



Quantum 912

Glider Tug Manual



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1.0 General

The Pegasus Quantum 15 912 equipped with Modification PG 134 can be used for towing banners up to 50 sq.m, hang gliders up to 250 kg and sailplanes up to 500kg AUW. The towing speed range is from 37 to 70 mph. Once a pilot is familiar with the Quantum 15 912, tow flying is simple to master and the aircraft's handling while towing is little affected.

A BHPA or BGA aerotow rating is necessary to act as a tug pilot. We also recommend a minimum trike flying experience level of 100 hours P1 and at least 20 hours on a Quantum, 5 of which are Quantum 912. Experienced XL hang glider tug pilots should have no problem converting to the Quantum 912 and glider towing, however different procedures apply and the section 17-Aerotow Launch – of the BGA's Instructor Manual makes sound reading in preparation for glider towing operations.

In general, towing should be carried out as a solo tug pilot operation to maximise climb rate, and also to minimise towing speed when hang glider towing. However, the Quantum 912 tug can be used for training of tug pilots when required. The fitting of the tow system does not affect the aircraft's use when not towing, except that the tow system must be maintained according to this manual and the rear hang point setting is not recommended for general purpose flying. Figure 1 shows the general arrangement of the Quantum 15 912.

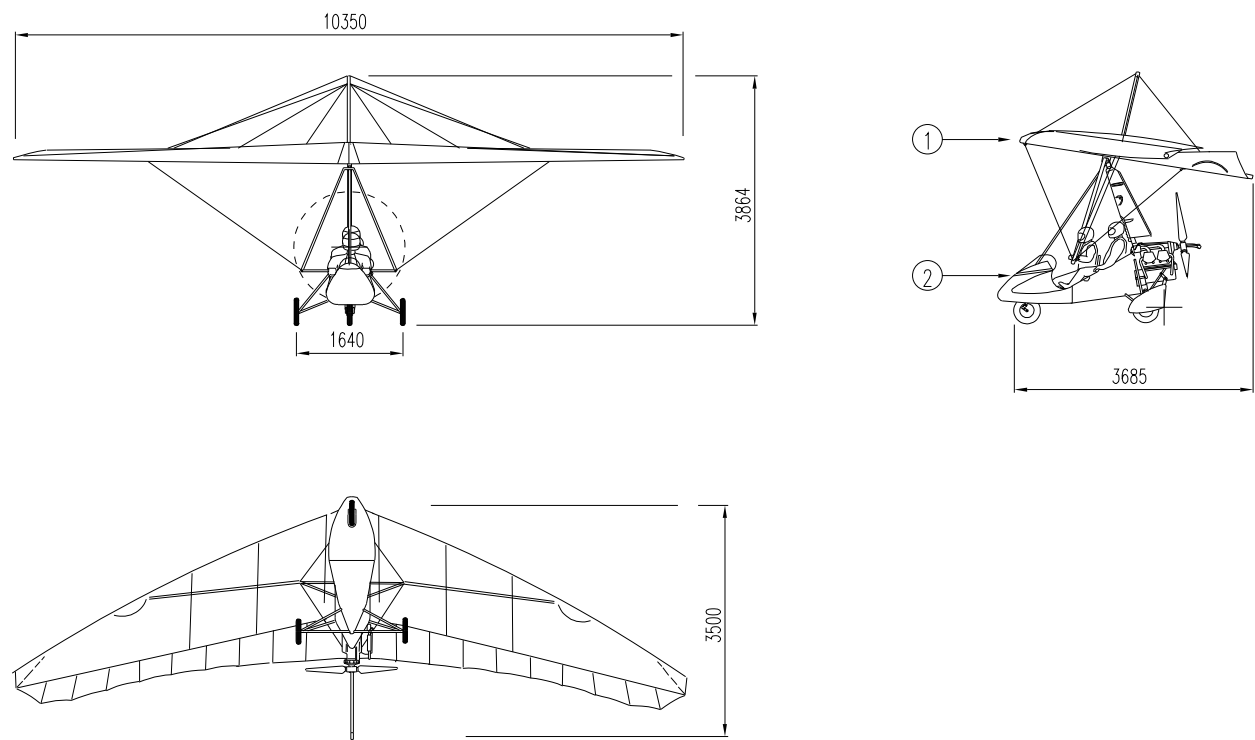


Figure 1: Quantum 912 General Arrangement.

The optional tug system employs a propeller hub tow release catch which is supported on a flexible hose to a tow tube running through the propeller shaft and bolted to the crankcase. The tow tube is supported by a ballrace where it emerges from the propeller. The ballrace is rubber mounted to isolate vibration and expansion/contraction. The release catch is operated by a yellow release cord via a 2:1 pulley to a bowden cable which passes through the tow tube. The flexible mounting of the release catch allows it to align with the towline force whilst maintaining towline clearance when taxiing.

Since the tow line is attached to the propeller hub where the thrust is produced, the glider has little influence on the controllability of the tug. The release catch is provided with an automatic release system in the event of exceeding the maximum towline angles by more than 10 degrees. The mirror supplied with the towing kit, mounted on the trike front strut, should always be used when towing.

