Kites for Connoisseurs

WannaBee

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WINDMAN BIEGOLMAI

The *WannaBees* are inspired by **Nest Lernout**'s kite *Bee Nest*. I saw the *Bee Nest* already at a kite festival in Washington/Sunderland in 1996 and liked it very much, but thought there was something fundamentally wrong with each bee: It had a pointed head and a round bottom whereas a real bee has a round top and the bottom, where the sting is, is the end that is pointed. I quickly made a clever design that only needed two sticks: one shorter for the body and one longer for the wings. However, it took till 2009 till I found material to actually make it: a single 200 cm piece of fibreglass rod cut into two parts was perfect for one bee: 78 cm for the body and 122 cm for the wings.

Size: 40 x 40 cm. Wind range: 3 - 6 m/s.

Material for a set of five kites.

- Black ripstop
  - 70 x 55 cm for bodies
  - 72 x 6 cm (5 pcs à 72 cm) for edge binding (or a total of 145 x 26 cm)
- Yellow ripstop, 70 x 12 cm for bodies
- White ripstop
  - 45 x 100 cm for wings
  - 2 x 70 cm, 5 pcs for wing sleeves (or a total of 145 x 50 cm)
- Coloured ripstop or transparent and silver mylar for eyes, 8 x 50 cm
- Black dacron, 6.5 x 55 cm
- White dacron, 2 x 20 cm
- 1.5 (or 1.6) mm fibreglass rod, 2 m, 5 pcs
- 1.5 mm mini Eddy dihedral, 5 pcs
- 3 mm plastic tube, 15 cm
- String for bridle and branch, < 10 kg, 11 m
- String for stack line, ~30 kg, 11 m
- Three-way swivels, ~15 - 50 kg, 5 pcs
- Snap lock swivels, small (~15 kg), 5 pcs
- Snap lock swivel, medium (~50 kg, 1 pcs

Choice of material.

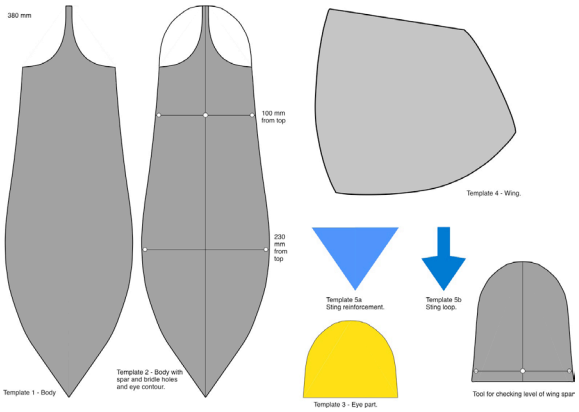
- The ripstop for the body should be rather stiff to make it easier to get the binding (step 13) to follow the outline of the body.
- The fibreglass rod should be of good quality so it doesn't break at the curve of the head. Both 1.5 mm and 1.6 mm will work. To avoid waste the length of the rod should be 200 cm, where 78 cm will be used for the body and 122 cm for the wing.
- The Eddy connector should be as small as possible, like the *mini Eddy* connectors used here (step 16).
- For sources of verified fibreglass and connectors see the very end of this document.

Templates.

Five templates are required for the different parts of the kite:

1. Body.
2. Body contour with spar and top bridle holes marked.
3. Eye part.
4. Wing.
5. Sting reinforcement, part a and b.

Furthermore there is a tool for checking wing spar level.



The templates come in separate alternative PDF and JPEG documents:

- one PDF for being printed on an A3 printer as two A3 pages.
- one PDF for being printed on an A4 printer as four A4 pages. For the A4 only two pages need to be glued together; the blue cross lines help for precise alignment of the body parts.
- The JPEG to be plotted out in full scale.

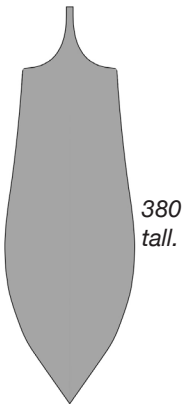
Quality printers should print out the PDFs in the exact size, otherwise plot out the JPEG.

1. Template 1 is used to cut out the body with the outtake for the eyes. It is crucial that the template is exactly 380 mm tall. If the PDFs don't print out in the actual size use the JPEG to plot out in full scale.
2. Template 2 shows the location of all holes for spars and for bridling. It also shows the full contour of the body including the eyes for the edge binding in step 13.

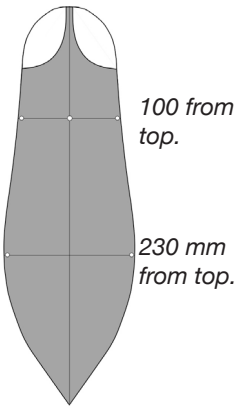
   Prepare template 2 by punching the holes for wing spars at the edge of the template (the holes should break the edge). Then punch the hole for the top bridle point. This is to ensure that the holes always come in the correct position, see step 20.

3. Prepare the tool for wing spar level checking by punching the three holes.

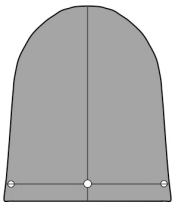
   The tool is for checking that the wing spar is straight in level (horizontal) and not slanted if the kite has problems flying straight.



Template 1. Body.



Template 2. Body with spar and top bridle holes.



Tool for spar level checking.

How to make the WannaBees.
As bees fly in swarms, the WannaBee kite should be made in sets of (at least) five, where the five preferably should be made in parallel, step by step.

Body.

4. Sew together 70 cm long strips of black and yellow ripstop. Seen from the front the parts should have the width measurements in cm, shown in the figure; from top: black 15, yellow 2, black 3, yellow 2, black 3, yellow 2 and black 10 when sewn together. Add sewing allowance depending of your favourite method of joining two straight panels:
   - For overlapping zig-zag (lapped seam with zigzag) add 10 mm to each yellow strip.
   - For folding-over double straight seams (plain seam with a single stitch) add 15 mm to all strips.
5. Use template 1 to cut out the five bodies.
6. Cut out the material for the eyes using the eye part template 3.

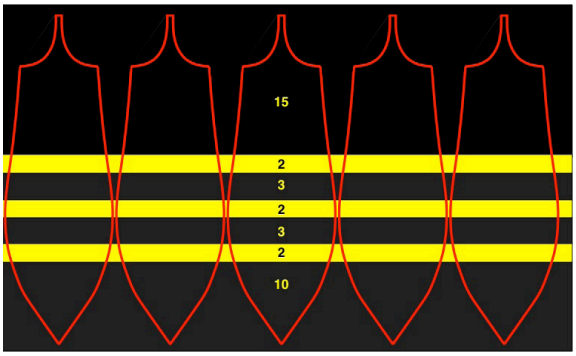
   The eye material can be ripstop in any colour. The best result is with a translucent material. For examples of holographic lens films with faceted eyes look see the end of this document. If using two layers (e.g. silver mylar or holographic film plus reinforced mylar) for the eyes the two layers should be sewn together first to avoid slipping between the layers.
7. Sew the eyes part onto the backside of the body. To prevent the eyes part from slipping out of position while sewing, fixate it to the body part by using a piece of adhesive tape, temporarily put along the straight base of the eyepart.
8. Cut out the excess material between the eyes on the backside.

