Evergreen Soaring Multiple Tow Procedures

(released 1/12/2011)

Contents:

I) Defined: A multiple glider tow is accomplished with a single tow plane towing multiple gliders simultaneously over long distances to reduce launch cycle time and increase the tow plane's efficiency.

II) Equipment:

a) Rings: A multiple glider tow requires the use of special tow rings to allow all the aircraft to separate in case of emergencies. The rings must conform to the following standard adopted by Gliding New Zealand Inc. as described in their Manual of Approved Procedures, Appendix 3-A, Towing Rings included at the end of this document: Important information to note, the maximum total weight of all the gliders to be towed is limited by the rings to 1500kg (3300lbs). The rings should be spliced on to towline according to Evergreen standard practices with a double ring end and a TOST ring end on the first line and a triple end and a TOST ring end on the second towline. If three gliders are to be towed, the third rope will have also have a double ring end and a TOST ring end.

b) Tow Lines: Multiple tow lines consist of a "short rope" of not less than 50m (150ft) between rings and a "long rope" of not less than 80m (250ft) between rings. If three gliders are to be towed, the additional "triple long rope" will not be less than 110m (350ft) between rings. The Gliding New Zealand Inc. Manual of Approved Procedures, Appendix 3-B is included at the end of this document as a reference for developing our own tow rope construction.

c) Release Interface: All aircraft to be towed must have releases compatible with the rings as described above or use an acceptable adaptor. The tow lines are connected at the tow plane release end by fitting the two small rings of the triple ring set through the largest ring of the double ring set and then connecting the end of the triple ring to the tow plane release. For three gliders, a 2nd double ring set would be placed alongside the first before the triple ring is connected to the tow release. See the pictures below for further illustration:

III) Pilot Qualifications:

Please see the club by-laws, section 3.2.10 Multiple Tow Procedure and Qualifications.

IV) Operations:

A glider pilot should not participate in a multiple tow operation unless he/she is familiar with the procedures that will be used. Each pilot in the formation is responsible for his/her own safety, and should interact accordingly when agreeing to participate in a multiple tow. Tow pilots are under NO obligation to perform multiple glider tows and may decline to fly them at any time.

A) Safety Considerations: In the interest of safe operations, only two gliders will be towed simultaneously at Arlington. A preflight and pre-operation briefing will occur daily before multiple glider towing begins and will include all involved pilots and ground personnel. Test all releases to be certain proper separation will occur in an emergency. Verify emergency landing areas are clear of obstructions, and ground personnel know the limitations other traffic in the pattern will impose on the launch. Maximum crosswind component shall not exceed 10 knots for multiple tow operations.

B) Obstructions: During operations at Arlington the following will be observed: For a launch to the North it is important to verify the 34/16 pattern is clear to the base leg and that the ultra-light pattern and ground activity will not conflict in case the tow plane has engine trouble. Also, the grass strip immediately adjacent to the runway should be clear for the westernmost glider to land. For a launch to the South, verify the 16/34 pattern is clear to the base leg and that 11/29 traffic will not interfere. The field south of the hangars and over by the western hangars and warehouse should be checked for obstructions.

C) Ground Operations: The tow pilot will be the overall flight leader and will review with all involved pilots the particular procedures for the current operation. The glider pilot on the long rope will be leader of the glider formation. Wing runners will work wings on opposite sides of the centerline unless visibility dictates otherwise. The wing runner on the long rope glider should have a radio and will clear the pattern(s) before raising the long rope glider's wings to level. Considerations addressed during the preflight review should include the placement of towropes

and gliders, as it may differ from launch to launch. Factors like crosswind, glider handling limitations or weight, terrain, and pilot experience may affect which glider is on which length of rope and which side of the tow plane. Below is a list of scenarios to which solutions should be discussed during the pre-launch briefing

1) Scenarios:

- Tow plane power failure before glider are airborne
- Tow plane power failure before rotation but after gliders are airborne.
- Tow plane power failure after all aircraft airborne below 200ft
- Tow plane power failure above 200ft
- Tow plane releases early below and above 200ft
- Short rope glider releases early below and above 200ft
- Long rope glider releases early below and above 200ft
- Emergency in climbing configuration (both gliders above wake)
- Emergency in cruising configuration (gliders split by wake)

2) Takeoff Distances:

- Though no published takeoff figures for glider towing are available for the Pawnee, the maximum demonstrated takeoff load on the Arlington center grass strip behind a 235HP Pawnee was a multiple tow of two L-13s (Gross weight 1102lbs) in the summer on the hard and dry grass surface with a temperature of 24C and humidity slightly above standard atmosphere, and calm wind. This takeoff required almost the entire length of the strip.

