider radio output power. The most powerful radios should be used by senior members of the tow crew, operating in the most critical roles. This increases the likelihood of critical messages being able to be transmitted over other (less important) radio transmissions.

NOTE: Radios must conform to AS/NZ standards

6.3.2 Visual Signals and radio calls

Visual signals depend greatly on the tow system used (i.e. pay-in/pay-out). Each operation must establish signals that all tow pilots and crew on the day are familiar with.

Signals must be incorporated into tow pilot and crew briefings.

Radios must be used when towing whenever the tow vehicle is at a distance, or out of sight of the pilot. As a back-up, members of the tow crew and towed pilot must know the visual commands applicable to towing. Many can be used when training and will be critical in the event of radio communications failure.

Use of a large bright coloured bat or flag enables the signal to be seen from as far away as the length of the tow line. A fluorescent colour is recommended.

The following are examples of signals and radio calls:

Signals from observer at the pilot end

Take up tension	Swing the flag from 3 o’clock through 6 to 9 o’clock and back repeatedly, big arc with straight arm in front of knees.
All out, all out, all out	Swing the flag from 3 o’clock through 12 to 9 o’clock and back repeatedly, big arc with straight arm overhead.
Stop, stop, stop	Hold the flag steady at 12 o’clock, straight arm overhead.

Signals from pilot on tow

Faster, faster, faster	Running motions with legs
Slower, slower, slower	Hold legs apart
Stop, stop, stop:	Move legs apart and together laterally repeatedly

Radio command calls

Driver	“Tow car [or winch] ready”	When line is laid and ready for next tow
Pilot	“Standby”	If pilot is not yet ready, reply with standby
Pilot	“Pilot ready, take up tension”	Driver “Taking up tension” acknowledging the command was heard
Driver	“Taking up tension”	Acknowledging the command was heard
Pilot	“All out, all out, all out”	To start tow
Launch Marshal AIRBAND RADIO CALL	“Hang Glider Launching, (Runway), (Tow Altitude)”	[Mandatory] if operating on an airfield with other GA users, transmit on local Airband frequency

Optional Command Calls

Pilot	“Take up tension”	
Driver	“Are You Hooked In?”	Confirmation the pilot is hooked in before tow
Pilot	“Affirmative, Hooked In”	Confirmation the pilot is hooked in
Pilot	“All Clear Above and Behind”	A command to observer / signaller or other pilots who are close enough to check. Sailplane pilots use this command and expect other glider pilots to also do so.
Driver	“Tension On, back to zero”	This is said after applying 20kg of tension, then releasing back to zero.
Pilot	Clipping on mike, wind strength and direction is…	The pilot will now clip on microphone, then advise All out, all out, all out

During Tow (If needed)

Pilot	Faster Faster Faster	Car to increase speed.
Pilot	All Good, All Good, All Good	Confirms comms, allays any driver concerns
Pilot	Slower Slower Slower	Car to reduce speed.

At Release

Pilot	Releasing Releasing Releasing	Car to slow down to reduce tension on the line.

After Release

Pilot	"Thank You Driver"	This is to remind the pilot to unclip the microphone after release.

In Emergency

Pilot	Stop stop stop/cut line.....	Lockout, equipment malfunction, any problem.

6.4 Wind Conditions

Pilots should only consider tow launching in conditions they are comfortable with and proficient at handling their glider in.

6.4.1 Wind Conditions

Light winds: 0-15 kph (0-8 knots) recommended inexperienced pilot wind range. Strong or gusty/thermic conditions: 15+ Kph (8+ knots) experienced pilots only.

6.4.2 Changes in Wind Strength and Direction

Be observant of changes in wind strength and direction as a pilot gains altitude. The low-level winds can be different to the upper level wind.

A change in wind can lead to difficulties remaining online and inefficient tows. The vehicle may need to increase or decrease its speed when pay-out towing. There may be an observed change in the rewind rate when pay-in towing.

6.5 General Operations

6.5.1 Launching

The towing procedures for the static tow line and pay out/pull-in winch systems are identical for foot launch operations. The use of vehicle/platform launch systems requires special considerations. Please refer to 7.7.

Prior to being attached to the tow it is essential that you have been checked ready to launch. Checks include:

- Glider pre-flight check AND harness pre-flight check.
- Pre-tow check i.e. hang check, radio check, release check [physically do a test release].