9. Cut out the sting reinforcement parts in black dacron according to template 5a and 5b.

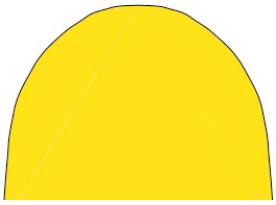
10. Sew the two dacron sting parts together with a single straight seam across 5b, from corner A to corner B of sting 5b, see dotted line.

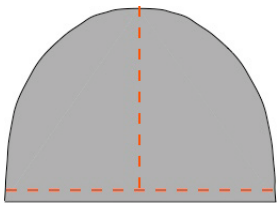
11. Sew the complete dacron sting reinforcement onto the sting of the body with a seam just inside the edges of the dacron triangle and with the loop part, 5b, facing out.

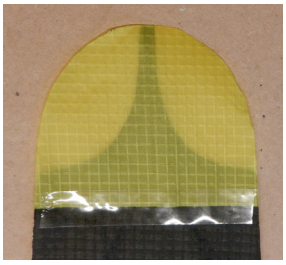
    Tip: to keep the alignment between ripstop and dacron it might be better to start the seam from one of the body sides instead of from the sting tip.

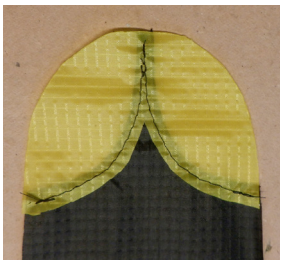


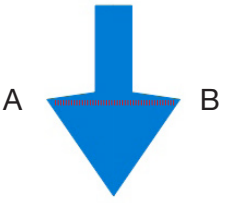
Black and yellow strips sewn together for five WannaBees. Measurement of strips in cm.


Template 3
Eye part.

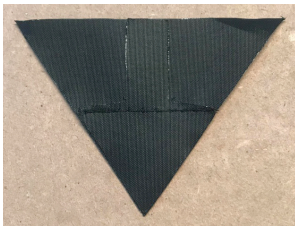

For double layered eyes sew first the two layers together as the dotted red lines show.

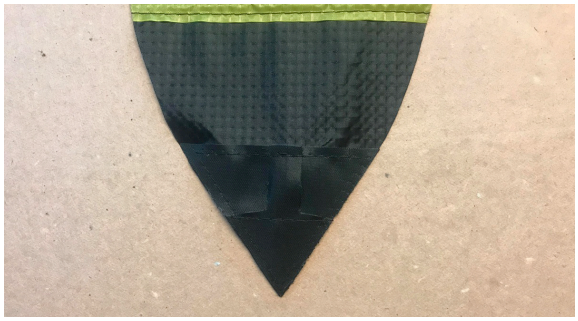

Backside with eye part taped to the body.


Eye part sewn and with excess eye material cut off.



Sting template 5b. Loop for rod connector.


The two sting reinforcement parts sewn together.



12. Glue a round (15 mm) dacron piece as reinforcement for the top bridle point with the centre 100 mm from top and in the middle of the backside of the body. (Use template 2 or the level tool if necessary to find the exact location.)
13. Sew a 2 x 71.5 cm ripstop binding around the edge, starting and finishing 60 mm from the sting tip, overlapping the sting dacron reinforcement with 10 mm. Sew the binding so that a 1.5 mm spar can be inserted into it.

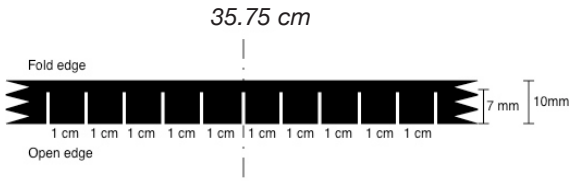
The edge binding and the dacron hole reinforcement are coloured red here for clarity only.

They should of course be black.

Since the radius of the head is less than 4.5 cm it is very difficult, if not even impossible, to sew a ripstop binding in a neat way along that very tight curve. For a cheap and dirty solution slits can be cut in the binding around the head top, see description below.

For discussion of alternative to ripstop binding see the end of this document.

'Cheap and dirty' solution for tight curve binding.
Fold the 2 x 71.5 cm binding double to 1 cm and make a sharp crease. Find the exact middle, 35.75 cm, by folding the binding double lengthwise. At this middle cut a 7 mm deep slit from the open side. On each side of this slit cut five similar slits with a space of 10 mm between each slit. Having the front side of the body up this will, with careful sewing, allow the binding to curve relatively smoothly around the top of the head.

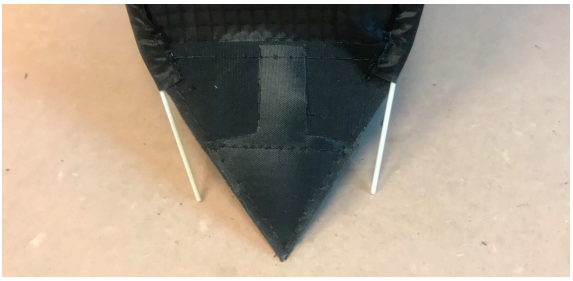


Binding around head top with 'cheap and dirty' solution.

If the edge of the eyes part tends to fold inwards inside the binding when sewing, the edge can be stiffened up by either applying a thin layer of wood or paper glue or colourless nail polish along the edge on both sides, or by gluing a piece of baking paper (same size as the eye part template 3) at the backside. Let the glue dry completely before sewing.

Fibreglass frame for the body.
1.5 mm fibreglass of good quality should be used both in wings and on body.

14. Cut the 200 cm long fibreglass rod in two parts:
    - For body frame: 78 cm.
    - For wings frame: Check that the remaining part of the rod is 122 cm. Put it aside for the time being.
15. Insert the 78 cm fibreglass rod into the sleeve around the body. To facilitate this put a 1.5 mm end cap on the rod end being inserted in the sleeve. Getting the fibreglass rod through the sleeve around the head (with the radius ~4.5 cm) can be a bit difficult, but with careful bending of the rod and a gentle pushing and pulling of the sleeve, little by little, it certainly can be done.
    Make sure that both sides have equally long rod parts at the bottom by 'standing' the frame straight up and "equalizing" the sides.



'Equalize' the rod ends by 'standing' the framed body up on the rod ends and simulateously on both sides pulling the skin down, thereby tensioning the skin around the head.

Joiner.
To join the ends of the fibreglass rod in the bottom of the body a small 1.5 mm "Eddy dihedral" is used. The superior Eddy dihedral to use is the mini 1.5 mm Eddy dihedral that can be found at e.g. *Wepa Flyer*, see "Sources" below. The "standard" 1.5 mm Eddy dihedral is far more bulky, and may bring difficulties in achieving a stable flight.

16. Insert the 'Eddy connector' through the loop in the outer dacron reinforcement.
17. Insert one side of the rods fully in the connector.
18. Then carefully insert the other end of the rod in the connector. Make sure it is fully inserted into the bottom of the connector.

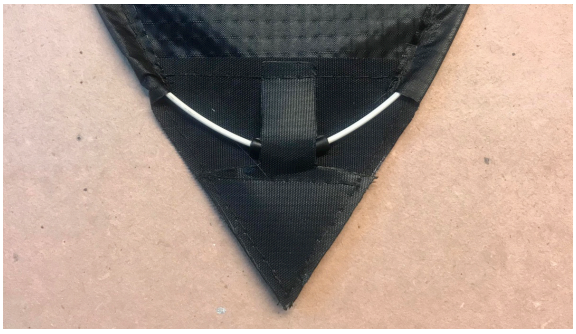
    Look at the flat body from the side and from the front to check that it is not warped. If it is warped: file off 1 mm on each rod end.