3) Other Operational Considerations:

- High-performance gliders on the long rope will have more time and space to correct slack rope resulting from their reduced drag.

- It is recommended that the emergency low altitude abort turn direction be determined prior to launch and generally should be upwind unless conditions dictate otherwise. In consideration of a scenario where both gliders must abort between 150ft to 500ft and turns may be made, it is encouraged to place the long rope glider downwind and direct that pilot to maintain position and visual contact behind the short rope glider through any turns to avoid a collision. On landing both pilots should do their best to separate in the same direction as their relative position during tow. I.E. If the short rope glider was on the left during tow, it will attempt to extend touchdown and its relative position as far to the left as is safe in whatever new direction the gliders end up landing. The long rope glider would attempt to land short and to the right of the short rope glider.

- Placing gliders too far off the centerline, especially in a crosswind or without a significant headwind, may cause control difficulties during the takeoff roll. It has been demonstrated that the short rope glider's inboard wing may be placed over the top of the long rope to alleviate this without compromising safety.

- In a crosswind the long rope glider has less side vector from the rope and may have an easier time maintaining the windward position off the centerline unless a low altitude abort scenario or conditions dictate otherwise.

- When cruising, the glider in low tow position (usually the long rope) is vulnerable to the tow rope rings should a release occur. Be prepared to avoid the rope if a release occurs before transitioning to high tow.

- In no wind or crosswind scenarios, runners will need to run farther than normal with the wing to compensate for the reduced control authority and slower acceleration.

D) Actions:

Pilots should review these procedures for each and every flight and discuss them during their pre-takeoff briefing with the ground crew. Explain to everyone the items you intend to do differently if applicable:

1. **Long rope** is the leader of the glider formation and controls the glider preparation.
2. **Short rope** signals to their wing runner to raise the wing when ready.
3. **Short rope** calls leader and states "Up & ready."
4. **Long rope** glider signals their wing runner to raise the wing when ready.
5. **Long rope** calls tow pilot and states "xx, flight of two, ready for takeoff."
6. **Tow plane** calls “(location) traffic, tow plane (call sign) taking off (to the direction of departure), two gliders in tow.”
7. **Short rope**, while on takeoff roll, stays to its side of the long rope and keeps their wheel off of the long rope; lifts off normally and stays slightly to its side and clear of the long rope, and does not descend below a normal tow position.
8. **Long rope** stays slightly to the other opposite side of the short rope glider and assumes the pre-determined tow position as soon as practical after takeoff.
9. **Short rope** remains in high tow and maintains a position slightly to the opposite side of the long rope glider.
10. Turns are flown normally.
11. **Long rope** initiates the release by announcing, "Standby." followed by "Releasing now.", and then “Off tow.” once rope separation is confirmed. Turn is made away from the formation centerline to the side takeoff roll was initiated on.
12. **Short rope** releases after hearing “Off tow.” and turns opposite.
13. **Tow plane** goes straight ahead.