2.0 Description of Aircraft Tug Kit

The Quantum 912 tug kit comprises of the following: Angles to mount the aerotow tube to the crankcase; aerotow tube to connect the tow release through the hollow prop-shaft; propeller hub bearing and carrier; aerotow release hook on rubber tube mounting; automatic release arms and cable; release cord and pulley with bungee retraction; fasteners; mirror; towline, with 200kg, 90kg,120kg AND 175kg weak links. Refer to drawing KIT-QTM-010 in appendix 1.

When the tow system is installed, the trike rigging procedure is not affected except to take care not to strike the mechanism with the wing keel when raising the wing. When not aerotowing, the release cord can be left retracted with the snap hook clipped to the tang on the pylon. For towing at under 50mph, a slow rear hang point hole, 6.0mm diameter, must be drilled in the wing keel 30mm behind the standard hang point hole. The rear hang point is intended for slow airspeed towing operations only.

Tow Line

The towline must be at least 70 M long. See figure 2 below.

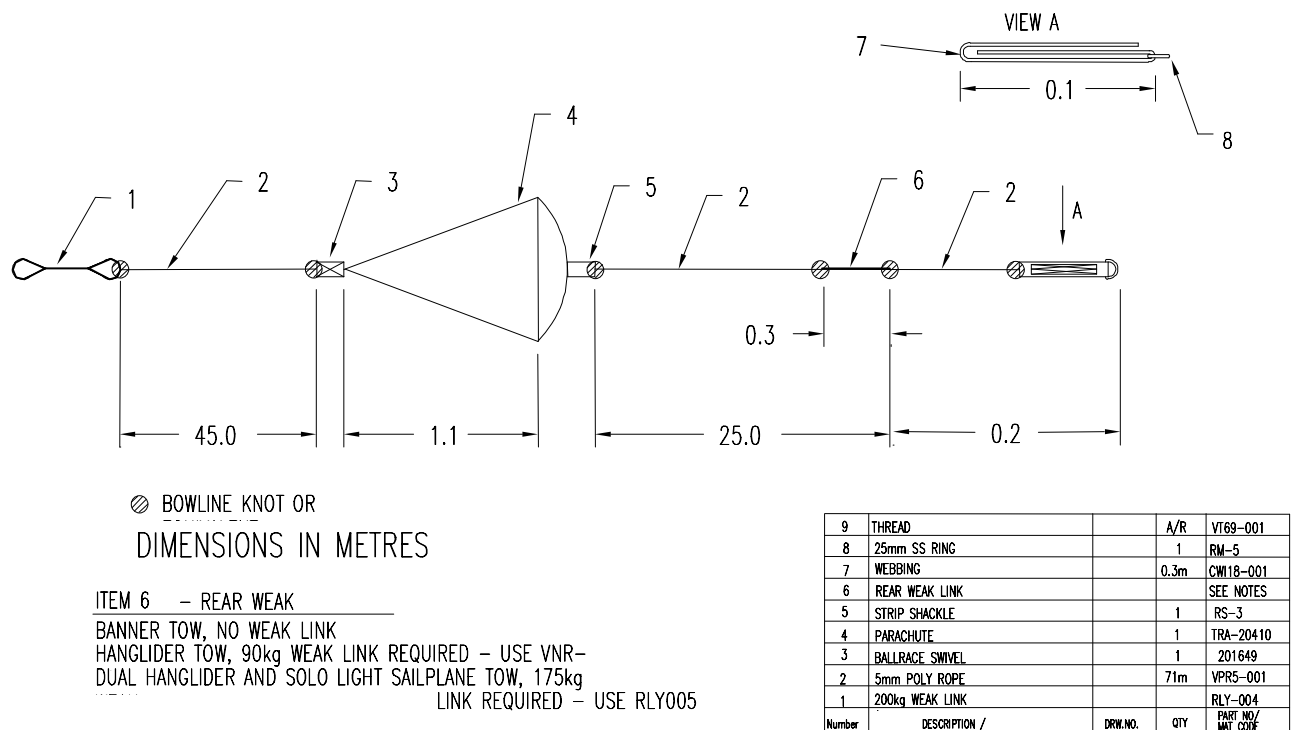


Figure 2: Towline.

Weak Links.

A 200kg weak link, Part no. RLY-004, must always be fitted at the tug end of the towline to protect the system, for ALL towing operations. NEVER EXCEED 200KG WEAK LINK STRENGTH.

For banner towing no other weak link is required. For hang glider or sailplane towing the following must be observed:

Hang gliders - A maximum weak link strength of 100 kg must be observed according to the BHPA aerotow manual. A single cord of line part no. VNR-004 has been found to break at 90kg.

Sailplanes - The glider end weak link must always be weaker than the 200 kgf max tug end weak link, to avoid the hazards of the glider carrying the towline. A stainless steel 1.5mm 7x7 cable weak link, part RLY-005, breaks at 160-180kg. Tests showed this sufficient to launch sailplanes up to 500kg max all up weight. Initial acceleration on soft ground should be applied progressively with heavy gliders, to avoid premature weak link failures.

3.0 Inspection

The tow system and tow mirror must be inspected by a Pegasus or BMAA inspector before initial use. The aircraft technical log book must be endorsed by Pegasus or a BMAA inspector to show that the approved tow system modification PG134 is correctly fitted to the aircraft and functions as intended.

