

Gatineau Gliding Club (GGC)



Tow Rope Maintenance Guide

April 2011

Manual Owner:
Chief Field Manager

Approved by [Name]

Revision 1

REVISION RECORD

REVISION NO.	AFFECTED SECTIONS	DESCRIPTION	ISSUE DATE	INITIAL
0 1	All Figure 1	Initial draft release. Figure 1 updated	January 2006 April 2011	RH RH

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
1.	Overview	1
2.	Applicable standards, References & Definitions	3
2.1	Standards & References	3
2.2	Definitions	3
2.3	Credits	3
3.	THE ROPE FABRICATION PROCESS	1
3.1	Step 1 – Required Materials	1
3.2	Step 2 – Prepare Weak Link and Glider End	1
3.3	Step 3 - Create Weak Link and Terminate Glider End	2
3.4	Step 4 – Start Splice	2
3.5	Step 5 – Complete Splice	3
3.6	Step 6 – Tape Splice	4
3.7	Step 7 – Tape Tube	4
3.8	Step 8 – Splice Weak Link	5
3.9	Step 9 – Prepare Both Ends of the Weak Link Splice	5
3.10	Step 10 – Mate the Two Different Diameter Ropes	5
3.11	Step 11 – Tape One Side	6
3.12	Step 12 –Complete Opposite Side of Weak Link Splice	7
3.13	Step 13 Inspect the Completed Weak Link Splice	8
3.14	Step 14 - Tape Over the Weak Link Splice	8
3.15	Step 15 - Slide Tube in Place and Tape Ends as Shown	9
3.16	Step 16 - Prepare Tow Plane End	9
3.17	Step 17 - Schweizer Ring Short Link	10
4.	Tow Rope Best Practises	11
4.1	Daily Operations	11
4.1.1	Daily Inspection	11
4.1.2	Furry Rope Syndrome	11
4.1.3	End-of-Day	11
4.1.4	Rope Stowing	11
4.2	Rope Re-Build	11
4.2.1	Tools	11
4.2.2	Weak Link	11
4.2.3	Thimble	12
4.2.4	Repair/Re-build Cycling	12
4.2.5	Abrasion/Sun/Weather Protection	12
4.2.6	Tape Experience	12
4.3	Unusual Rope/Failure Events	12
4.3.1	Rope Damage	12
4.3.2	Ring Hardware Damage	12
4.3.3	Bad Rope Substandard Strength	13

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
Figure 1	– GGC Operational Manuals	2
Figure 2	– Required Materials	1
Figure 3	- Prepare Weak Link and Glider End	1
Figure 4	– Create Weak Link & Terminate Glider End.....	2
Figure 5	– Start Splice.....	2
Figure 6	– Complete Splice.....	3
Figure 7	– Taped Splice	4
Figure 8	– Completed Glider End of Tow Rope	4
Figure 9	– Ends of Weak Link and Tow Rope Prepared for Splice.....	5
Figure 10	– Wrap of Tape on Ends to Eliminate Destranging.....	5
Figure 11	– Mated Rope Showing Strands Emerging Alternately from Each Rope	6
Figure 12	– Ropes Mated, Tube Ready to Slide Over Splice	6
Figure 13	– Tape One Side of Splice	7
Figure 14	– One Side of Splice Completed.....	7
Figure 15	– Completed Splice - Notice Smooth Regular Weave.....	8
Figure 16	– Taped Splice	8
Figure 17	– Completed Weak Link Splice.....	9
Figure 18	– Prepare Tow Plane End	9
Figure 19	– Completed Schweizer Short Link.....	10

1. OVERVIEW

Over the years the GGC tow rope construction process has been refined in order to achieve these specific and prioritised goals:

- Minimise the Occurrence of Unexpected Rope Breaks –Our unexpected rope break rate is now arguably and considerably less than 1 per 5000 tows.
- Minimise end abrasion (particularly at the glider end) that limits rope life.
- Maximise resistance to weather and sun in the event a rope gets left out.
- Provide long lasting ropes (replacement rate of 5-10 new ropes built per 2000 tows-nominally one year of GGC operations).
- Provide reasonable construction time of approximately 30 minutes when done in batches of 5;
- Support 1-2 repair rebuilds of each rope usually at the higher wear glider end.
- Readily support ongoing inspection, repair and rebuilding.