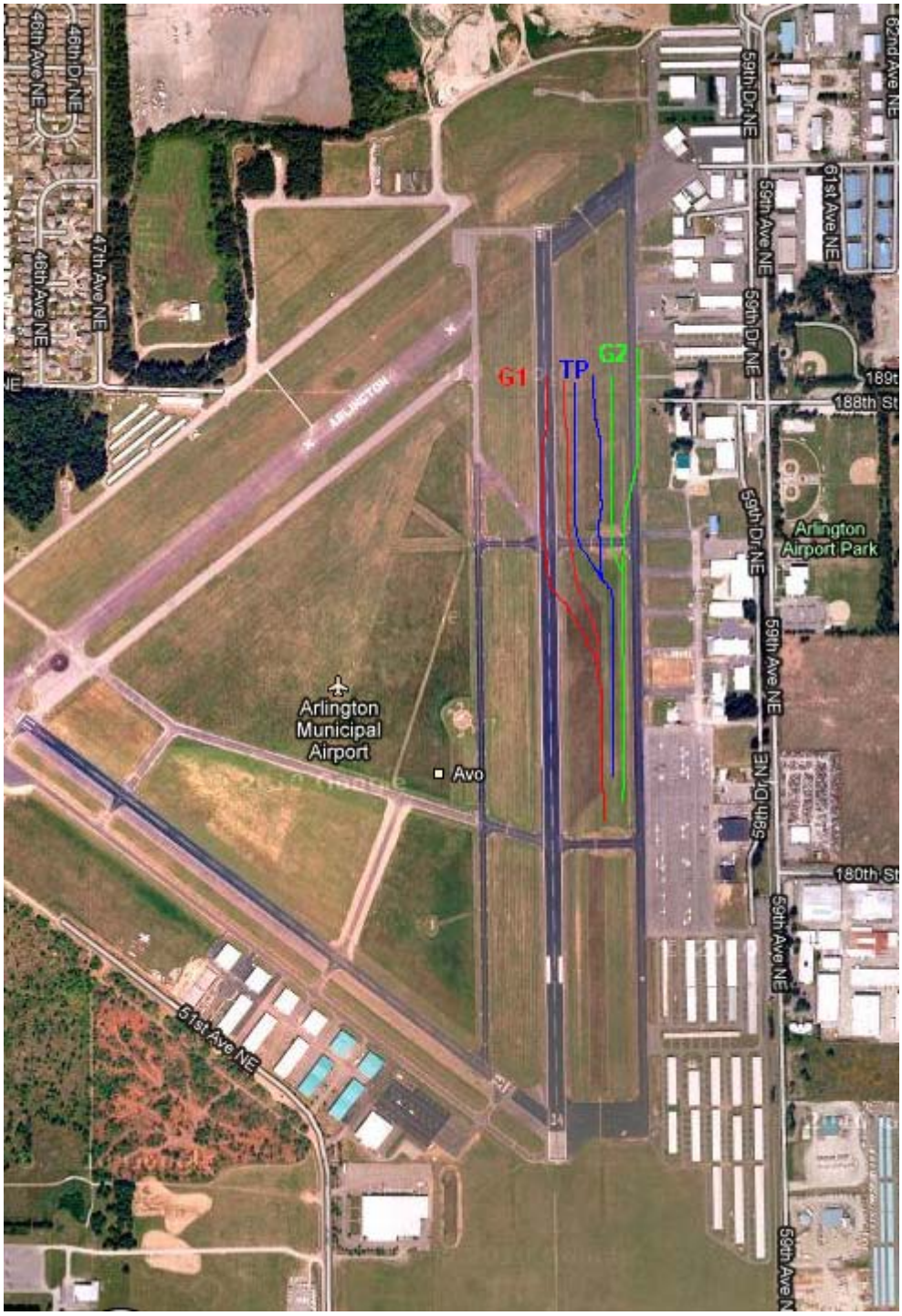
E) Configurations and Examples: Below are some pictures of a typical operation, the reference appendixes mentioned above, and some illustrations of early launch abort options. In the latter’s case, “G1”, “G2”, and “TP” indicate each glider and the tow plane respectively and are placed near the terminus of each landing option(s).

The photo below shows gliders on takeoff roll. The glider on the short rope (left side in this example) should lift off first, followed by the long rope (right side in this example) glider.