19. Using template 2 mark the position for the wing spar holes and the top bridle hole.

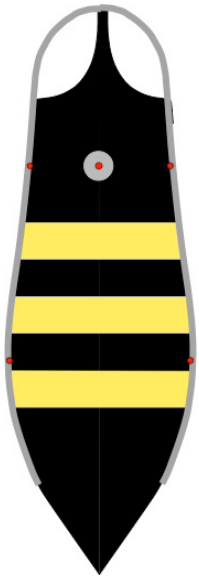
20. Burn with a soldering pen 1.5 mm holes at the marks (red dots) for the wing spars just <u>inside</u> the body frame spar. Burn also the top bridle hole.

Mini 1.5 mm Eddy dihedral from Wepa Flyer. This is by far the best connector to use.

"Standard" 1.5 mm Eddy dihedral. Avoid using it if possible.



Alert! A manufacturing advice.
Finish all the five bodies up to this point and let the bodies rest over one or two nights. The reason for this is that some fibreglass rods, despite that they are supposed to be of high quality, sometimes break somewhere around the head curve after a while. Replacing a broken fibreglass rod is much easier with only a bare body than with a complete kite with wings and bridle attached.

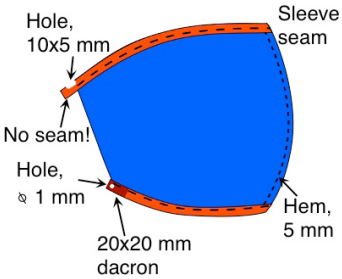


Edge hole just inside the body frame spar.

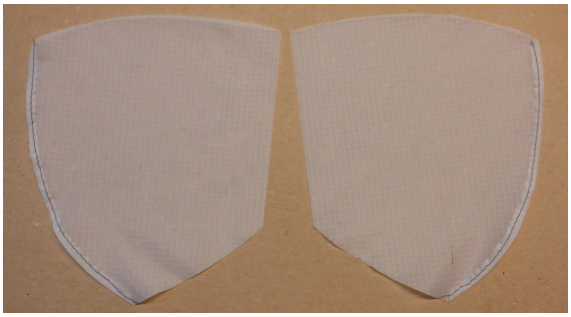
Wings.
The pair of wings are symmetrical, i.e. one left wing and one right wing. They have hems on the outer edge and sleeves for the wing spars. The sleeves are also used to fixate the wings to the body frame, so both sleeves are slightly protruding at the inner body edge.

21. Cut out the wings in white ripstop (or light mylar).
22. Cut four 2 cm wide strips, two of 13 cm and two of 21 cm long, of the same ripstop for the wing sleeves.

23. Hem (single hem) the outside of the wing (opposite the straight side). Note that the hem must be on different sides of the material for the two wings, since there is a left wing and a right wing.



Principle view of wing part with hem and sleeves. The different colours (red and blue) in this drawing are just for making the picture more clear. The sleeves should be of white ripstop like the wing.

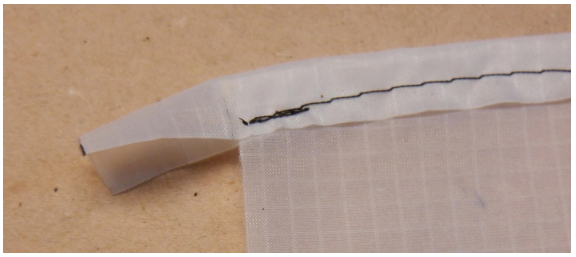


Wings with symmetrical hems on the outer edges.

24. Prepare the shorter rear sleeves by sewing a 20 x 20 mm dacron reinforcement at one end. A single seam across the inner end of the dacron is enough to fixate the dacron to the ripstop.

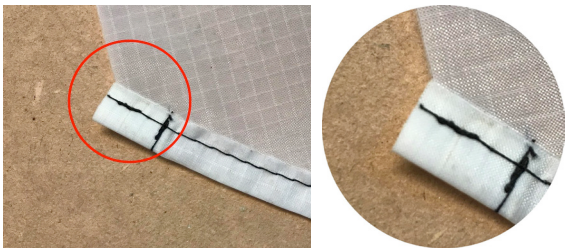
Dacron reinforcement fixated with one single seam across one end of 13 cm rear sleeve.

25. Fold all four sleeves double along the middle and make a sharp crease on each sleeve. For the shorter rear sleeves the dacron should be on the inside when folded.
26. Sew the separate sleeves on the curved front and rear edges of the wings.
    - The 21 cm front sleeve should protrude 20 mm on the inside of the wing (the straight side), creating a 'flap' without any seam. Start the seam on the top sleeve at the straight edge where the wing ripstop begins.



Front wing sleeve with flap on inside (straight side) of the wing.

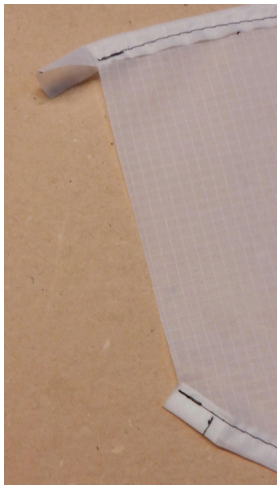
    - Align the open corner (inner corner) of the dacron on the 13 cm rear sleeve with the straight edge of the wing so the closed corner (with the crease) is protruding ~8-9 mm. (darker red in the figure above).



Rear wing sleeve with the reinforced end protruding on the inside (straight side) of the wing and the inner corner of the dacron aligned with the straight edge.

    - Trim the sleeve ends along the outer wing edges.

Put the wings on top of each other and check that they are exactly the same size after the sleeves have been added. Even small differences in sizes may cause balancing problems.



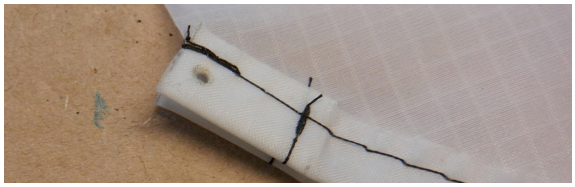
The inside (straight side) of the wing with both front and rear sleeves slightly protruding.

Sleeve end trimmed along outer wing edge.

27. Cut an oblong hole 10 x 5 mm in the flap of the top sleeve, just outside the straight edge of the wing.

The top sleeve: an oblong hole through the flap.

28. Punch a 1 mm hole in the bottom sleeve 3 mm inside the dacron corner of the sleeve. The hole should be on the outside of the straight edge of the ripstop. To get the holes perfectly symmetrical on both wings align both wings on top of each other and punch the hole through both wings at the same time. This hole is for the horizontal bridle string.



The bottom sleeves: 1 mm hole through both wings, through the dacron.

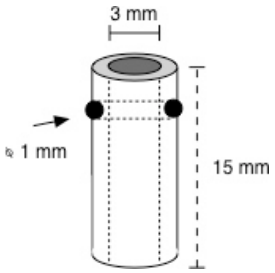
Fibreglass frame for wings.

29. Check that the remaining part of the fibreglass rod actually is 122 cm; if longer cut it to 122 cm. Mark the exact middle, 61 cm, with permanent marker to make it easier to position the rod middle at the upper bridle hole and to attach the bridle in correct position.

The middle of the wing fibreglass rod marked.