Many process and component improvements have been made over the decades based upon the input provided by many clubs and individuals experience with tow ropes.

An overview of how this guide fits into the GGC governance document structure is shown in Figure 1.

Gatineau Gliding Club
Governance Documents

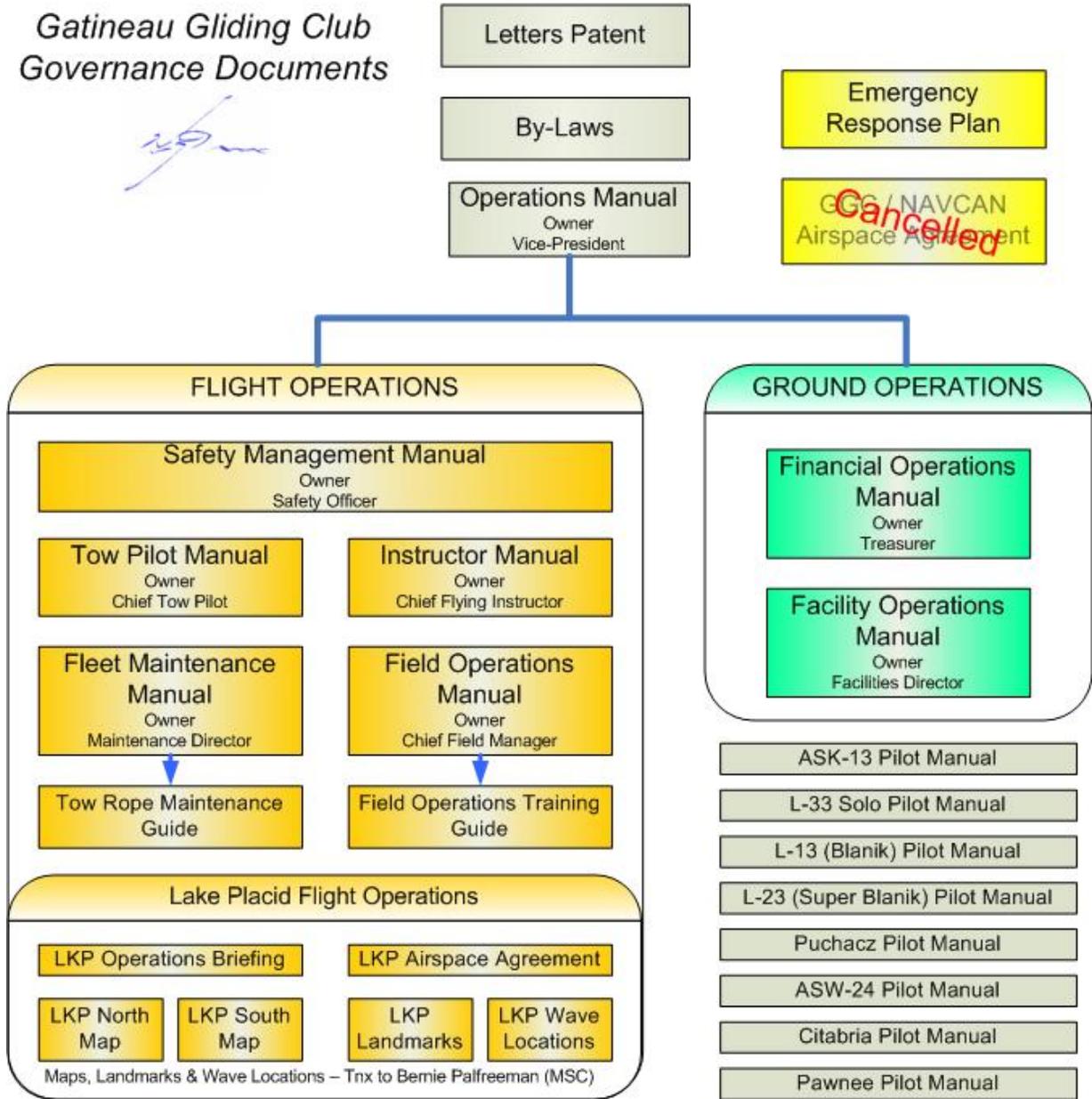


Figure 1 – GGC Operational Manuals

2. APPLICABLE STANDARDS, REFERENCES & DEFINITIONS

2.1 Standards & References

- Soar and Learn to Fly Gliders - Soaring Association of Canada Student Manual
- Instructors Course Manual – Soaring Association of Canada

2.2 Definitions

- **Tost Ring Set** – a double tow ring set used with the Tost release mechanism which is used in most European design gliders.
- **Schweizer Ring** – a large single tow ring to be used with all Schweizer built gliders and with the releases on GGC tow planes.
- **Short Link** – a 3 foot piece of tow rope with a Schweizer tow ring on one end and an open loop on the other end. This rope is looped through the larger of the two rings Tost set to allow Schweizer gliders to tow using the standard GGC tow rope.
- **Weak Link** – a small piece of smaller diameter (lower strength) rope that is spliced into the tow rope near the glider end. In the even of the rope being overloaded, the weak link will fail first leaving only a short length of rope attached to the glider in the event of a glider release failure.

2.3 Credits

Text – Andrew Robinson

Photos – Sonia Hildesheim

3. THE ROPE FABRICATION PROCESS

The following 17 steps detail the process to construct a tow rope and the required short link for gliders that need a Schweizer rather than Tost ring.

3.1 Step 1 – Required Materials

- 160'-180' 5/16" Polypropylene (one roll 972' produces 5 ropes), [Boat Supply]