4.0 Taxiing with the towline.

The Quantum 912 towing system carries the tow hook well behind the propeller so that it is possible to turn through 360 degrees at full steering lock with the towline attached. Taxiing with the line attached must be done with care at low speed. Be especially careful of dragging the line across parked gliders, equipment etc. If the line snags when it is at more than 60 degrees to the trike, the line will auto-release. Avoid taxiing over the towline unnecessarily, as the line might be flicked up into the propeller with the rear wheels.

5.0 Preparation for Flight

All Towing operations must be in accordance with this manual. For aerotowing hang gliders, operations must also be in accordance with the current issue of the BHPA aerotowing operations manual. Aerotowing of hang gliders must be in accordance with BGA recommended procedures.

Preflight Checks

In addition to the normal preflight checks for the aeroplane, check:

- Towline is un-knotted and free from abrasions.
- 200 kg tug end weak link fitted and in good condition.
- For Aerotow, weak link at glider end fitted in good condition, correct rating.
- Connections between the main line, parachute and fittings are all intact.
- Glider release ring is intact.
- Tug release functions correctly.
- Automatic release functions correctly.

Preparation for Tow Operations

Banner towing and aerotowing are advanced skills. Aerotowing requires a BHPA or BGA rating to tug gliders. It is also recommended that pilots considering towing take a short course at the Factory. Pilots must have at least 100 hrs TT in flex-wings and be completely familiar with the aircraft.

Set the trike hang position to the required speed range. For hang glider towing this will be the rear (slower) hang position and for gliders, the normal or forward position. It is normally easier to change the hang position with the wing de-rigged, or at least without it being attached to the trike. With the Quantum 912 rigged for flight as normal fit the mirror to the front strut. Adjust the mirror to a position where maximum rearward view of the glider can be obtained, for most pilots this will be when the keel pocket can be seen in the top ¼ of the mirror with the control bar fully forward. Once you have set the mirror, carry out a control bar full and free check to ensure that the mirror does not foul the controls or the side wires. Fit the release cord front strut attachment bracket to the front strut and clip the release cord to it.

The aircraft must be check flown and all systems tested before aerotowing operations commence each day.

Initial aerotows must be in smooth conditions, preferably in a 5-10 mph wind straight up the runway.

Ensure sufficient fuel, bearing in mind aerotowing uses high power settings. Ensure that the runway length is adequate. For banner and hang glider towing, we recommend that at least 400 metres into wind runway is available with clear approaches.

During preparation for glider towing, be aware of the location of the glider's airbrakes to enable recognition of them being inadvertently deployed in the tow.

Payment for towing services constitutes aerial work, which is not currently allowed by the CAA on permit-to-fly aircraft.

Signals

Ensure that both tug pilot and glider pilot are aware of hand signals that may be used during aerotow:

1. **Emergency wave off** – the tug pilot waves his extended right arm up and down from a position 45° above horizontal, to 45° below horizontal.
 2. **Airbrakes are open** – the tug pilot holds his extended left arm horizontally out sideways.
- See section 12 for a fuller explanation and diagrams.

6.0 Banner Towing:

The towline and maximum size of banner must conform to the drawing in figures 3 and 4 on the following page.

For all banner towing operations, the airfield surface must be smooth and free of obstacles. Carry out normal aircraft pre-flight checks and additional tug system checks. Position the tug at the beginning of the runway. Lay out the 70m long towline alongside the tug, at least 5 metres to the side, and running forwards according to Figure 4. Lay out the banner and fold it like a concertina, so that it unfolds easily when pulled. If desired, the banner mast can be supported off the ground on 2 plastic buckets or similar. Connect the towline to the banner. Check operation of the tow release. If all is satisfactory repeat the towline attachment. Start up, warm up the engine, carry out pre-take off checks.

Take-off with Banner.

The snatch take-off technique depends on the aircraft being as high as possible when the towline tightens, so as to lift the banner rather than drag it. Take-off using full power with the bar pushed fully out and climb at 45mph. A slight dragging sensation and surge will be felt as the banner is lifted, however there is little effect on pitch. Once established in the climb, the banner should be checked in the mirror to be attached and flying stably.