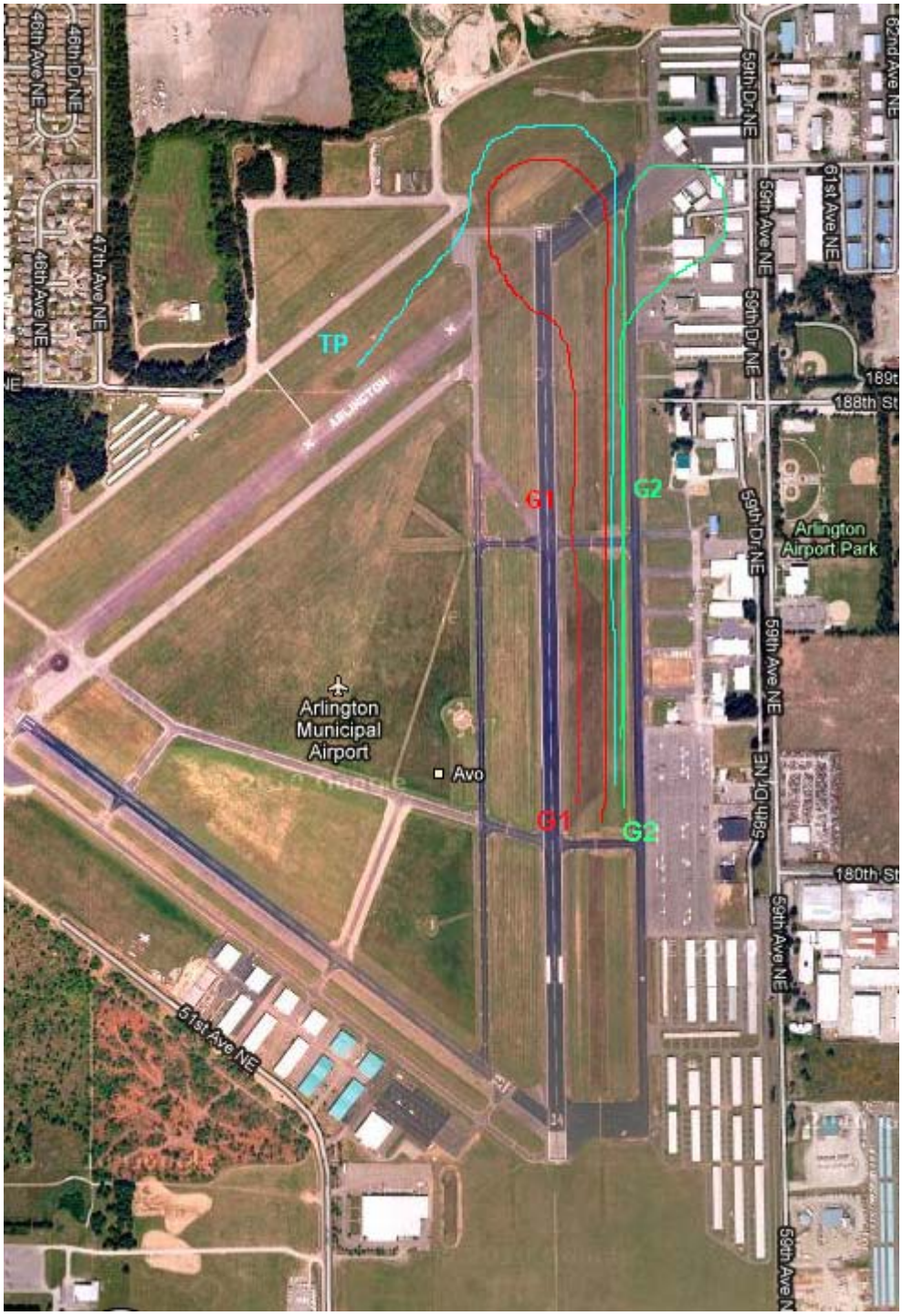
Preferably, at 20 feet in the air, the short rope glider assumes a position no lower than normal high tow and moves slightly to the left of centerline, whereas the long rope glider is slightly below normal high tow height, and remains to the right of centerline.

The lateral displacement is maintained until the long rope glider assumes the chosen tow position and may be maintained the entire flight depending on conditions. The photo below illustrates the beginning of the transition of both gliders moving towards the centerline. Evergreen has found that maintaining lateral and vertical separation with both gliders in a high tow position often works well for climb out and the photo below is more illustrative of a cross country cruise situation where the prop wake has less vertical displacement behind the tow plane. In the latter case the long rope glider has an easier time of maintaining position in low tow without hitting wake turbulence, especially when flying through already turbulent conditions.