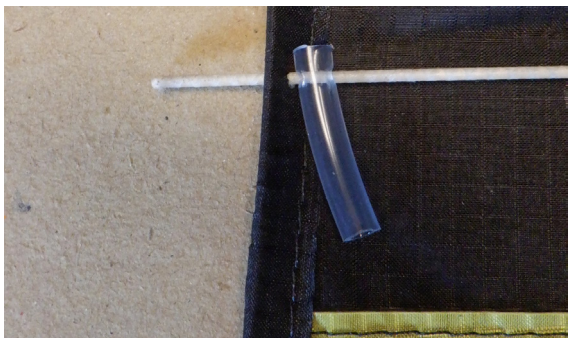
Wing connectors

30. Prepare 2 pieces of 3 mm (inner diameter) plastic tube of 15 mm length.
31. Punch a 1 mm horizontal hole straight through the tube 5 mm from the top.

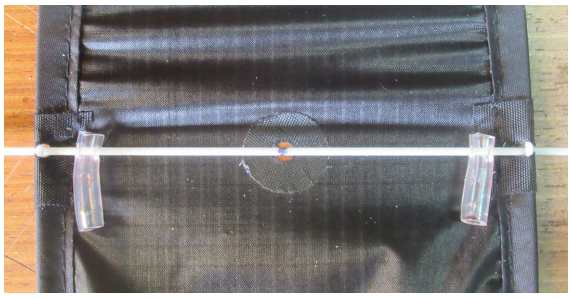


32. Insert the 122 cm long rod through the upper hole in the body edge from the front and under the frame rod. Then insert the rod into the 1 mm hole in the plastic connector.

33. At the other side: Insert the rod first through the 1 mm hole in the plastic connector, then into the edge hole and under the frame rod.

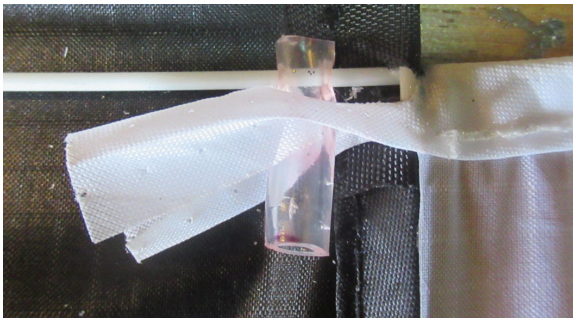


34. Continue to insert the rod until the centre mark of the rod is at the bridle hole in the body.



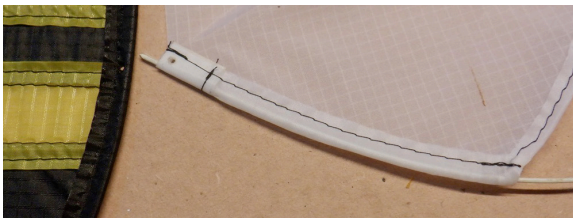
35. Pull one wing part over the rod, through the oblong hole of the front wing sleeve then inside the sleeve. Make sure the hem on the outer wing edge faces the backside of the body.

36. Pull the flap with the oblong hole from under onto the plastic connector. The flap is for securing the wing fabric in its place.



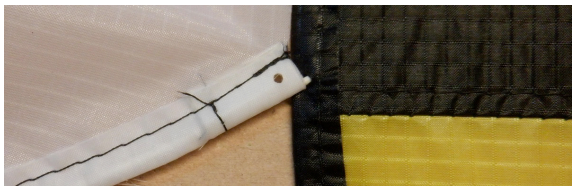
37. Do the same with the other wing part.

38. Bend the free end of the rod and insert in the outer edge of the bottom sleeve of the wing.



39. At the end of the sleeve insert the rod <u>from the front side</u> of the body into the edge hole in the body.

    Pull the edge of the wing close to hole in the body.

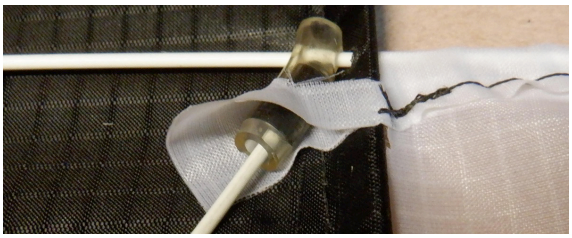


View from front: the sleeve corner is slightly overlapping the body.

40. Now glue a 1.5 mm end cap to the end of the rod.
41. Do the same (steps 38 - 40) for the other wing side.

42. Insert the rod ends crosswise in the plastic connectors at the wing fronts.

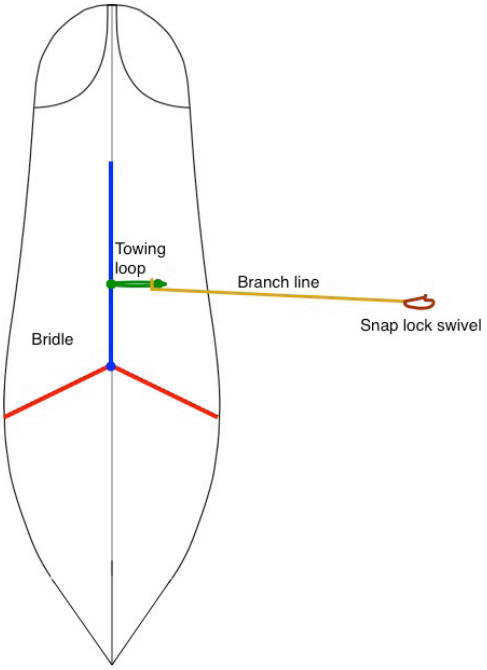
    Normally it doesn't matter which rod part is put on top of the other. However, if it seems impossible to achieve a stable flight the solution might be to swap the order of over/under of the crossing rod parts.



Bridle system.
The line system of a *WannaBee swarm* consists of three parts: individual bridles, branch lines and a stack line. All lines should be of braided type (not twinned).

- The bridle and the branch line to each kite should be thin (~ 10 kg).
- The stack line should be different and more strong (20 - 30 kg).

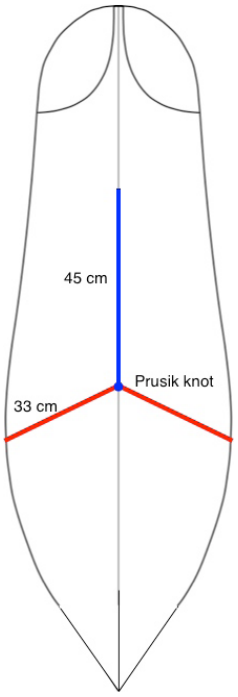
Avoid slippery string for the bridle and branch.



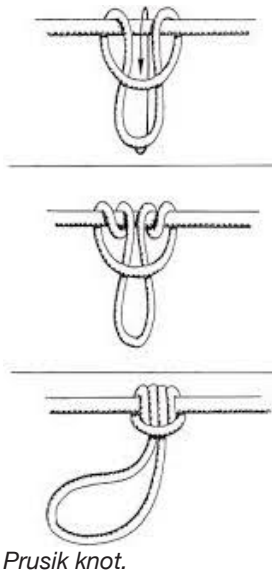
Bridle introduction.
The bridle system for a single kite consists of four parts: A three-point bridle, a towing loop, a branch line and, in the end of the branch line, a snap lock swivel.

The branch line is attached to the front part of the bridle via a towing loop that is tied to the bridle using a Prusik knot.

The three-point bridle consists of two strings and a towing loop. The horizontal string (red) should be cut to 33 cm and the vertical string (blue) to 45 cm. The lengths are optimized so that the bridle can not slip over the sting or the wings. The vertical string is attached to the horizontal string with a Prusik knot to make adjustments sideways easy. The other end of the vertical string is simply tied to the centre of the wing spar.