Note: It is preferable not to have instruments on the base bar as they can interfere with the bridle lines.

When car towing, do not attach the pilot to the tow line when the car is returning to the car-end of the line in case the car fouls the line on the way.

When attaching to the tow line, test the release, check ropes for knots and tangles and make sure the harness is clipped into the glider. It is preferable to leave your harness clipped into the glider all the time.

All launches are to be treated in the same manner as if you were launching from a hill. Go only if you are satisfied ALL is right - equipment, glider, and conditions. Fortunately towing gives a greater tolerance to cross wind and tailwind launches. Remember that you are the pilot in command, and it is your decision only, to go or not! If you are not satisfied with any aspect, e.g. if the conditions are not favourable to you, let somebody else have a go if they think they can handle it and are ready to launch.

Remember, you are being towed, so the take-off run need not be so aggressive. The tow will pull you and the glider, so you are primarily concerned with maintaining wings level.

During launch you should offer a slight amount of resistance to the tow at the beginning. i.e. hold back briefly as the tension increases. Launch into the wind, but wait for good wind direction, strength, and smoothness before initiating the launch. (i.e. down tow strip).

Once off the ground, most systems require the pilot to remain in the upright position (not prone). Maintain a stable body position allowing the bridle to set the rate of climb. Cross ankles to affect better weight shift authority.

6.5.2 Strong Wind Launch

Like normal launch procedure until the pilot requests for line tension.

Once the standard line tension 15-20 kgs (then back to zero) is supplied by vehicle, the pilot then is ready to launch. A slightly neutral angle of attack may be required to stop the glider from wanting to fly up against the line tension.

When the glider is stable to the pilot’s satisfaction, the pilot then informs the vehicle to “ALL OUT, ALL OUT, ALL OUT.

Due regard must be given the headwind component. The vehicle should move off slowly increasing the tension smoothly.

In these conditions cross winds are to be treated with extreme caution.

6.5.3 Cross Wind Launch

The most crucial phase of towing is the first 100 ft above take off. Launching should be aligned into wind, as much as possible, to minimise lockout risk. Wind direction becomes less critical once 100 ft ATO has been achieved. The stronger the wind, the more into wind the take-off should be.

Moderate and strong crossed wind launches should only be attempted by experienced tow pilots.

In crosswind conditions it is important to remember that obstacles such as powerlines or fences etc may exist on the down-wind side of the tow strip.

6.5.4 Under Tow

Under tow, it's common practice to remain with your hands on the uprights allowing the glider to trim. The correctly set up tow bridle will make the glider adopt the correct attitude. Maintain the heading on the towline – do not drift off to either side. The correct airspeed in smooth conditions is approximately trim or slightly faster. Rough air may require a little more airspeed.

With sufficient altitude after launch, and when pointing correctly (towards the winch or tow vehicle) you should fly with a light grip, allowing the glider to fly at trim.

When not pointing correctly, or when turned away from the winch/tow vehicle it is essential to roll the glider by moving your body in the direction of tow, simultaneously pulling weight forwards and through the control frame. Having weight forward and glider corrected back on course prevents a lock out from occurring. Failure to take this action immediately could lead to a lockout scenario!

There are reasons why it is advisable to keep your hands on the uprights.

- If you have a weak link or line break near the ground, then your body and hand positions are ready for immediate response and flare.
- If you get gusted or turned away from the tow line you must steer back on line, however the centre of mass bridle system does provide some tracking assistance so apply the roll correction steadily. This will require a little more effort than normal due to the higher angle of attack related to the towing forces. It is important not to over control or to pull in dramatically whilst attempting to get back on line. This will either initiate yaw oscillations in the case of over control or will create line slack as the glider stops climbing and flies forward. The resulting loss of Line tension often causes the driver to respond by accelerating to increase tow tension.
- The more upright position keeps your head out of the way of the rope at the top of the tow.

Concentrate on directional control and airspeed at low altitude. Once sufficient height has been gained, if there is a cross wind some directional input may be required to be able to drop the tow line onto the strip after releasing. The pilot should ‘crab’ upwind to allow for wind drift of the line.

The tow should only require “fingertip” flying. Keep most responses minimal. Assist with control but keep input to a minimum unless necessary. Many control problems are pilot induced, so relax and keep the glider tracking straight ahead.

If the glider is yawing significantly, it is usually because the pilot is over correcting or holding in too much. Ask the driver to “slow down”.