- 15' 1/4" Polypropylene [Boat Supply] for construction of weak links
- Schweizer ring (Tow Plane end) [Schweizer, Wings & Wheels]
- Tost ring set (Glider end) [Wings & Wheels]
- (2) Stainless or Steel 1/4 -5/16" Rope Thimbles [Boat Supply]
- 1/4" and 1/2" Plastic Clear Tape with Fiberglass strands in 1 dimension along the tape for strength [Canadian Tire, Grand & Toy]
- (3) 6" pieces of Black Rubber Washer hose 1/2" internal diameter [Home Depot]



Figure 2 – Required Materials

3.2 Step 2 – Prepare Weak Link and Glider End

If reusing the hardware, remove rope and tape remnants from hardware using shears.



Figure 3 - Prepare Weak Link and Glider End

3.3 Step 3 - Create Weak Link and Terminate Glider End

- Thread 5' foot section of ¼" weak link through tube
- Tape inside of thimble to ensure no sharp edges are exposed to rope
- Secure polypropylene rope around thimble with tape as shown
- Detwist 6" rope for splice as shown
- Bind three separate strands with ½" fibreglass tape



Figure 4 – Create Weak Link & Terminate Glider End

3.4 Step 4 – Start Splice

This is the trickiest phase of the operation. It must be done right to get a strong and reliable splice. Arrange the loose strands in order of length from shortest to longest. The length is measured from the thimble to the first wave in the delaminated strands. The shortest delaminated strand is weaved through the nearest strand of the rope not delaminated. The second shortest strand is passed through the second nearest strand. Finally the longest strand is put through the remaining strand. This should yield three strands protruding from the intact rope at equal 120 degree angles to one another. If this is the case, you are ready to splice for 3-6 weaves (of all three strands) or 6 inches. Start weaving the splice very close to the thimble with using shortest strand.