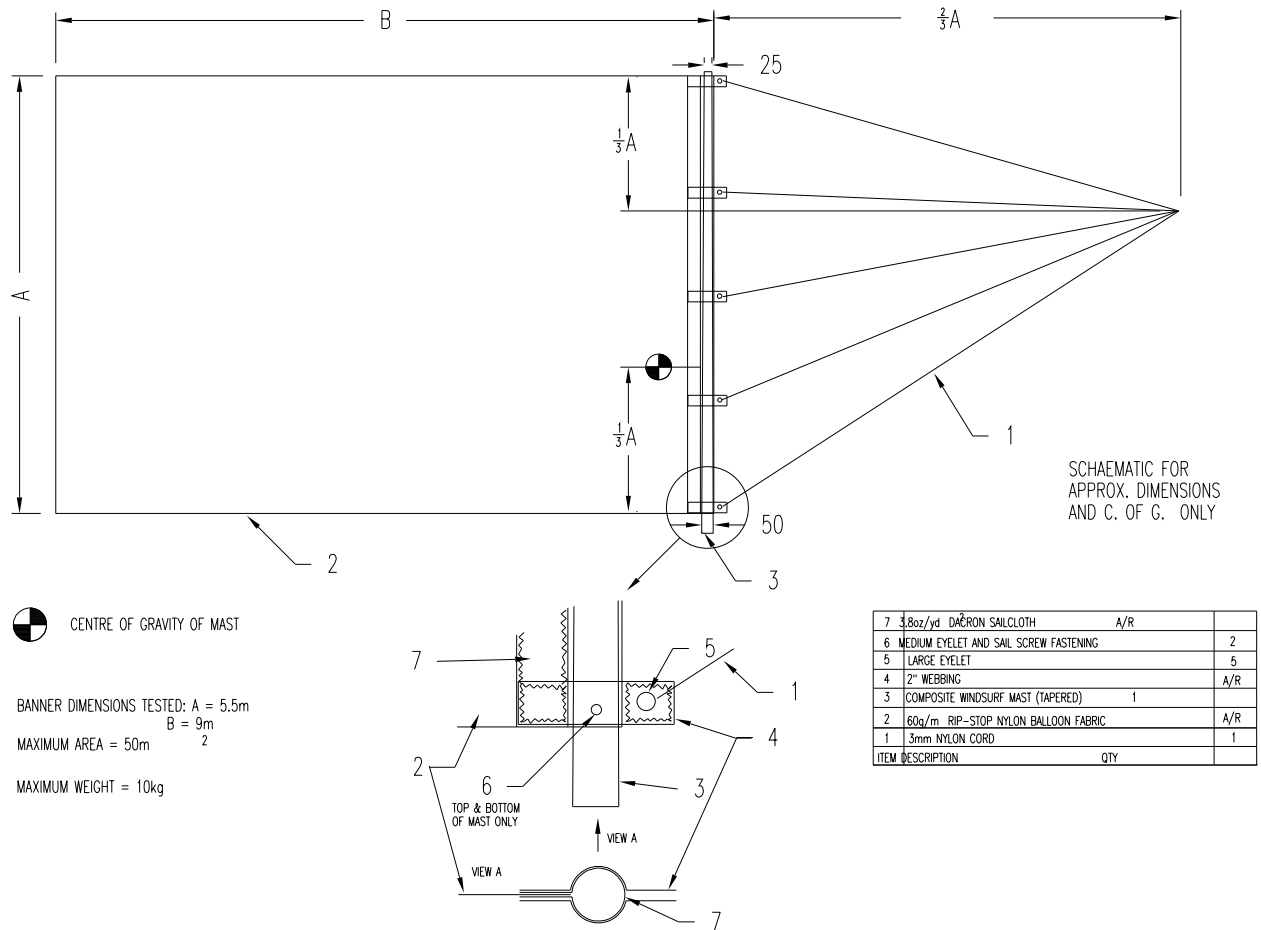


Figure 3: Banner specifications.

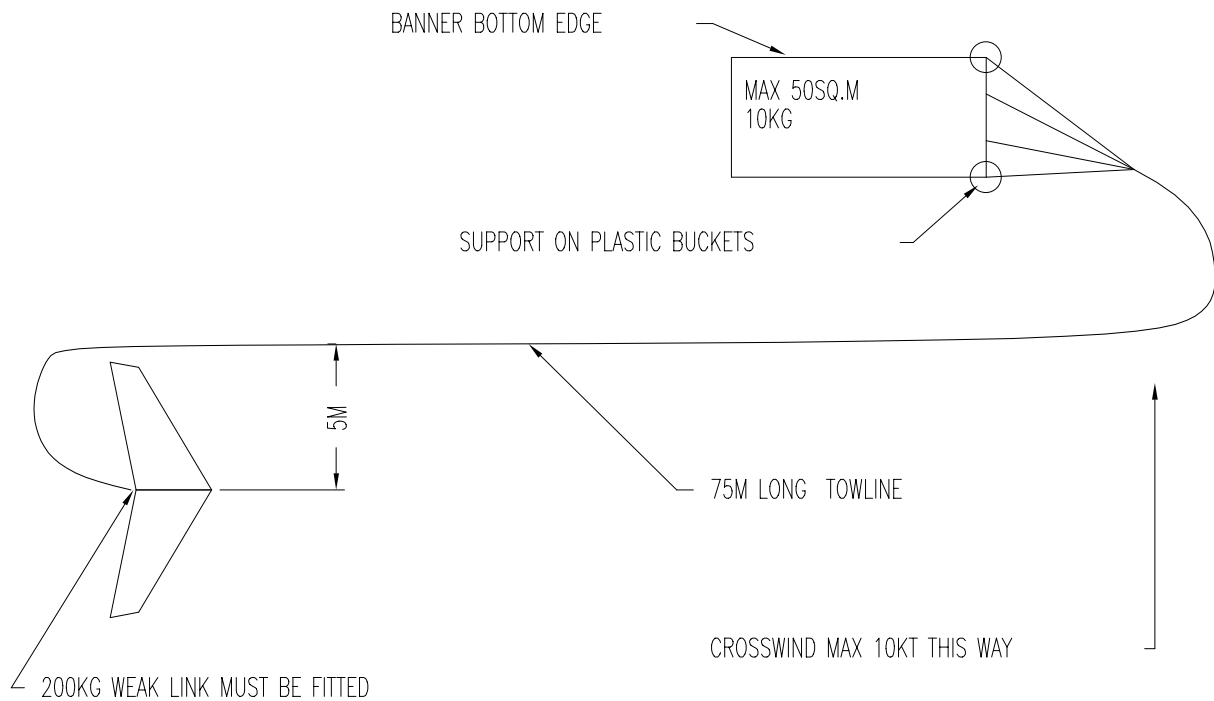


Figure 4: Banner towing.