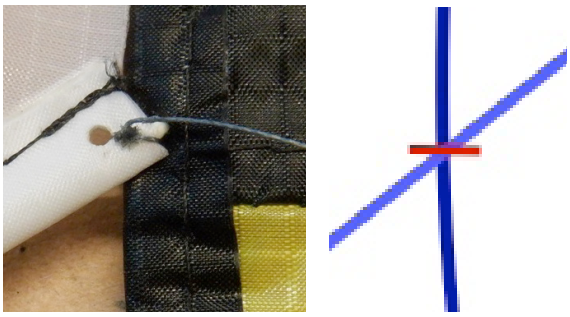
43. Cut the two strings for bridle: 33 and 45 cm.



Prusik knot.

44. Tie the 33 cm horizontal string through the holes in the wings over the wing spar and the body frame.

    Use slip knots so the knots can be widened if a spar needs to be replaced.

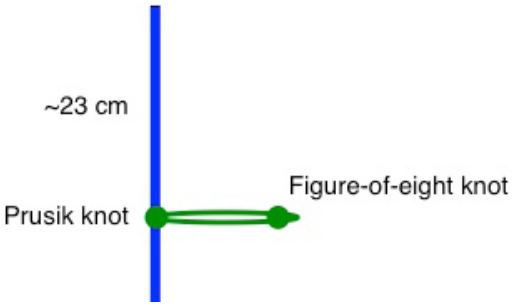


Rear bridle string (red in the figure) tied around both wing rod (light blue) and body rod (dark blue).

45. Tie a small (5 cm) loop in one end of the 45 cm vertical string and tie the loop to the horizontal string using a Prusik knot.
46. Tie the other end of the vertical string to the marked centre of the wing spar, through the hole in the sail.

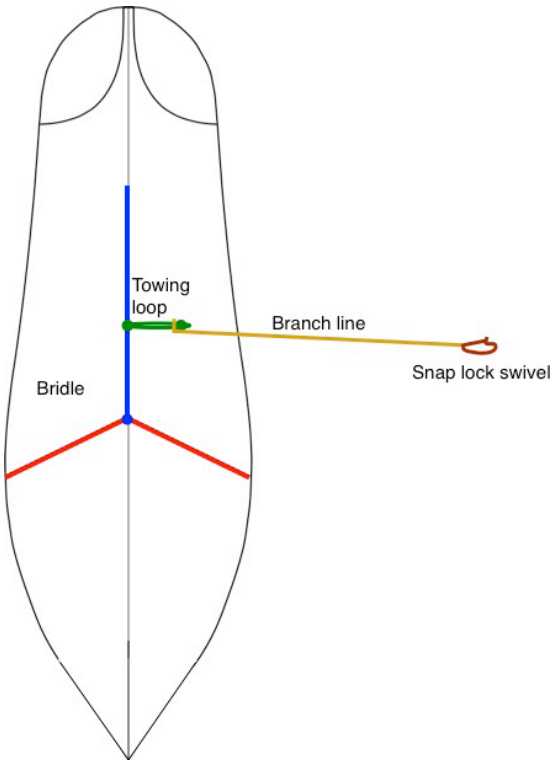
    Also here use a slip knot for the same reason as above.

47. Cut 15 cm of the same kind of thin string, fold it double and tie a figure-of-eight knot in the end.
48. Tie this loop to the vertical string with a Prusik knot. The loop should be fixed at about 23 cm from the top.



49. Cut a 110 cm piece of the same thin string for branch line.
50. Tie a 5 cm loop in both ends.
51. Tie one of the loops around the towing point loop using a lark's head.
52. Tie a snap lock swivel in the other end, slipping the loop through and over the snap lock swivel.

    (The term "snap lock swivel" is used throughout this document instead of "Snap swivel" or "Swivel" to emphasize the three functions of the item, see picture at next page.)



53. Wind the branch line of every kite diagonally around the kite and hook the snap around the wing spar on the backside of the kite.

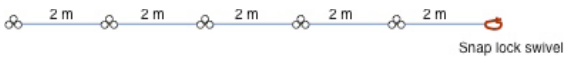
Preparing the stack line for 5 WannaBees.
The stack line consists of five segments of 200 cm line plus five 3-way swivels. The stack line should be visually different and stronger than the branch lines and up to 30 kg. The use of visually different lines for branch and stack is also important to make the winding out and winding in of both stack line and branch lines more easy.

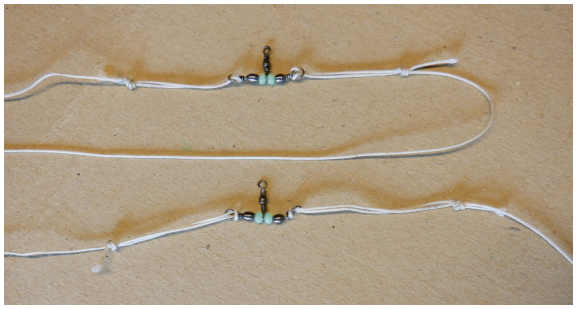
If there are more then two segments of five WannaBees in a swarm the additional segments should have larger 3-way swivels.

The small items used for the WannaBee
- *3-way swivels.*
- *a small snap lock swivel for each branch line.*
- *a larger snap lock swivel for the end of the stack line.*

Note that both snaps must have the latching function (lock) to avoid accidental opening during stress!

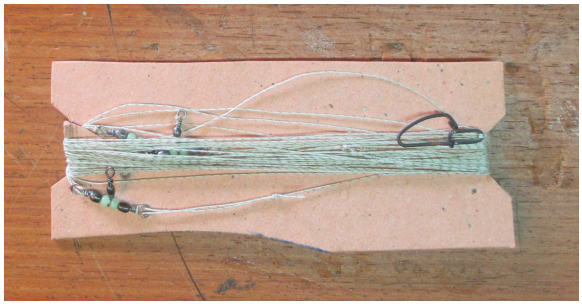
54. Cut five pieces of line, each 210 cm. Use 5 cm in each end to tie a loop.
55. Start from left in the drawing and tie the loop in one of the two symmetrical points of a 3-way swivel.
56. Tie another 3-way swivel in the loop in the other end.
57. Repeat steps 55 and 56 until all five segments are complete.





58. Tie a larger snap lock swivel at the end of the last segment.

The kite strings (branch lines) are NOT to be connected to the stack line yet. Each kite needs to be test flown first.



59. Wind up the stack line temporarily on a piece of card board.

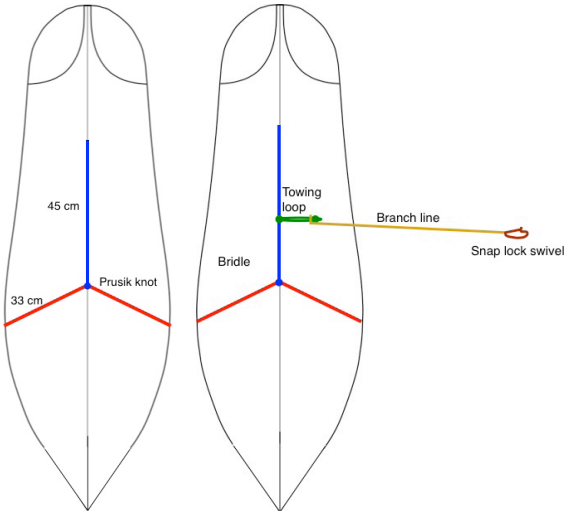
Preparation of a WannaBee Swarm for First Flight.