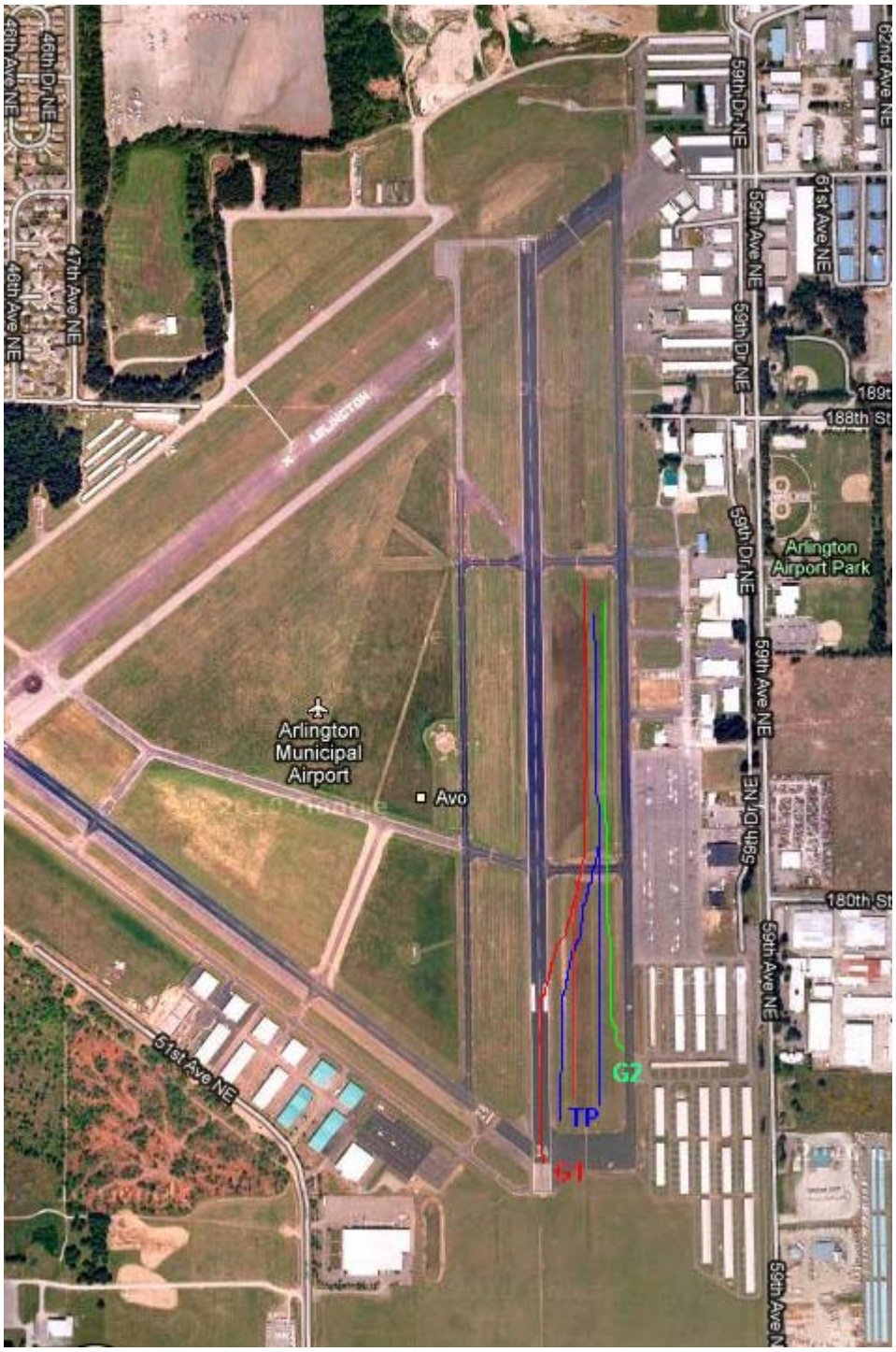
When the gliders in the above photo release, the forward glider (top) turns left, and the rear glider (right) turns right, and the tow plane continues forward. The rear glider should consider moving back into high tow prior to release to avoid hitting the rope.