To dampen out oscillations, request a lighter tow pressure, remain central in the frame, keep input to a minimum and allow the glider to fly at trim, do not pull in on the bar. Wait for the oscillations to stop. If they continue a slight amount of push out may be needed. Once stable, ask your driver to resume normal tow.

If the situation continues or worsens, end the tow by releasing.

Remember, it is your tow. If at any time you are not satisfied with the way the tow is going, stop the tow and release, It must be the pilots decision to launch.

Towing in Prone: ONLY if you have experience in prone should you, after establishing a stable climb, move one hand at a time to the base bar and without pitch, roll or yaw input bring your legs up into the harness and adopt the prone position. Do not close the harness.

6.5.5 Releasing

Once the pilot has sufficient altitude or the vehicle has reached the end of the tow strip, the pilot may tell the driver "RELEASING, RELEASING, RELEASING".

Once the tow rope starts to go slack, the pilot should then release. This is done to eliminate the problem of "pitch up" associated with release under load. The best procedure is to reduce angle of attack slightly to provide some line slack.

Releasing in a Thermal. It is quite safe to release while climbing with tension-on and entering a thermal but be aware of pitching up and the resultant risk of stall.

After releasing, informing the driver of your release and saying "thank you" will hopefully remind you to unclip the mike!

6.5.6 Off-Line Towing

Being off-line is inefficient with reduced height gain. It is usually apparent to the winch operator that the pilot is not fully on-line, but this becomes increasingly difficult to determine when the pilot is at high altitude or a long way away.

Being off-line is the first stage in the development of increased lock out risk (refer Lockout Section).

It needs to go no further than being off-line, however, the winch operator should reduce the tension if the pilot fails to make corrective action. The vehicle or boat can reduce speed (remember, slack should be avoided). The tow crew may be able to signal to the pilot which way to turn.

By reducing tension, it makes it easier for the pilot to come on-line. Normal tension can resume once the pilot is back on-line.

6.6 Pay-out Winching

6.6.1 General

A Pay-out winch is defined as a winch which is mounted on a vehicle, it must then have the ability to deliver a constant tension to the pilot being towed whilst paying out line.

A streamer can be installed above the highest point of the vehicle to indicate the relative wind direction.

The winch must be securely fitted. Manufacturer's recommendations should be followed, where applicable.

6.6.2 Platform Launch

The pilot is hooked in and lying prone with the glider mounted on the launch platform (back of a truck or trailer).

Both releases (nose and towline release) must be tested and proved to be working properly. When all is ready the pilot commands, “ALL OUT, ALL OUT, ALL OUT”.

The truck accelerates smoothly and at about 40 kph airspeed the pilot pulls the nose release. Just prior to launch the pilot should adopt a bar-body position of best L/D. The glider and pilot should FLY from the vehicle, not rocket out like a jump jet. Actual release should occur at around 40 kph or just above normal trim for the glider being used. The truck continues to accelerate up to 55 kph airspeed whilst the glider climbs out.

In-flight procedures are the same as for static line and winch towing.

If no automatic tension regulation is used, an operator/observer must control the winch brake. The winch operator must, and the pilot should, carry a hook knife. Tension is critical for the first 150 ft of altitude.

6.6.3 Vehicle Towing

The ideal vehicle would be 4WD, compact and automatic.

The vehicle should be equipped with:

- Communication Equipment. A good vehicle mounted aerial is preferable.
- First aid kit.

6.6.4 Leader Length

The length of line paid out prior to beginning a tow is an important consideration. The greater the distance between a pilot and the winch, the slower the glider will deviate off-line if the pilot manages their heading poorly. Consideration should be given to cross wind and pilot experience.

6.6.5 Step Towing

Step towing offers the greatest altitude on tow. It entails that after each into wind tow of the glider, the pilot turns downwind and runs as far as safely possible before turning back 'into wind' and commencing another into wind tow. This can be continued until optimum height is achieved, or other constraints of line/tow field length arise. It requires specific equipment, and an experienced team. While New Zealand doesn't ban the procedure, it is not recommended unless suitable tow teaching and learning programmes, equipment, experience or instruction are available.

6.6.6 Rewind

It is essential to have a smooth rewind and slack must not be allowed at any time. Slack can cause knots, line jams (and weak link failures) and subsequent tows may be erratic.