Tuning of the bridle.

The tuning must be done individually for each kite before the first flight of the swarm. A good breeze, at least 3 m/s, is required for a reliable test flight.

60. Adjust the Prusik knot on the rear, horizontal, bridle so it is exactly under the front bridle hole.
61. Check that the wing cross spar is perfectly horizontal and not slanted.
62. Check that the front bridle point is still fixed on the mark for the centre of the wing cross spar.
63. Adjust the towing point on the branch line so the kite gets an approximate angle of 15 - 20° to the horizontal plan. This should be 22-23 cm from the front bridle point.
64. Attach the branch line to a thin kite line and test fly. If the kite doesn't fly straight and steady tune the position of the Prusik knots:
    a. If the flight is unstable: move the towing point Prusik knot towards the rear until the flight is stable. If the kite won't lift: move the towing point forwards. The best towing point is usually just in front of the lifting point. Move the knot 1 - 2 mm at a time.
    b. If the kite leans to one side move the rear Prusik knot: if the kite leans to the left: move the knot to the right, 1 mm at a time until the kite flies straight. Vice versa if the kite leans to the right.
    c. If **b.** doesn't work then shift how the wing rods cross each other on the backside (over and under), see step 42.

It is however not necessary to get each WannaBee flying perfectly balanced since they will be swarming around anyway; it is perfectly normal for a bee to dance a little.



Approoximate position of the towing point, ~23 cm from front bridle point.

65. When the kite flies well, wind in the branch line diagonally around the kite (see step 53) and repeat the tuning for the other four kites until all five kites fly well. You might want to apply a drop of super glue on the towing point Prusik knot to prevent it from moving.

WannaBee Stack Line.

The WannaBee Stack Line allows five WannaBees to fly in a swarm. Each WannaBee is connected to the stack line via a snap lock swivel that is hooked onto the horizontal point of a 3-way swivel.

The stack line has a larger snap lock swivel in the bottom end so it can securely connect to the top of a 3-way swivel on a second stack line, which gives 10 WannaBees in the swarm. (20 WannaBees in one swarm have been tested but that is certainly not the maximum.)

66. When all five kites have been tuned, lay out the stack line on the floor and then attach the WannaBees to the 3-way swivels of the stack line. Put the best flier of the five kites on top.

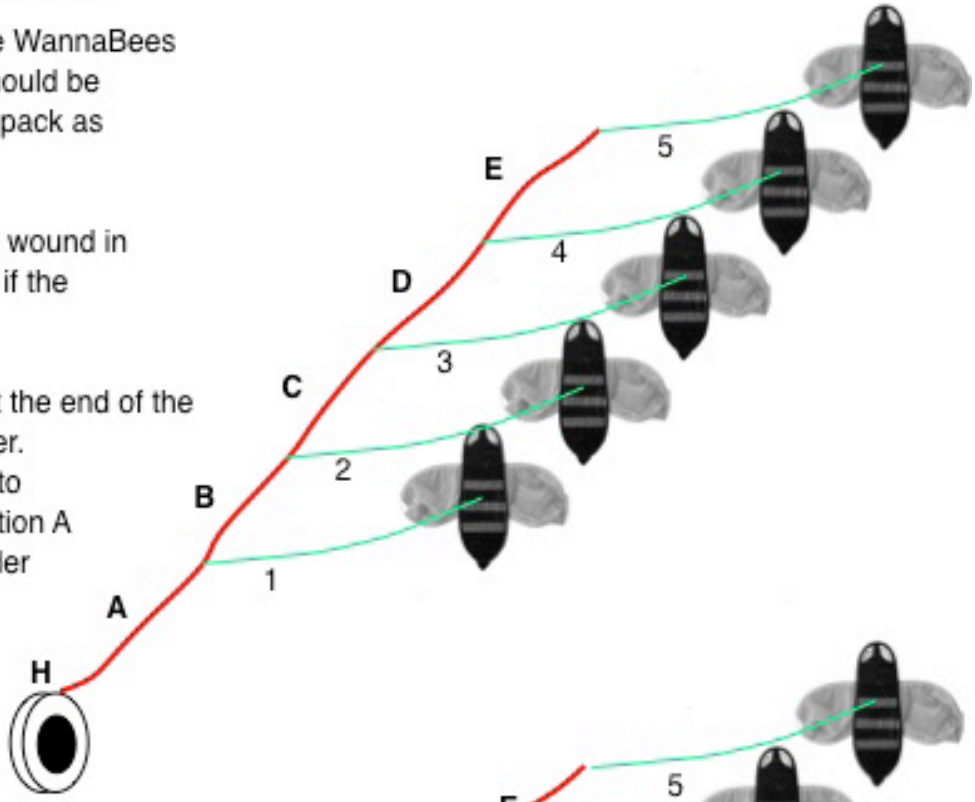
Stack line for five WannaBees.

Winding in a WannaBee stack

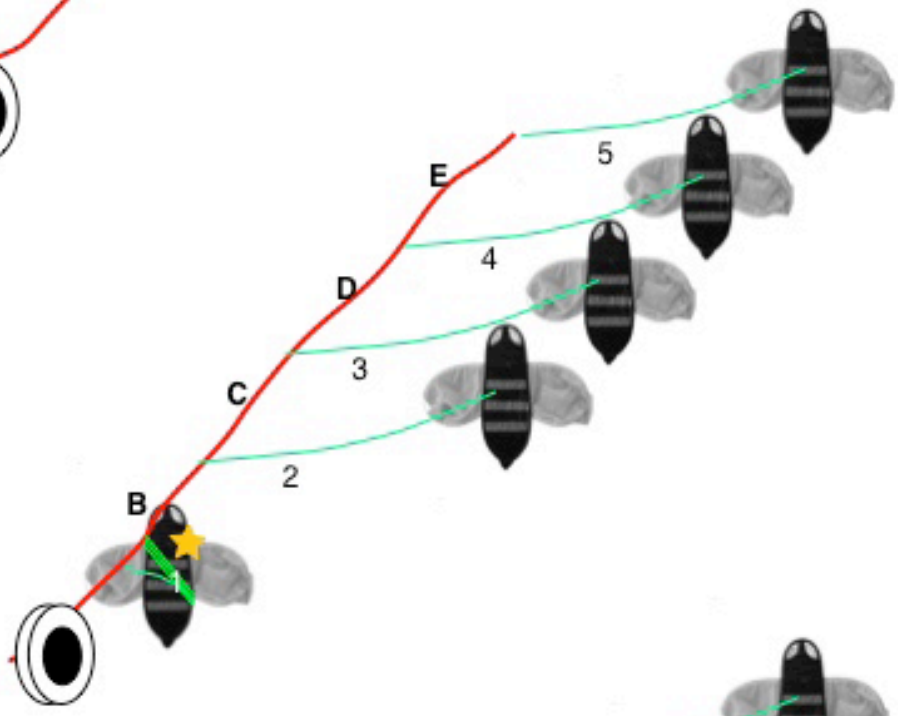
1. After having connected the WannaBees to the stack line, the stack should be carefully wound up to a neat pack as follows:

(The WannaBee train can be wound in whilst flying in the same way if the wind is moderate).