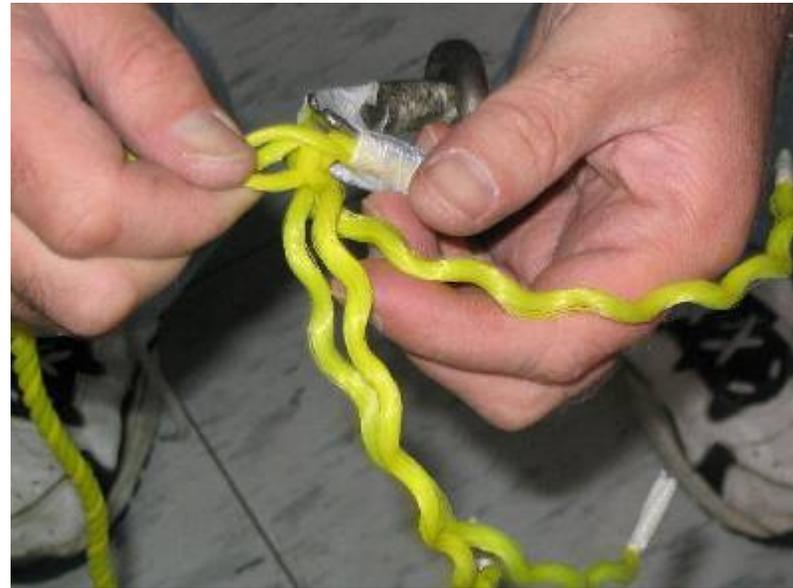


Figure 5 – Start Splice

3.5 Step 5 – Complete Splice

Confirm Splice Start is Good -Three strands should protrude from rope at 120 degrees and as close as possible to the thimble, as shown in Figure 6. If not, remove all strands and retry until the strands appear at equal 120 degree angles.

Continue splicing 3 strands at time by skipping over one strand and then splicing the first strand under and through the next strand. Repeat this for the other two strands.

Repeat this until the splice is at least 6 inches in length to assure the strength is at least that of a section of unspliced rope.

Put splice on the floor and roll back and forth with your foot a couple of times, as shown in Figure 6. This will compact the weave and make the splice nice and smooth.

Carefully inspect the completed splice to ensure there are no irregularities – it should be smooth, with no irregular bumps that would indicate an incorrect weave, as shown in Figure 6. **If there are any irregularities the splice MUST be redone.**



Figure 6 – Complete Splice

3.6 Step 6 – Tape Splice

- Tape over splice ensuring ends are flat to allow tube to slide over.
- Slide tube over the taped end.



Figure 7 – Taped Splice

3.7 Step 7 – Tape Tube

Tape tube as shown completing glider end of towrope.



Figure 8 – Completed Glider End of Tow Rope

3.8 Step 8 – Splice Weak Link

- **REMEMBER to SLIP a piece of rubber tube on one side of the splice first**
- Prepare two different diameter rope ends as shown
- Unweave 6” of the end of the 1/4” weak link just constructed and 6” of one end of the 5/16” tow rope, as shown in Figure 9.



Figure 9 – Ends of Weak Link and Tow Rope Prepared for Splice

3.9 Step 9 – Prepare Both Ends of the Weak Link Splice

- Put a small piece of tape to prevent further destranding of each side of the weak link splice.



Figure 10 – Wrap of Tape on Ends to Eliminate Destraining

3.10 Step 10 – Mate the Two Different Diameter Ropes

- Mate the destranded rope ends together such that each strand from each rope lies between alternate strands from the other

rope. Once mated, the strands will alternate from each rope as you go around the mated ropes, and the strands from each rope **MUST** be at an even 120 degrees.



Figure 11 – Mated Rope Showing Strands Emerging Alternately from Each Rope

3.11 Step 11 – Tape One Side

- Confirm that the tube is in place ready to slide over the splice once completed, see Figure 12.



Figure 12 – Ropes Mated, Tube Ready to Slide Over Splice

- Tape one side as shown to hold it in place while the other side is spliced, as shown in Figure 13.