6.7 Pay-in Winching

6.7.1 General

A Pay-in winch is defined as a winch which remains stationary whilst rewinding the tow line back to itself, whilst delivering a constant measurable tension to the pilot being towed.

Pay-in winches used for towing PG and HG are either professionally manufactured for purpose or be custom built (it has been common for them to be made by modifying a scooter).

All pay-in winches must have the ability to pay-out if it became necessary to avoid a lockout situation if a pilot was to lose direction and fly away from the winch, especially in wind.

6.7.2 Reflex Towing with a pay-in winch

A pulley can be used when pay-in towing. Please refer to the section on pulleys under the Equipment section of this manual.

NOTE: The complexities associated with pulleys must not be combined with step towing.

6.8 Information for Pilots

6.8.1 Launching

The pilot has checked the glider and performed a harness hang check. Connect the tow release and tow rope to the harness or bridle attachment without exiting the harness or unclipping from the glider. It's usual to have a helper to do this.

After a pre-flight release check, the pilot will contact the driver identifying both driver and pilot clearly and may inform the driver of the conditions at the take-off area. Once clear communication with the driver is established and the pilot is ready, they inform the driver to "Take up tension". This is done to take up the slack and elasticity out of the poly rope. This tension is usually about 15-20 kgs. Ideally, the driver will then release tension back towards zero. If there is too little/ much tension inform the driver or step back/ forward to achieve suitable tension to commence tow.

The driver will then radio that they have taken up tension and released to zero. If the pilot did not get tension, then there may be a snag or more likely a breakdown in communication. Once tension has

been applied, The pilot will respond that they have had tension and are clipping on their mike. The Launch Marshall can check that the pilot is on constant transmit. [optional]

When ready the pilot will pick up the glider, telling the driver of this action. This prepares the driver for launch and indicates that the vehicle/winch should be in gear or ready to go. If conditions change and you put the glider down, again, tell the driver.

When satisfied with conditions the pilot will pick up the glider, advise this to the driver, then start the tow with the command "All out, all out, all out". The driver will respond immediately.

If nothing happens within 10 seconds call "STOP, STOP, STOP' and release from the line. There is most likely a communication system failure, but other problems may have occurred, and it is safer to get off the line.

At the start of the tow the pilot shuffles forward, allowing the line to tow them off the ground. The pilot must not run towards the line as this will decrease the line tension. The glider should remain wings level, and very slight pitch-in applied to maintain airspeed and control.

NOTE: YOU MUST LET THE LINE TOW YOU OFF THE GROUND.

6.8.2 During Tow

After take-off, and for the first 100 ft fly slightly faster (best L/D). This extra speed allows the pilot to recover if there is a weak link or line break close to the ground. Do not pull in too much as this may lower line tension. Cross legs at the ankles for better Roll Authority

6.8.3 Release

Once the pilot has sufficient altitude or the car has reached the end of the tow strip, the pilot may tell the driver to, "stop, stop, stop", or "releasing now, releasing now, releasing now". As tension decreases, the pilot should release their end of the tow rope. This method of release is to eliminate the problem of pitch up associated with releasing under load. It is okay to release under tension, but the pilot must be aware of the resultant pitch-up and stall and know how to correct this.

After release, the pilot can inform the driver you are clear of the tow line and say, "clear of tow". If using constant transmit be sure to stop it.

The pilot should always check the line has separated from the bridal and it has not snagged on the bridal, pilot, or harness. An inflated drogue chute usually confirms this.

6.9 Responsibilities for Tow Pilots and Crew

Pilot Responsibilities

- Well-functioning and maintained equipment that is safe and 'fit for purpose'.
- Arrive fit for towing 'IMSAFE'
- Pre-flight checks, including a check of tow bridal connection, weak link and release.
- Adjustments for difference between hill and tow launching.
- Readiness to release. Release criteria: vehicle stops or confusion or discomfort or lock out.
- Tow line separation, timing, and glider pitch and direction control
- Safe Tracking of line over tow field, safe release of tow line
- Lock out prevention, recognition, and recovery.
- Ensuring pilot to operator communication and signals.
- Low altitude tow line separation.
- Lock out avoidance and recovery.
- Premature recovery drogue deployment (depending on system used).
- Recovery drogue entanglement.
- Managing a broken tow line.