Nil wind take off distance at 390kg AUW is 260 metres for the banner to clear 15 metres with the maximum size banner as defined.

Climb with Banner.

With the banner as defined the climb rate at 390kg AWW is 600 fpm at 45 mph. The engine temperatures and pressures should be monitored regularly during the climb.

Cruise with banner.

At the top of the climb, re-trim and fly at between 45-70 mph bearing in mind that the life of the banner as well as fuel economy is increased at lower airspeeds.

The maximum towing speed of 70mph must not be exceeded.

The presence of the banner has little effect on the handling of the Quantum in roll or pitch. Very tight turns and other violent maneuvers should be avoided, to avoid the possibility of auto-release of the towline or of flying into the banner.

The banner may at times fly up to 200 ft below the tug. This height **MUST** be added to the planned minimum flight altitude.

The banner must not be towed over densely populated areas or large gatherings of people except by express CAA permission.

Landing Approach with Banner

It is not recommended to land with the banner attached as this will cause unexpected deceleration during the landing flare, as well as damage to the banner and anything it should hit. Descend to 300ft AGL over the airfield and release the banner in the designated dropping area. If space is available, land ahead. If not, fly another circuit and land clear of the banner and line.

7. Hang Glider Aerotow.

Aerotowing must be carried out according to the BHPA aerotowing operations manual. Hang gliders to be towed must be capable of a sustainable maximum speed of at least 55mph. **Note – Aerotowing of hang gliders in heavy rain is not recommended because of the stall speed increase of 4mph to the tug, caused by droplets on the leading edge.** Initial tows must be in smooth conditions with an experienced, briefed, hang glider tow pilot. The Quantum 912 makes a powerful tug and the following procedure is recommended when towing hang gliders.

A rear hang point position 30mm behind the standard Quantum position must be used when towing weight shift hang gliders. This gives a hands-off trim speed range of 40-50 mph, using the trimmer. The rear hang point is intended for aerotowing operations only. For the slowest tow speeds and fastest climb rate, solo pilot tug operation is recommended.

The pilot must be completely familiar with flying on the rear hang point before aerotowing hang gliders. Initial takeoffs should be with the trimmer set fast (cable fully slack). The climb attitude on the rear hang point at full power and slow trim, solo, with no towline, is steep - approximately 40 degrees. **Do not exceed the pitch attitude limitations of 45 degrees nose up or down.**

The controlled throttle climb transition procedure below should be practiced until it can be flown smoothly and repeatably, before tugging. For training purposes, the Quantum feels very similar in take-off and initial climb when loaded dual, to when tugging a hang glider with the Quantum loaded solo.

Hang Glider Take-off Procedures

Firstly, check fly the tug and set the hands-off trim speed as close as possible to the desired towing speed. Move the hang point to the rear position and set the trimmer to give 45-48 mph hands-off.

- i) Take up slack as per normal, ensuring the engine is properly warm and vital actions completed.
- ii) On the "all out" sign, open the throttle smoothly to full power.
- iii) Push the control bar out and lift off at 35-40 mph.
- iv) Reduce power to approximately 4,800 rpm.
- v) Smoothly transition into the climb.
- vi) When the glider is settled into position behind the tug, smoothly increase to full power (around 5,400 rpm), maintaining 40-45 mph.
- vii) Adjust trimmer as required to maintain 40-45 mph.

The takeoff distance is considered to be the distance from the glider to the point at which the glider/tug combination clears 15m AGL, assuming a 75m long towline, in nil wind, on short mown grass. Note these values are factored by 1.3 from calculated values.

Glider Type	Initial Climb Speed	Takeoff Distance, tug weight 300kg.
Solo hang glider, 120 kg AUW	45mph	260m

Hang Glider Aerotow Climb

For hang gliders, maintain 40-45 mph, never exceeding 50mph. Fly as smoothly as possible, keeping turns gentle. Bear in mind the into-wind penetration of hang gliders is poor, so always tow upwind. Monitor engine temperatures and pressures regularly during the climb. When the desired altitude is reached, reduce power to level flight and wave one arm to signal the pilot to release. Turn off to the right.

If the glider pilot releases during the climb, a slight surge may be felt - check visually he has released then turn off to the right.

Glider Type	Climb Airspeed	Climb Rate, tug weight 300kg.
Solo Hang Glider	45 mph	900 fpm.

Descent and approach.

After the climb, allow the engine temperatures to cool slowly rather than suddenly cutting the power. Descent with a glider on tow will cause the towline to slacken whenever the descent angle is steeper than the glider's gliding angle at the towed speed. After release of the glider, descend as normal, warming the engine periodically. Avoid very tight spiral dives or other maneuvers that may cause the cable to auto release or risk tug contact with the towline. Remain within the placarded attitude limits at all times. Approaching the airfield, either drop the line within the designated dropping area, or if still attached, approach the field higher than normal and aim to land 1/3 of the distance up the runway. Watch for people or carelessly parked gliders etc which could be caught by the towline. Remember the towline will be drifted off to the side of the runway if there is a crosswind. Some extra deceleration may be felt as the line begins to drag - have a little extra speed in hand before the final flare. Beware snagging the line and be prepared to release it if it does.