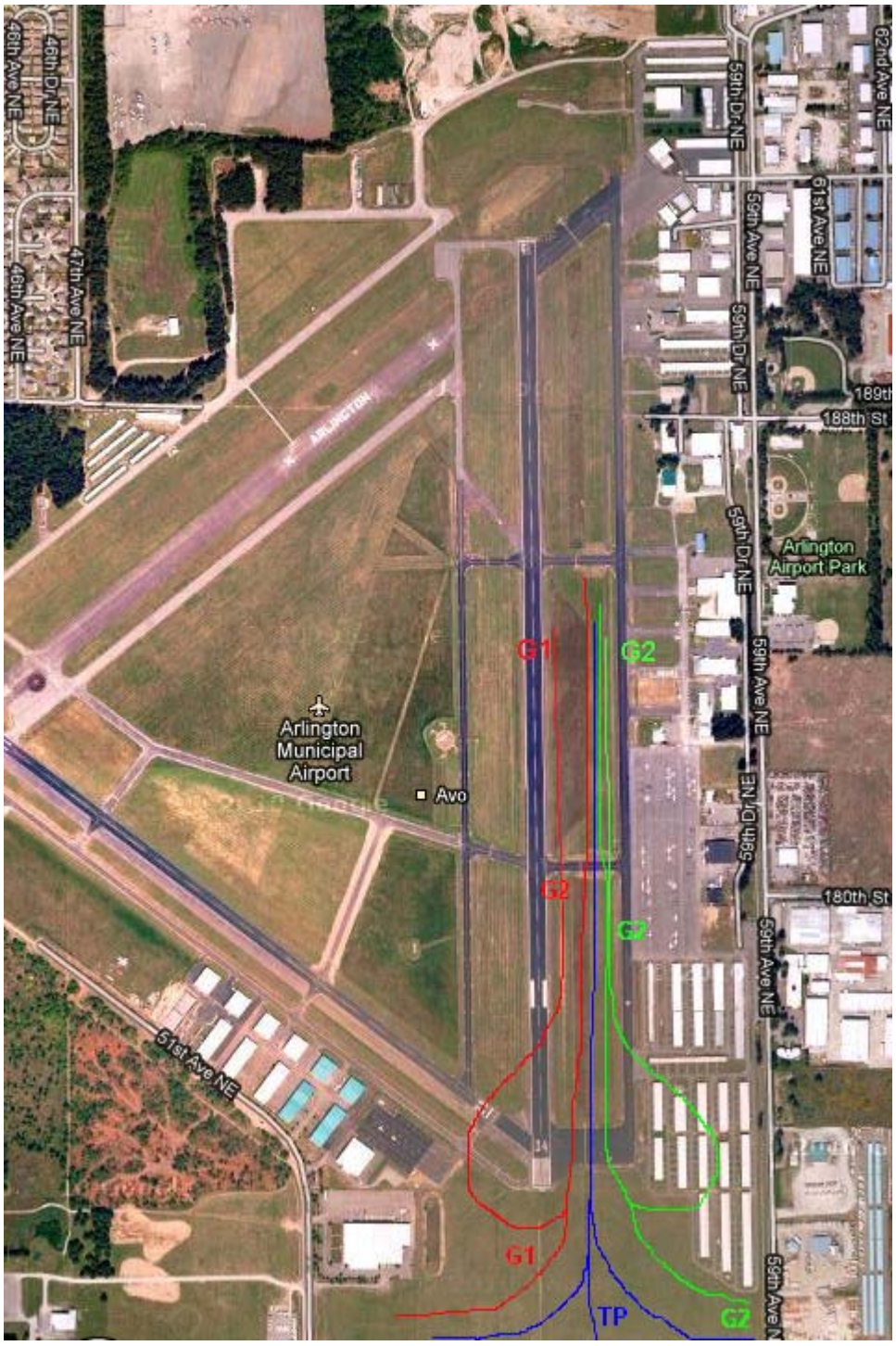
The diagram above shows North departure abort options where a straight ahead run out is possible.



This diagram shows some possible North departure ~200ft abort options.