Tow Operator Responsibilities

- Use of pre-launch checklists.
- Identify and mitigate hazards for launching, including briefing of tow pilot to any identified.
- Pre-launch setup and check of tow system, tow rigging and connections.
- Correct tow pressure for AUW of pilot and pilot experience
- Ensuring operator to pilot communications and signals.
- Tow line: leader length (pay-out), start tension and slack removal.
- Lift off/abort criteria; glider orientation and attitude
- Adjusting tow line tension and/or vehicle speed for glider tow angle and climb rate.
- Cause, prevention, and alleviation of pay-out reel surging, line rewind issues.
- Lock out recognition and recovery.

Take Off Crew Responsibilities

- Pre-launch checklists.
- Pre-launch check of tow rigging, connections, and layout.
- Ensuring pilot to operator communication and signals.
- Lift off/abort criteria.

6.9.1 Launch

Different tow systems will require different tow procedures.

During launch it's crucial that the operator and observer (if required). Keep an eye on the glider. If the pilot lowers the glider or the launch looks at all suspect, they must tell the operator to "stop, stop, stop".

With a pay-in winch system, the pilot may be 1000+ metres away, and may rely on the radio.

With a Pay-out winch the hang glider and car will be much closer. So, the operator and observer can see more of the launch.

With all systems, the tensions used for the launch should be much less than the max tow tension, this tension must be based on the AUW of pilot, Increases in tension should be made smoothly.

The tension used should be based on the pilot's flight weight and you should never tow with a loading more than 1G, or their all-up flight weight (whether tandem or solo). The strength of the weak link should be considered when determining the intended tow tension.

The tow crew should be familiar with towing emergency scenarios, and the appropriate courses of action.

6.9.2 During Tow

Following a successful launch, the tow crew must monitor the wing's reaction to tension, pilot input, for possible deviation off-line, and for lock out risk (see Lockout Section).

At all times, the driver must be aware of the tension climbing too fast. The driver's action must be 'smooth and steady' and anticipate pressure change. The driver should be advised to have no hesitation in stomping on the brakes should line tension rapidly increase.

Once the tension has stabilised, the tension can be increased to the optimum of 75-100% of the AUW (all up weight) of the pilot and equipment.

6.9.3 End of Tow

There should be a clear signal for the pilot to identify the end of tow and this procedure explained to the tow pilot before initiating the tow. These signals could be a combination of tension change, land based signals and radio calls.

Depending on the tow system being used procedures to reset ready for the next tow will be different.

7 Emergency Scenarios

This section describes towing situations that may require immediate attention. The list is not exhaustive or exclusive. Some 'situations', if managed correctly, need not become emergencies.

NOTE: First – AVIATE, then NAVIGATE, then, if time – COMMUNICATE.

7.1 Loss of Line Tension (Line Slack)

There are four common scenarios of Tension Loss during tow.

- Momentary power loss (e.g. operator error, tow vehicle loss of traction or engine problem).
- Permanent tension Loss – tow remains connected (e.g. Winch/tow system failure).
- Weak link break.
- Tow line break.

In most cases it is a potentially dangerous situation to remain attached to a slack tow line. Where possible RELEASE would come first in the above line.

7.1.1 Momentary Tension Loss

Momentary power loss might be caused by operator error (or intent due to safety concerns), loss of traction by the tow vehicle or an engine problem. Whenever tension has been lost, the first task is neutralising glider pitch and regaining or maintaining control (steady glide). Tension may have been intentionally slackened by the operator if the tow was becoming hazardous e.g. the glider heading off course. Again, regain control e.g. return to correct heading and if necessary, signal for more power. Be prepared to control glider pitch as power comes back on.

7.1.2 Permanent power loss

As before, the first action is always to regain control of your glider. If it then becomes clear that tension (tow) will not / cannot be resumed, the tow line must be released. If there is not time (altitude) to do this, then do what you can to avoid dragging over snag hazards on the ground. Most likely after releasing the tow line, landing nearby will be inevitable, so proceed with landing.

7.2 Weak Link Break

Low Level

Regain/Maintain control, and/or prepare to flare.

High Level

If this situation occurs, immediately stop the resultant pitch up (pull in bar), maintain control, plan your new flight course for a safe landing, and if there's time, inform the driver that you are off safely.

Lock Out

A weak link break during a lockout could make the associated loss of control worse. Immediately pull in the bar and attempt to get out of any turn. If low, once out of the turn maintain a straight heading for landing.
If higher, the pilot has a greater chance of getting the glider back onto course. If time, pull in the bridle and set-up for landing into the wind. Unlikely on a pay-out winch.