8. Sailplane Aerotow

For towing sailplanes, set the hang point in the position for the appropriate aerotow speed, this is likely to be the standard Quantum hang point. Set the hands-off trim as required within the 45-65mph range available.

On the "all out" sign, power should be fed in progressively to full throttle for the whole takeoff. When towing heavier sailplanes, the tug should be held down after take-off under full power, accelerating until the proper speed is attained to start the climb.

Aerotow Takeoff Performance.

The takeoff distance is considered to be the distance from the glider to the point at which the glider/tug combination clears 15m AGL, assuming a 75m long towline, in nil wind, on short mown grass. Note these values are factored by 1.3 from tested values.

Glider Type	Initial Climb Speed	Takeoff Distance, tug weight 300kg.
Sailplane, 300kg AUW	60mph	480m
Sailplane, 500kg AUW	65mph	613m

Sailplane Aerotow Climb.

For sailplanes, climb steadily at the desired towing speed, bearing in mind that a high towing speed (65mph+) will reduce the climb rate. Fly as smoothly as possible, keeping turns gentle. Monitor engine temperatures and pressures regularly during the climb. When the desired altitude is reached, reduce power to level flight and wave one arm to signal the pilot to release. Turn off to the right.

If the glider pilot releases during the climb, a slight surge may be felt - check visually he has released then turn off to the right.

Aerotow climb performance

Glider Type	Climb Airspeed	Climb Rate, tug weight 300kg.
Sailplane, 300kg AUW	60 mph	450 fpm
Sailplane, 500kg AUW	65 mph	350 fpm

Descent and approach.

After the climb, allow the engine temperatures to cool slowly rather than suddenly cutting the power. Descent with a glider on tow will cause the towline to slacken whenever the descent angle is steeper than the glider's gliding angle at the towed speed. After release of the glider, descend as normal, warming the engine periodically. Avoid very tight spiral dives or other manoeuvres that may cause the cable to auto release or risk tug contact with the towline. Remain within the placarded attitude limits at all times. Approaching the airfield, either drop the line within the designated dropping area, or if still attached, approach the field higher than normal and aim to land 1/3 of the distance up the runway. Watch for people or carelessly parked gliders etc which could be caught by the towline. Remember the towline will be drifted off to the side of the runway if there is a crosswind. Some extra deceleration may be felt as the line begins to drag - have a little extra speed in hand before the final flare. Beware snagging the line and be prepared to release it if it does.

9. Limitations

Maximum weak link strength - tow line	200 kg
Maximum towing speed - rear hang point - V_{trmax}	55 mph
Maximum towing speed - front hang point - V_{tfmax}	70mph

Maximum glider stall @ max AUW - Vgs	50mph
Minimum towing speed, rear hang point - Vtrmin	37 mph
Minimum towing speed, front hang point - Vtfmin	43 mph
Minimum glider max continuous speed - Vgmax	55mph
Maximum tug weight for towing	390 kg, but never exceeding combined 800kg maximum tug plus glider weight
Maximum hang glider all-up weight	250kg
Maximum sailplane all up weight	500kg
Maximum banner weight/size	10kg & 50 sq.m
Maximum towing cross wind component (for the tug)	10 mph
Release ring	TOST part number 102000 (available from the factory or RD Aviation.

See BHPA aerotow manual wind limitations for hang glider towing limits.

10. EMERGENCY PROCEDURES.

Most towing emergency procedures involve releasing the towline - if the situation allows, fly the glider to within range of a clear landing area before releasing the line, being especially wary of dropping it onto power lines, roads and houses. If the towline is across a power line DO NOT TOUCH IT because dampness may cause it to conduct. Treat any grounded line as live.

Contact the emergency services as soon as possible (use 121.5 if airborne) with the location and nature of the incident. Keep people away till the services arrive.

Banner Towing	
Emergency situation	Action
Weak link fails on banner launch.	Fly circuit and land. Replace 200kg weak link -never tow without one.
Banner folded or ripped.	Release banner if still over airfield, otherwise circuit, drop banner and land.
Line snags on takeoff.	Release banner land ahead if there is space.
Banner fails to release.	Fly a circuit and determine if the airfield is large enough and clear enough to land with banner attached. If not, divert to a larger clear landing area. Approach high and deep into the field so as to clear the boundary and obstacles with the banner. Descend to flare height at 55 mph being ready, with power if necessary, for any sudden deceleration. Land.
Engine failure after takeoff.	Release banner, shut throttle, turn off ignition, land ahead.
Engine failure at altitude.	Reduce speed to 45mph: check ignition, fuel, temperatures. Attempt restart, if unsuccessful, turn off ignition and fuel. Glide to a clear area, release towline, land. The glide angle with the maximum size banner is 6:1 at 45mph or 0.88 miles/1000 ft.