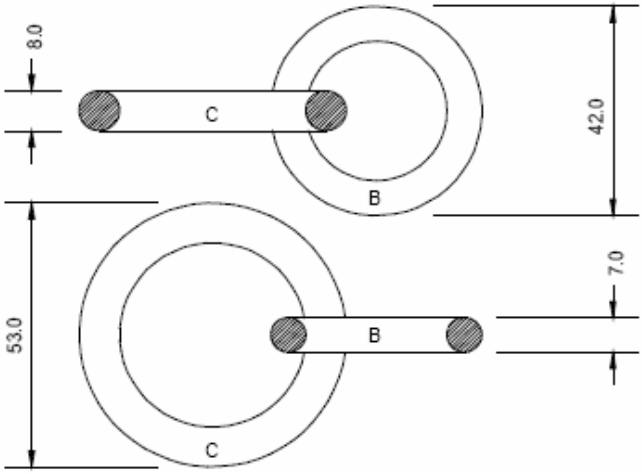
The diagram above shows South departure abort options where a straight ahead run out is possible.



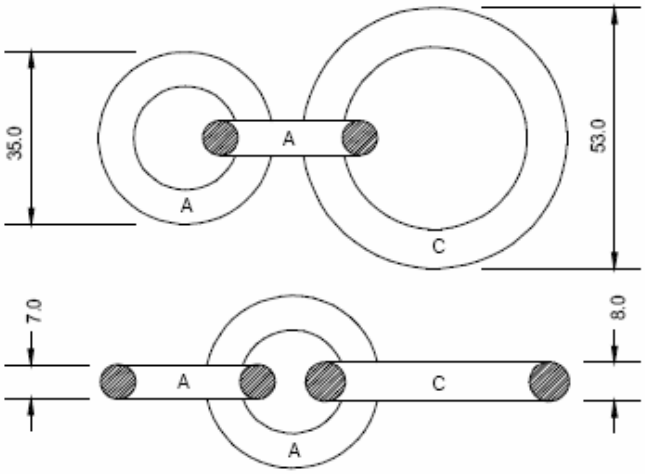
This diagram shows possible South departure ~200ft abort options.

V) Appendices:

3.3 Multiple tow double-ring assembly: Ring C, Ring B.



3.4 Multiple tow triple-ring assembly: Ring A, Ring A, Ring C.



4. GNZ Specifications

4.1 Rings are to be manufactured from round section hard drawn wire to the following Specs:

(a) Wire diameter (Ring A & B) 7mm + 0, - 0.3

(b) Wire Diameter (Ring C only) 8mm + or - 0.3

(c) Material spec (All Rings) BS-NZS 3421 or AS 1303.

4.2 Rings are to be circular in shape and cold formed around a mandrel to achieve the following dimensions after welding:

(a)	Standard small ring (ring A)	OD = 35mm, + 0, - 0.3 ID = 21mm, + 0, - 0.3
(b)	Standard large ring (ring B)	OD = 42mm, + 0, - 0.5 ID = 28mm, + 0, - 0.5
(c)	Special large ring (ring C)	OD = 53mm, + 0, - 0.5 ID = 37mm, + 0, - 0.5

4.3 After forming, and cutting into single rings, the ring should be pressed so that the ends are aligned. The cut ends are to be ground at an angle of approximately 45 degrees, from each side to just less that half thickness, (ie. grind to be in the shape of a "J"). The cut ends are to be welded, using MIG or TIG welding methods and technique, and electrode to specification BS2901 Pt 1 Type A18 or AWS A5.18: ER70S-6.

4.4 It is normal that the small ring is made separately, and the large ring joined to it before the large ring is welded.

Note: During welding care should be taken not to cause heat build-up in the ring, causing it to loose strength.

4.5 Excess weld is to be ground off. The maximum deformity at the weld to be + or - 0.3mm.

4.6 Final treatment.

(a) Rings are to be passivated.

(b) Finished rings may be plated for preservation during storage.

4.7 Identification. Any form of ID or other information required, may be stamped or embossed ONLY on the standard large ring.

4.8 Design Loads.

(a) Maximum continuous load. - 1500 Kilograms.

(b) Maximum peak load - 1800 Kilograms.

TOWING ROPES

1. Rope Strength

1.1 Towrope strength must comply with CAR Part 91 Appendix A.26, which states:

A Glider tow line must -

(1) except as provided in paragraph (2), have a breaking strength of not less than 80% or more than 200% of the Maximum Certified Take-Off Weight (MCTOW) of the glider to be towed; and

(2) if the tow line used has a breaking strength of more than 200% of the MCTOW of the glider to be towed, have a safety link installed at the point of attachment to -

(i) the glider with a breaking strength of not less than 80% of the glider's MCTOW but not more than twice the glider's MCTOW; and

(ii) the aircraft with a breaking strength of at least 100% of the glider's MCTOW but not more than twice the glider's MCTOW.