7.3 Tow Line Breaks

Low Level

Like a low level weak link break. Always maintain control of your glider, release the trailing rope if possible before landing, or simply fly into wind and land.

High Level

Recover from pitch up and maintain control of your glider first. Then RELEASE and inform the driver when you have released safely that there was a line break, and the remaining rope has been dropped.

7.4 Drogue Issues (If using a drogue)

Some drogue designs are prone to spinning. If loss of tension is experienced for any reason, this type of drogue can spin and wind up your bridle, preventing release. If at any stage the tension is lost, and you see the drogue spinning - release immediately.

7.5 Release Failure

Call "STOP, STOP, STOP" then "Release failure" over the radio so the driver can select neutral and cut tow line. Try pulling the release up to you by the release line and releasing or untangling by hand.

If this is too difficult, use your hook knife to cut the bridle free of the tow line.

If all else fails, fly in descending circles and land virtually in the circle of tow line. In windy conditions a “S” turn (figure eight) descent pattern should be used to avoid dragging the rope on the downwind leg of 360 degree turns.

Remember, do not trail rope over any obstacle big or small.

7.6 Risk of Lock Out

A pilot is in a lockout if they find themselves with their wing in a diving turn, diverging away from the direction of the tow line by greater than 45 degrees.

The pilot must control their direction to keep the glider on-line to avoid a lockout developing.

NOTE: A weak link will not protect a pilot from lockout.

The tow operator **must dump tension**. Should this fail to achieve the desired result, or where there is insufficient time to wait, the **guillotine** should be used. The pilot should be ready to regain control of their glider!

The pilot **must release**. A tow bridle release should work reliably, but the pilot should be prepared to use their **hook knife** in case of a failure. Pilots should be aware that they may not have sufficient altitude for a successful reserve deployment, but it remains available as a last resort. A pilot **should not hesitate** to deploy their **reserve parachute**. It is essential for the tow crew to pay close attention to the pilot’s launch.

Any pilot can shout “STOP, STOP, STOP” if they identify a problem. Once the pilot’s feet leave the ground the problem is compounded.

A smooth reduction in tension may be preferable to dumping tension in some situations, where the concerning aspect is likely to be recoverable. This is often the case where the pilot is already airborne, and the issue is recognised early.

A reduced tension usually allows relatively normal control to be regained. The pilot may be able to bring their wing on-line once the tension has been reduced. Tension should not be increased until their wing is back on-line.

Be very mindful of deterioration in the pilot’s heading, and the need to dump tension prior to lock out.

7.6.1 Lockout Causes

Lockouts are the most potentially dangerous situation that can occur to a glider on tow. A lockout can be caused in several ways:

- Too high angle of attack at launch causing the wing to stall and drop a tip. Too much tension thereby increasing the angle of attack. If this occurs at launch the increased stall potential and subsequent wing drop and lockout may result in a highly dangerous low altitude weak link or line break.
- Tow line hooking under the Control bar (or catching on object e.g. instruments mounted on base-bar).
- Failure to compensate for cross wind at launch.
- Not staying in line with the tow line.
- Thermic conditions and willy-willy (dust devil) activity.

Any one of these examples can increase the lifting force on one side (relative to the other wing) causing the glider to bank as airspeed increases. Once the glider's course approaches 90 degrees to the direction of tow, the increase in airspeed and depending on the system the load is dramatic, the forces can quickly outstrip the effectiveness of any pilot weight shift.

If the tow line is cut or broken the pilot may find themselves airborne with a length of line attached, in this scenario you should release the line if possible. The hanging line could result in a lockout. This is most likely if the line were to snag on something on the ground or through water. This risk increases when longer lengths of the line are hanging, in this situation you should plan your flight path to avoid such risks.

7.6.2 The Lockout Scenario

The worst Lockout scenario would be the pilot diving into the ground from as low as 50ft. The main contributing force in the lockout scenario is line tension so relieving line pressure quickly but not instantly is ideal. Cutting the line or releasing whilst under high load and close to the ground will cause a sudden increase in angle of attack with the glider banking. This will most likely initiate a "wing over" type turn straight into the ground.