Aerotowing	
The tug pilot's scan should be 90% in the mirror on take-off, as most emergencies on take-off require rapid towline release. In flight, if time, height and the situation allows, the glider should be waved off within range of a landing area by waving one outstretched arm up and down. Otherwise, release the towline immediately.	
Emergency situation	Action
Glider uncontrolled in pitch, goes high before take-off.	This will tend to increase the tug take-off run and also make it more difficult to rotate on take-off. Release the line, continue take-off or stop as space dictates.
Glider uncontrolled in pitch, goes	This is a dangerous situation because it robs the tug of airspeed and tends

high after take-off.	to rotate it pitch down. Release the towline as soon as the tug feels abnormal, be ready to recover using power as necessary.
Glider uncontrolled in pitch, goes high in climb.	Firstly, reduce speed if possible. If glider is still climbing, wave an arm up and down to signal glider to release. If no response, release the line.
Glider fails to get airborne, or rolls/yaws off sideways on launch.	Release immediately from bat man signal, radio or what is seen in the mirror. Stop or continue take-off as space dictates.
Glider rolling and yawing excessively.	Reduce speed if possible, if still uncontrolled, wave glider off, if no response, release towline as soon as possible at a safe position/altitude.
Glider descends into tug wake.	Watch in the mirror - if glider still uncontrolled, use wave-off signal, release the line if there is no response.
Hang glider cannot release.	If the HG pilot is seen to lower his legs, this means he cannot release. Fly to within easy gliding range of a safe landing area, release the line.
Engine failure on takeoff.	Release, close throttle, cut ignition (if there is time) and land or roll to a stop ahead.
Engine failure in the climb.	Allow the bar to come back to the cruise trim position, close throttle, wave the glider off with an arm, turn right. If no response, release line. Assess reason for failure, attempt restart, if unsuccessful then do forced landing checks. Glide to a forced landing area, drop towline where clear, land.

11. Placards

The following placards are to be fitted and must be maintained in a legible state:

Placard DP-068
Placard DP-069

in view of pilot with arrow to release control.
 on release catch body.

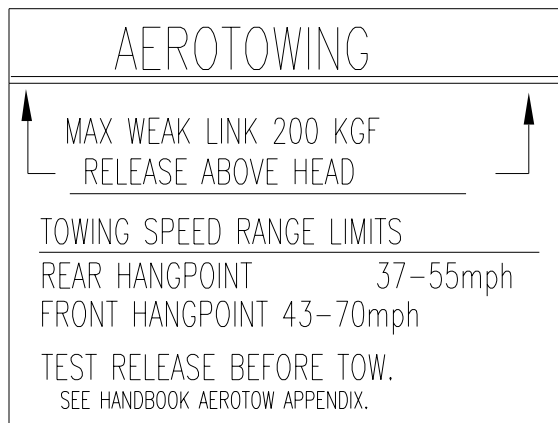


Figure 5: Placard DP-068.



Figure 6: Placard DP-069.

12. Maintenance

- Check the release mechanism before each day's operations.
- Regularly lubricate the release cable with WD40. Form a funnel around the end and pour/spray WD40 into the funnel.
- Check the release mechanism latch and return spring for wear and replace if necessary.
- Check that the release cables are un-kinked and do not form tight radius bends.
- Check operation of the automatic release.
- Check security of automatic release arms.
- Check condition of rubber hose to release catch.
- After 500 launches, check condition of inner load carrying cable and replace if necessary.

- Check temperature indicator strip on propeller bearing carrier regularly, temperature must never exceed 100°C. Excessive temperature or play indicates bearing failure.
- Check security of mounting bolts to crankcase.
- Check condition of release cord and bungee retraction.
- At 100hr intervals check condition of hub centre bearing and tow shaft. Use Loctite 'bearing fit' between shaft and bearing.

13. The Glider Pilot

This section is intended for the glider pilot to highlight the differences between conventional tug and Quantum trike operations. For the glider pilot, there are not many differences between being launched by a conventional 3-axis tug and a Quantum 912 trike. However, the few differences to note are significant. This does not mean that it is more difficult to launch behind a trike, in fact the contrary can be the case, especially for vintage glider launches where the best climb speed of the trike more closely matches that of the glider.

It is likely that the glider pilot will not have experience of aircraft with two axis weight shift controls, (although over recent years a significant number of hang glider pilots have taken up conventional gliding). This should not be a problem, provided that the glider pilot understands the basic operating differences, which are covered in the following sections.

Controls

With conventional aircraft the pilot has direct flight control of the aircraft in 3 axes, roll by way of ailerons, pitch by way of elevator and yaw by way of rudder. The ailerons and elevator are controlled by a stick or yoke and the rudder by rudder pedals, the controls being deflected by the pilot in the direction the pilot wishes the aircraft to go, e.g. left aileron to roll left. The Quantum is directly controlled in only 2 axes, roll and pitch. Roll and pitch is initiated by shifting the weight of the pilot and trike unit in the direction the pilot wishes the aircraft to go. This is achieved by the pilot moving a control bar attached to the wing in the opposite direction, e.g. move the control bar to the left to go right and pull the control bar towards the body to put the nose down. In effect, the controls in a trike are opposite to that of a conventional 3 axis aircraft, even on the ground where the pedals are used in the opposite direction to steer, the trike pilot pushes left to steer right.

Signals between the tug and glider.

The conventional signal to the glider pilot to indicate that their **airbrakes are open** is, "the tug waggles its rudder". The conventional signal to the glider pilot for **emergency wave off**, at which the glider must release is, "the tug rocks its wings". Both of these aspects present a problem for a trike pilot trying to signal the glider pilot in the conventional manner. This is because the flight controls on a trike can be heavy compared to 3 axis aircraft, especially when deliberately and quickly deflecting the wing. Also, due to the delta wing configuration, the secondary effect of roll input is yaw and this initiates a turn. Further, the trike pilot does not have a rudder and is therefore handicapped in not being able to give the conventional **airbrakes are open** signal.