1.2 Advisory Circular, AC 3-02 Aero Tow Ropes, provides information on the rope recommended and supplied by GNZ, as well as general advice on making up and caring for towing ropes. This rope does not require the use of a safety link (weak link).

2. Rope Splicing

2.1 Ropes are to be spliced at each end for the attachment of towing rings. Splices should have a minimum of five full tucks. Splices are not to be whipped and must remain open for inspection. It is a requirement that the towrope be passed twice around the ring in order to reduce wear at this point. The splice should also be as tight as possible against the ring.

2.2 Inline Splicing.

2.2.1 Splices anywhere along the length of the rope are permissible, providing:-

(a) The rope is that recommended by GNZ or one that is manufactured to equivalent specifications; and

(b) The rope is in good condition; and

(c) The inline splice is correctly made, with at least four tucks in each direction.

2.2.2 There is no limit to the number of splices allowed. However, as each splice makes the rope thicker and heavier, two inline splices will most likely be the practical limit.

3. Tow Rope Assembly - Single Tow

3.1 The standard tow rope assembly consists of rope (as described in Para. 1), spliced (as described in Para. 2) at both ends to standard tow ring assemblies (refer App 3-A). The standard tow rope is to be not less than 50m between end rings.

3.2 It is recommended that tow ropes be manufactured to a length of 55 metres in order to allow for shortening in use.

4. Tow Rope Assembly - Dual Tow

4.1 Two separate ropes are to be used. These are to consist of a "short" rope of not less than 50m between end rings, and a "long" rope of not less than 80m between end rings.

Note: A "long" rope about 50m longer than the "short" rope is recommended to provide increased separation between the gliders.

4.2 The "short rope" consists of rope (as described in Para. 1), spliced (as described in Para. 2), at one end to a standard tow ring assembly, and at the other end spliced to a multiple tow triple-ring assembly (ref App 3-A).

4.3 The "long rope" consists of rope (as described in Para. 1), spliced (as described in Para. 2), at one end to a standard tow ring assembly, and at the other end spliced to a multiple tow double- ring assembly (ref App 3-A).

4.4 The two ropes are coupled together at the tow plane end in such a manner that if jettisoned by the tow pilot, they will automatically separate.

4.5 This is accomplished by fitting the multiple tow double-ring assembly over the multiple tow triple-ring assembly, and then offering the last ring of the triple assembly up to the towplane's release in the normal manner. The double ring assembly will be captured on the triple-ring assembly until released.

5. Tow Rope Assembly - Triple Tow

5.1 Three separate ropes are to be used. These are to consist of a "short" rope of not less than 50m between end rings, a "long" rope not less than 30m longer than the "short" rope, and a "triple long" rope not less than 30m longer than the "long" rope.

Note: In all cases, each rope must be AT LEAST 30m longer than the preceding rope. This is to be checked by measurement before the tow can proceed.

5.2 The "short" rope is to be as described above in Para. 4.2.

5.3 The "long" rope is to be as described above in Para. 4.3.

5.4 The "triple long" rope is to be as described above in Para. 4.3 as for the "long" rope, but with a minimum length of 110m.

5.5 The three ropes are coupled together at the tow plane end in such a manner that if jettisoned by the tow pilot, they will automatically separate.

5.6 This is accomplished by fitting the multiple tow double-ring assembly of both the "long" rope and the "triple long" rope over the multiple tow triple-ring assembly of the short rope. The last ring of the triple assembly is then offered up to the towplane's release in the normal manner. The double-ring assemblies will be captured on the triple ring assembly until released.

6. Plastic Funnels

Plastic funnels are not to be used on towropes.

7. Thimbles

Thimbles should not be incorporated when the rope is to be used over hard ground or sealed surfaces.

8. Attachment to Tow Release

8.1 In all cases, it is the standard small ring (ring A) only, which engages with the tow release mechanism.

8.2 Tow release mechanisms on gliders and towplanes must be compatible with these standard rings.