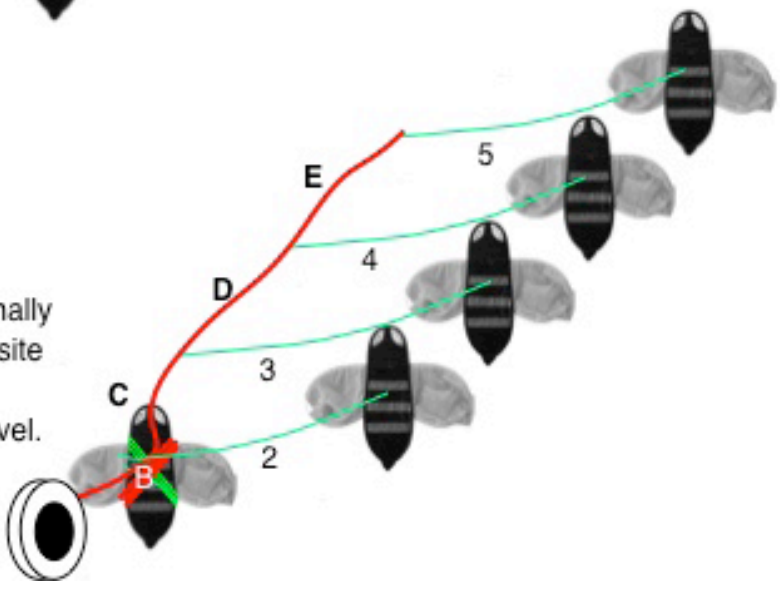
Attach the snaplock swivel at the end of the stack line to a line on a winder. With the hook H still hooked to your kite line wind in line section A of the stack line on your winder till the 3-way swivel of the first WannaBee.



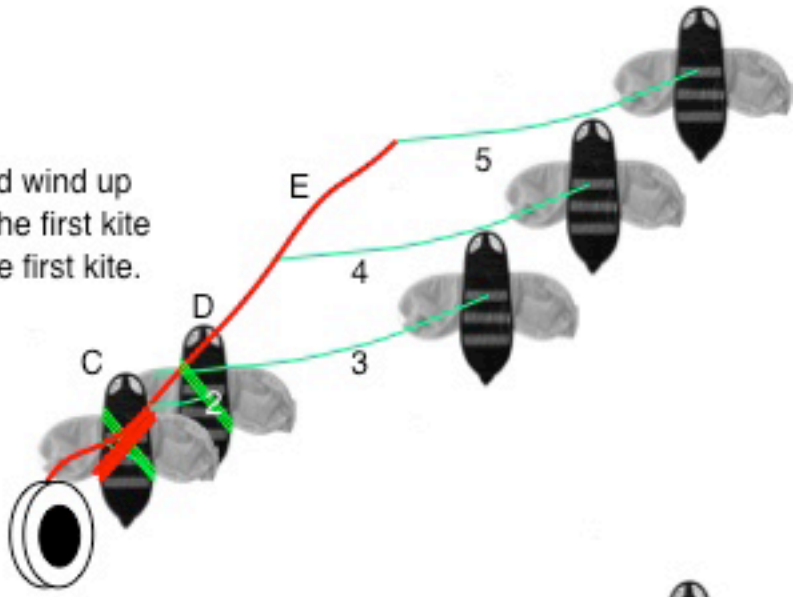
2. Grab the first WannaBee at the right wing/body connector (yellow star) and wind up branch line 1 digonally around the body.



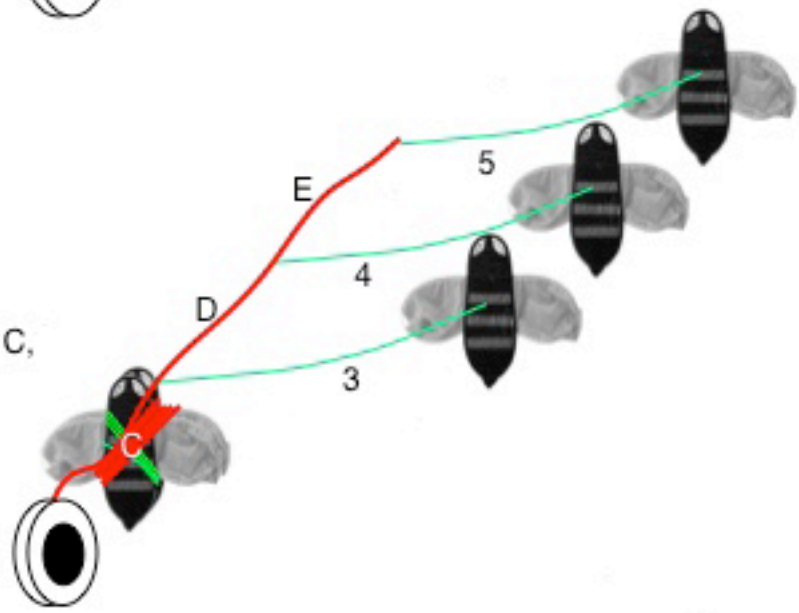
3. Wind up the stack line, section B, diagonally around the body of the WannaBee in opposite direction, so the two lines create a cross. Wind the stack line up until next 3-way swivel.



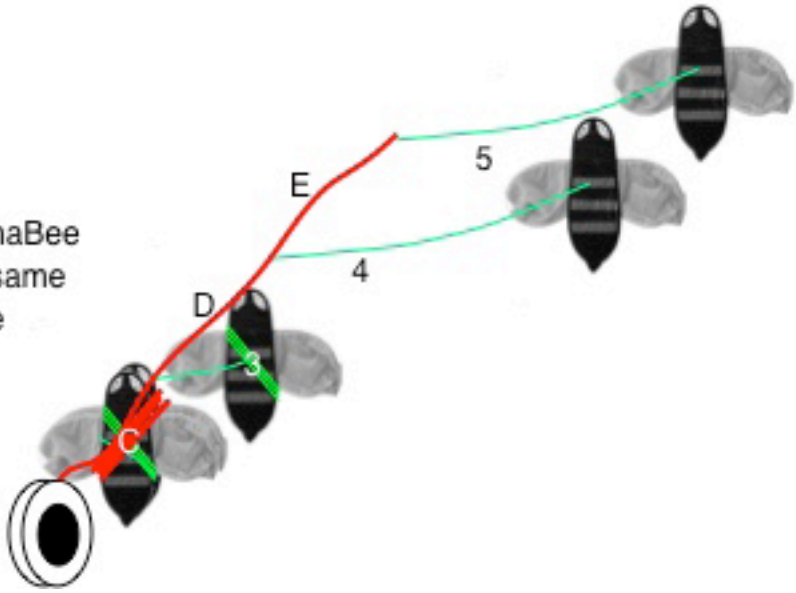
4. Grab the second WannaBee and wind up branch line 2 in the same way as the first kite and put this kite on back side of the first kite.



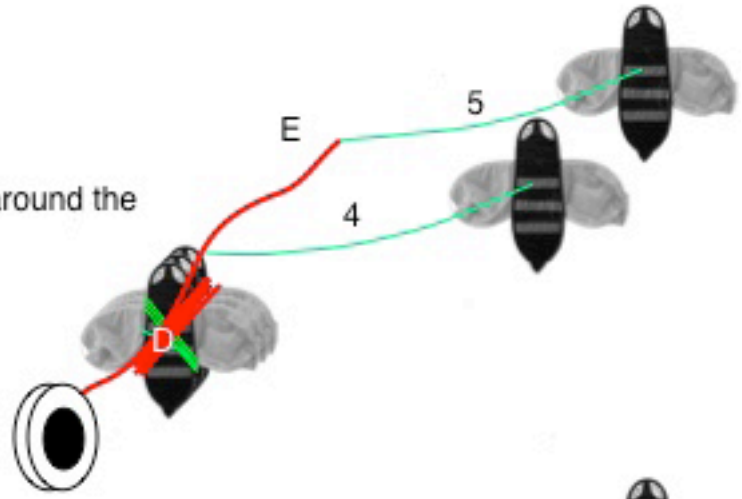
5. Wind up the stack line, section C, around the two kites diagonally as the previous section.