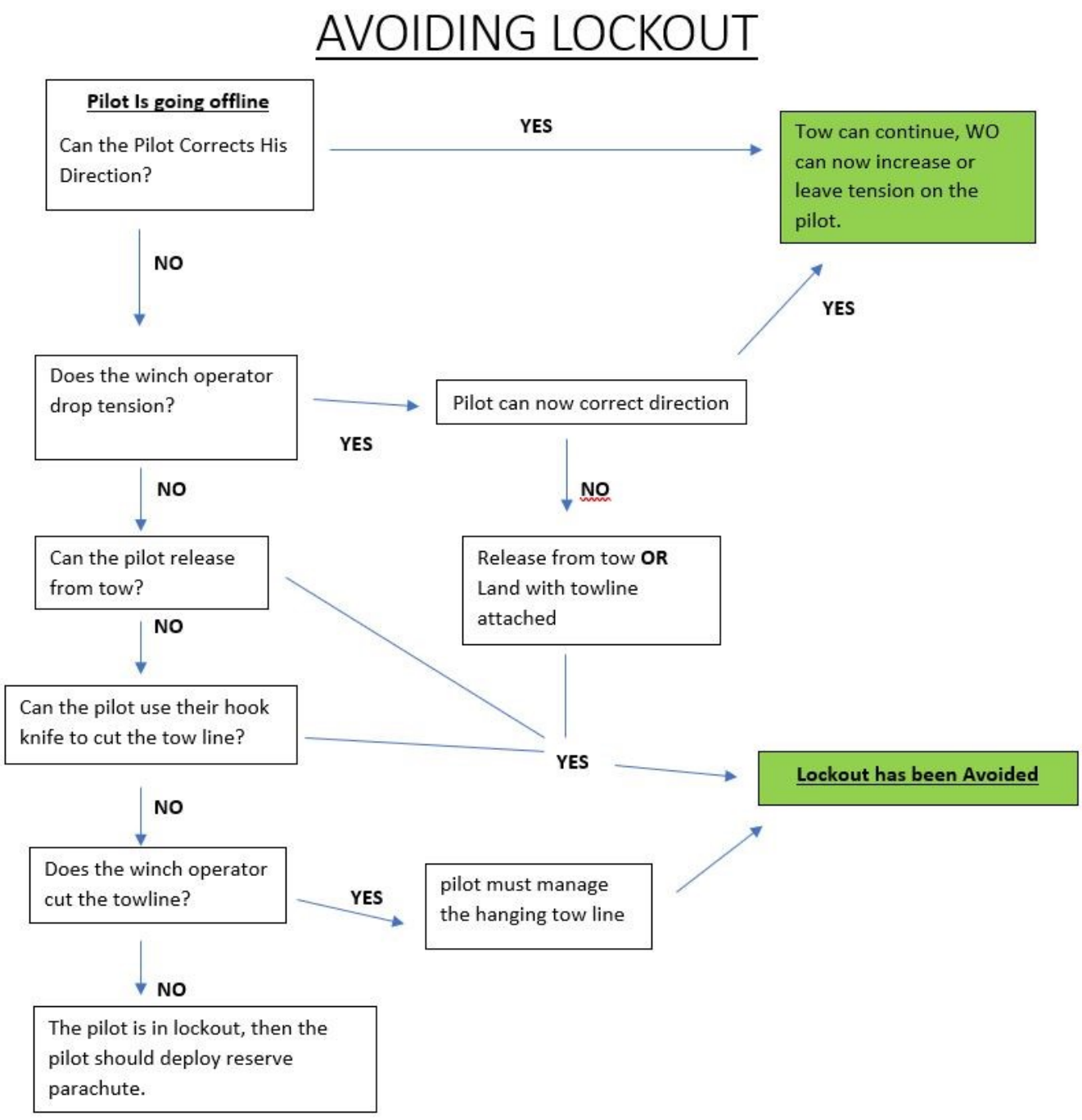
With controlled line tension reduction, the pilot will have more chance of regaining control without worsening the situation.

Pay out systems achieve this most effectively by the operator reducing tension and the reel paying out the line fast enough to remove the load on the pilot.

Static vehicle systems can only rely on an immediate stop and or line cut or release. The value of an observer for reducing the time of reaction in this scenario is most evident. Once the glider has more than 45 degrees of bank, the lockout will inevitably worsen. If the tension is not relieved, the glider (due to the towing force and direction of tow) will proceed to rotate further and fly away from the tow vehicle.