RT contact between the tug pilot and the glider is preferable. Where RT is not available visual signals are not too much of a problem as the trike pilot, in his open cockpit, can clearly be seen by the glider pilot. Hand signals are thus used to replace the conventional 3 axis tug signals:

1. The **emergency wave off** – the tug pilot waves his extended right arm up and down from a position 45° above horizontal, to 45° below horizontal.
2. The **airbrakes are open** – the tug pilot holds his extended left arm horizontally out sideways.

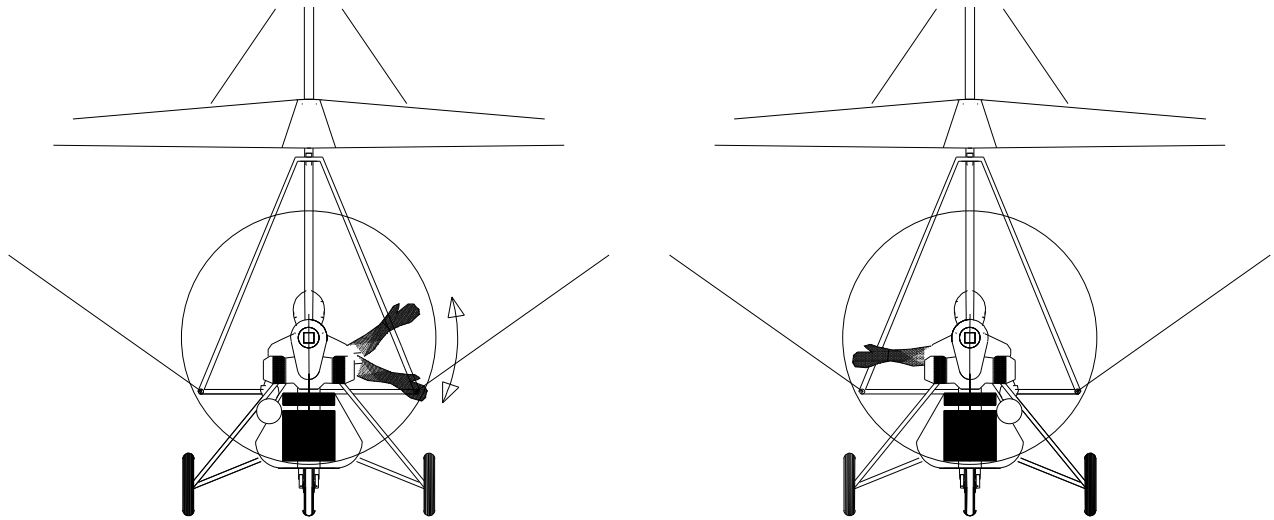


Figure 7: Aerotow signals. (a) The emergency wave off; (b) The airbrakes are open.

Tow hook position.

On the Quantum 912, the tow hook is situated directly behind the centre of the pusher propeller. This puts the towline exactly in the ideal position in the centre of the trikes thrust. Unlike with 3-axis tugs, a glider getting out of position does not easily upset a trike, this is for three reasons:

1. The powered trike unit from which the glider is towed is hinged independently from the wing. Forces applied to the tug through the towline do not influence the wing directly, just the trike unit.
2. The towline is not attached at a point where out of position forces have much influence over the trike.
3. On trikes, the tow line attachment point is much closer to the centre of gravity.

Because the tow line is attached to the centre of the trike propeller, in the event of a line break, it would be possible for the line to recoil and tangle with the prop. To prevent this occurring a small drogue parachute is inserted into the tow line about 20 metres in front of the glider. The parachute is attached to the tow line in a manner that the tow line tension keeps it closed during towing, but once the glider is released, the parachute deploys.

Out of position towing.

What happens if the glider should get too high? The towline, pulling close to the centre of gravity, at the centre of thrust and not on any airframe part connected to the wing, will tend to put the pilots control bar forward. This action will not change the angle of attack of the wing as it would with a conventional tug. If the glider should continue to overtake the tug while pulling increasingly upwards, a point would be reached where the control bar of the tug would reach the control stop (in the case of a trike, the front strut). The Quantum trike is fitted with an automatic out of position release, and so long before this point is reached the towline will be released from the tug. The automatic out of position release will operate when any extreme out of position angle is reached whether low, high, out to the side or a combination. For these reasons, and those outlined in 3 above, it is unlikely that the glider pilot will put the trike tug pilot into danger through being out of position. However, the glider pilot should follow normal Aerotow safe practice at all times.

Take off roll.

The ground roll acceleration of the tug glider combination and the time for the combination to clear 15 metres is likely to be similar to a conventional tug. Due to slower airspeed, the distance travelled to clear 15 metres will probably be less than a conventional tug, but with climb performance being the all important aspect, distance is not an issue. The tug is likely to lift off first and will accelerate to climb speed while remaining a few feet off the ground waiting for the glider to take off. Once the glider starts climbing, the normal position behind the tug should be taken up and maintained.

The climb and release.

Positioning behind the tug throughout all stages of the Aerotow and release should be accomplished using normal towing practice.

14.0 Appendix – Drawing KIT-QTM-010 (Quantum 912 towing kit).