Figure 13 – Tape One Side of Splice

3.12 Step 12 –Complete Opposite Side of Weak Link Splice

- Remove the tape and splice in the opposite direction.
- Put splice on the floor and roll back and forth with your foot a couple of times.



Figure 14 – One Side of Splice Completed

3.13 Step 13 Inspect the Completed Weak Link Splice

- Carefully inspect the completed splice to ensure there are no irregularities – it should be smooth, with no irregular bumps that would indicate an incorrect weave, as shown in Figure 14. Confirm the splice is symmetric and tight. **If there are any irregularities the splice MUST be redone before taping over it!!!**
- Run fingers over the splice and pull ends tight such that ½” protruding strands are ready to be taped down.



Figure 15 – Completed Splice - Notice Smooth Regular Weave

3.14 Step 14 - Tape Over the Weak Link Splice



Figure 16 – Taped Splice

3.15 Step 15 - Slide Tube in Place and Tape Ends as Shown



Figure 17 – Completed Weak Link Splice

3.16 Step 16 - Prepare Tow Plane End

Prepare tow plane end of the tow rope in the same way as the glider end of the weak link (repeat steps 2-7), but this time using a Schweizer ring.



Figure 18 – Prepare Tow Plane End

3.17 Step 17 - Schweizer Ring Short Link

Components Required

- 5' of 5/16" Polypropylene rope
- Schweizer ring (Tow Plane end)
- (1) Stainless or Steel 1/4 -5/16" Rope thimble
- 1/4" and 1/2" Plastic Clear Tape with Fibreglass strands in 1 dimension/direction
- (1) 6" pieces of Black Rubber Washer hose 1/2" internal diameter

Procedure

- Attach a Schweitzer ring to one end of the short link as per Steps 2-7.
- Create a loop about 6" in diameter in the other end of the short link, and make a 6" splice as described in Steps 4-6.

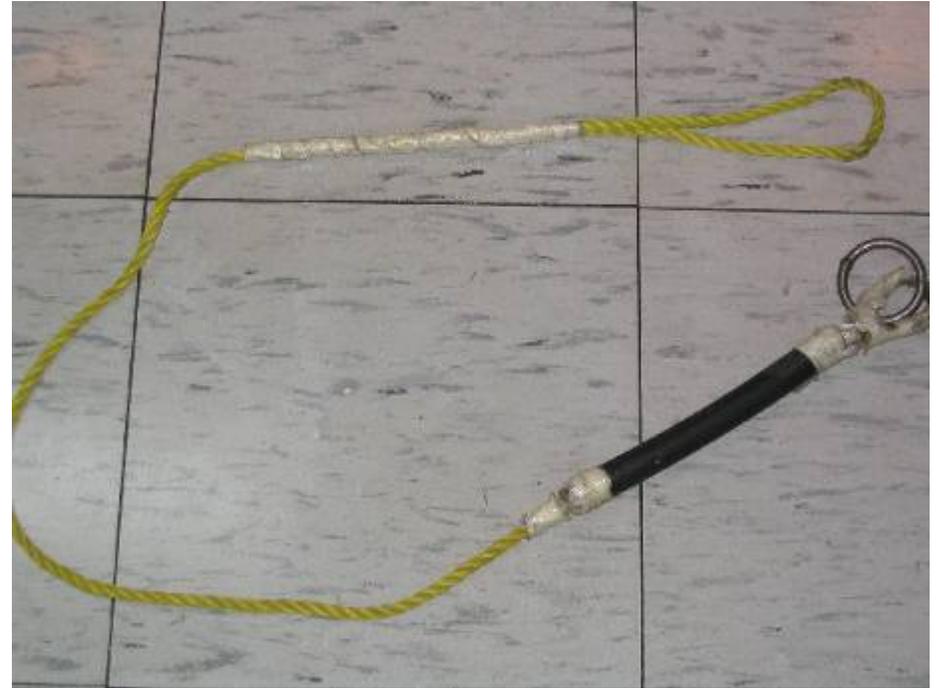


Figure 19 – Completed Schweizer Short Link

4. TOW ROPE BEST PRACTISES

4.1 Daily Operations

4.1.1 Daily Inspection

At the flight line the rope must be unreeled and inspected from tow plane to the glider end prior to use. This inspection should include both a visual and touch inspection based on running the entire length of the rope through ones fingers while looking at it. Most important is to look for cut strands or any indications of overstress or knotting – uneven delamination of the strands is the usual telltale sign.