Evidence has shown that the tension built up in a lock-out may not reach the force necessary to result in the weak-link breaking. It is therefore essential that the tow driver/operator and observers be competent at identifying early stage lock-out and be trained in how to respond. The glider's resulting attitude could be way beyond the experience or coping ability of the pilot but be aware that with sufficient altitude a glider can recover.

7.6.3 Recommended Actions – Lockouts.



Pilot Actions

Upon realising that a lockout is developing, and the pilot is unable to correct the pilot should release from tow.

To reduce chances of lockout developing the pilot should:

- Keep wings level and correct Angle of attack for launch. If in doubt, abort
- Only tow in light cross winds
- Be aware of wind gradient
- Be in constant radio contact with driver
- Keep on the direct line behind tow. (Get back online with persistent correction).
- Be aware of altitude and climb rate.

Operator and Observers Actions

Apart from always maintaining visual contact during tow, the observer and operator should:

- Be constantly aware of line tension and any fluctuations
- Be aware of glider at time of tension on
- Be aware of glider at time of launch, Observer can relay to driver that pilot is 'airborne' and stable
- Be aware of position of glider in relation to line and direction of tow
- Reduce tension immediately if requested, resume normal tow once pilot has control
- Release the tow line from the vehicle if the glider orientation doesn't improve

Observers and other pilots in the launch area should give verbal acknowledgment to the pilot of cross wind speed and direction at time of tension on and just prior to launch.

It is critical to realise the weak link **may not** prevent a lockout. The lockout situation can happen at tensions below the breaking point of a weak link, so other actions **must** be taken in the event of lockout.

The ideal is - call **" STOP, STOP, STOP "** before a real lockout develops.

IF YOU GET OFF TRACK - GET OFF THE TOW.

AVIATE, NAVIGATE, COMMUNICATE.

7.7 Glider Stalls

As a hang glider has a high angle of attack and/or airspeed whilst on tow, a sudden and significant loss of tension will likely result in a stall occurring. Considering that the glider transforms greater tow tension into greater lift force it is only to be expected that with increased tension the glider will pitch up more steeply at the instant of line or weak link break.

This pitch up effect should be reduced by pulling the bar in until the glider stops climbing (a slightly weightless sensation) and it is at this precise moment that you should allow the wing to find trim position.

7.8 Mechanical Failure of Vehicle

If the tow vehicle stops moving the pilot will have to release and may need to avoid the stationary vehicle. Static tow line systems must have an infallible release at the vehicle. This ensures that the pilot can be separated from the car in the event of a problem. The potential to need immediate separation of the line should not be underestimated. (refer Section on Guillotine).

7.9 Mechanical Failure of Winch

A winch must be well constructed and maintained to reduce the risk of mechanical failure. Although uncommon, it is a reason a form of weak link should always be used.

All towing operations are required to have an infallible method of cutting the tow line where the line leaves the winch. This ensures that the pilot can be separated from the winch in the event of a problem. The potential to need immediate separation of the line should not be underestimated (refer Section on Guillotine).

7.10 Risk of a Mid-air Collision on Tow

All members of the crew, and the pilot, should be aware of other potential airspace users.

Refer to sections on Airband Radios and Notams

If another aircraft fails to provide comfortable separation, then the tow should be terminated before any possible conflict can occur. The avoidance of a collision should never be dependent on the other aircraft taking appropriate action.

7.11 Reserve *Parachute Deployment*

The value of a reserve parachute can easily be overlooked in a towing environment. Successful deployment of a reserve parachute is a viable course of action in avoiding many dangerous situations. Deployment of a reserve should be considered in the event of a lock out.

7.12 Communication Failure

A communication (radio) failure, be it loss of pilot radio, loss of driver radio, or “talk over” by a more powerful transmitter is potentially disastrous especially if some other problem develops or equipment failure occurs.

The tow should be aborted by either pilot or driver upon recognition of the problem. However, if radios fail immediately following the “ALL OUT, ALL OUT, ALL OUT” call then to stop immediately or release of line tension would be ill advised, it would be best to gradually reduce tow tension and bring tow to a stop steadily so that pilot has a chance to adjust angle of attack and find normal flying speed enabling a line release before landing straight ahead. Secondly, for experienced tow pilots, if the tow is fairly progressed a visual observer in tow vehicle can direct the driver to either stop or continue depending on the appearance of the tow and according to tension readings. A far more conservative approach to the remainder of the tow can be attempted with the driver observer ready to stop and release rope at any moment the pilot wanders off-line or if tension increases.