4.1.2 Furry Rope Syndrome

Once a rope has had even abrasive wear it begins to get furry- small strands of the polypropylene stick out throughout the length. This is a telltale sign that the rope is ready for retirement and replacement.

4.1.3 End-of-Day

Available ropes should be cycled such that wear on them is evenly spread. It has been observed on many occasions that better ropes can be found deep on the reel or in the flight shack than the one in operational use. Also on many occasions ropes are left on the field at the end of the day. Either they are recovered by a future flight operation (sometimes a week or two later) or by a grass cutting tractor driver.

4.1.4 Rope Stowing

Be careful winding ropes onto the flight shack reel to take due care and caution to not nick or cut them!

4.2 Rope Re-Build

4.2.1 Tools

- Tin shears provide the best tool for reclaiming rope hardware from a rope being retired.
- Standard Kitchen Scissor/Shears seem to provide best option for new rope cutting that minimises the chance of nicking the ropes while building or re-working them.

4.2.2 Weak Link

A few feet of ¼” rope is used at the glider end to ensure that this will break in the event the rope gets tangled on something solid.

4.2.3 Thimble

Although use of thimbles increases the component count and the build complexity, their use largely eliminates the chance of rope breaks by minimising the wear on the rope loop at the ring. The glider end is most vulnerable to this type of wear. In fact most unexpected rope breaks can be eliminated by the inclusion of a thimble.

4.2.4 Repair/Re-build Cycling

A rope usually has 1-2 re-builds of the glider Tost/weak link before it reaches retirement. General, fuzz caused by abrasion along the length of the rope is an indication of time to retire. Usually, glider end ware is such that this state will not be reached.

4.2.5 Abrasion/Sun/Weather Protection

Use of Washer Black Tube rather than tape doubles or triples the end abrasion resistance. In fact rope lifetime that used to be limited by glider end abrasion tends to be limited only by total end to end abrasion.

4.2.6 Tape Experience

- Fibreglass weave (1d)- preferred abrasion resistance. Also inexpensive (under 2\$ per roll) and readily available (Canadian Tire or Grand & Toy)
- Fiberglas weave (2d) – available from speciality tape suppliers that stock 3M products- expensive, limited availability, abrasion benefits do not justify 10x cost increment
- Ordinary Black Electrical Tape - heats in the sun – subsequent abrasion causes rapid wear-still better than no tape- BUT NO longer recommended

4.3 Unusual Rope/Failure Events

4.3.1 Rope Damage

Young ropes with cuts, local fraying or abrasion to a single or more of the three strands can be cut at the wear point. The repair can be effected using an end to end splice (similar to the weak link splice between two different sizes of rope). Inevitably, the extra splice will increase wear on the rope and this should be carefully monitored during use. The increased wear will be lessened the closer the additional splice is to the tow plane end. A tow rope with more than one repair splice shall not be used. Spliced ropes should only be used as a temporary solution and they should be replaced at the earliest possible opportunity with a new rope.

4.3.2 Ring Hardware Damage

Although very rare, damage brought about by dragging rope through trees or ground obstacles/fences can be severe. We've very occasionally seen samples of sheared stainless steel thimbles. Such ropes should be retired on the premise that they have been overstressed.

4.3.3 Bad Rope Substandard Strength

One reel of rope purchased over the last decade was determined to be substandard. It simply kept breaking early in the tow (just after) slack was taken up and load increased. All of this rope was taken out of service after several like failures.