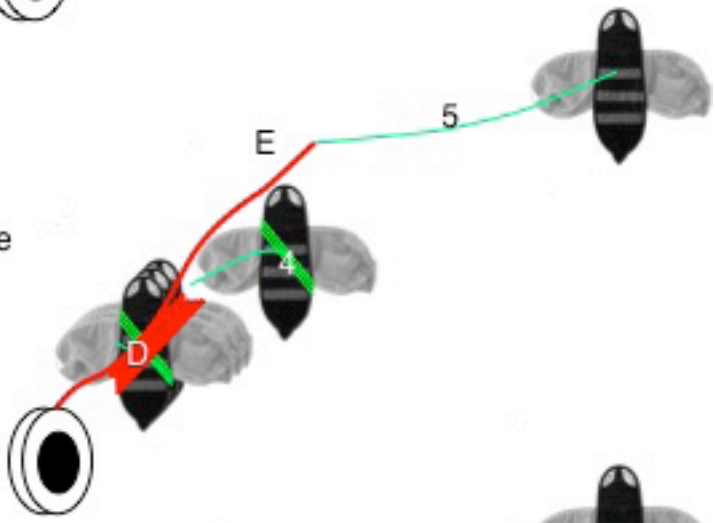
6. Proceed to grab the third WannaBee and wind up branch line 3 in the same way and put this kite on back side of the two other kites.



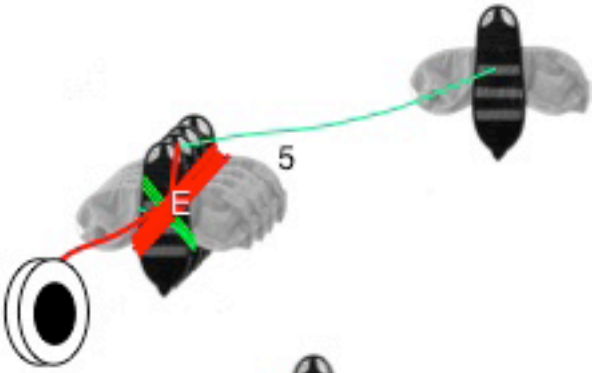
7. Wind up the stack line, section D, around the three kites.



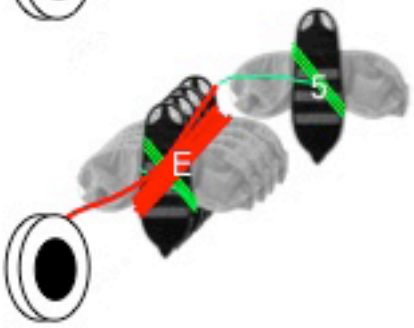
8. Proceed to grab the fourth WannaBee and wind up branch line 4 in the same way and put this kite on back side of the three other kites.



9. Wind up the stack line, section E, around the four kites.



10. Grab the fifth WannaBee and wind up branch line 5 in the same way and put this kite on back side of the four other kites.



11. Finally unwind the bottom part of the stack line (section A) from the spool, unhook it from the spool line and wind it around all the five kites in the same way as the previous sections. Secure the snap lock around the wing spar on the back of the fifth kite.

Flying a WannaBee swarm.
The WannaBee swarm needs a fairly good breeze to fly well: 3 ms / 11 kmh / 6 knots or 4 Bf. The wind range is 3 - 6 ms.

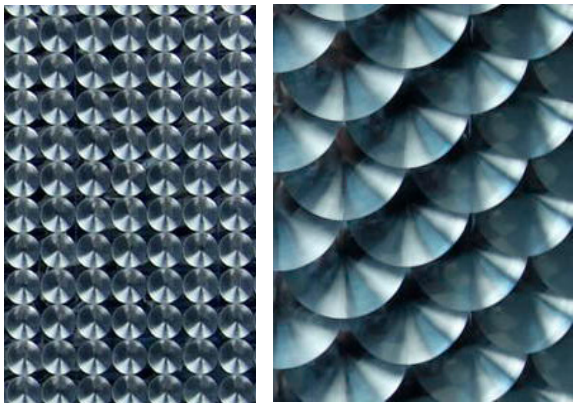
Winding out the pack of WannaBees is like winding in but in reversed order:

A. Detach the larger snap lock swivel of the stack line from the backside of the WannaBee pack and attach it to a flying line. Unwind the bottom part of the stack line from the pack while simultaneously winding it in on the line reel. When the top WannaBee is free, just release the kite in the air; normally the branch line will unwind itself from the kite (unless it gets stuck) and the kite will get airborne.

B. Unwind the top segment of the stack line (this is why the stack line and branch line should be visually different and wound in different directions across the WannaBee body) till next WannaBee is free and release this in the air. Proceed in the same way till all five kites are in the air. If the wind is strong, be careful so the remaining stack line around the swarm pack doesn't squeeze the remaining kites.

***Alternative eye materials*.**
Instead of using ripstop for the eyes silver mylar film or holographic lens film can be used. Google '*holographic lens film*'!

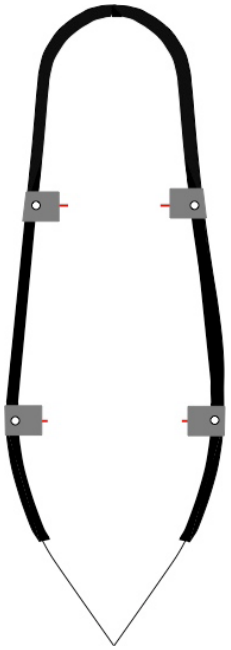
Since these materials tear easily they need an extra layer of reinforced mylar on the back side, see step 6.



Examples of holographic lens film with faceted eye look.

***Alternative edge binding materials*.**
Option 1. Instead of ripstop ordinary bias binding can be used, but since this material will easily fray, the holes for the wing spars must be reinforced with a short piece of ripstop or dacron.

Option 2. Make your own biased ripstop binding by cutting 75 cm long strips of black ripstop in a 45° angle to the grain of the ripstop.



Reinforced spar holes when standard bias binding is used.

***Source of materials*.**
Ripstop and such can be found in most kite material shops, but the fibreglass rods of sufficient quality and the mini Eddy connector are more scarce.

The type of fibreglass that is called 'spiral wound' (or 'wrapped') has proven to withstand the curvature of the head best.

In Europe at least two online shops, *Metropolis Drachen* in Germany and *Wepa Flyer* in Belgium, have this type of fibreglass rods (where Metropolis has the by far better price), but only (to my knowledge) Wepa Flyer provides the mini Eddy connectors.

***Fibreglass rod*.**
- *Metropolis Drachen*: 1.6 mm x 200 cm, Fiberglass rod wrapped.
  - https://www.metropolis-drachen.de/en/Kite-materials/Rods-Tubes/Glass-fiber-GFK-Wood/Fiberglass-rod-wrapped.html € 1.30
- *Wepa Flyer*: Fiberglass X-Reinforced Ø1,5/200
  - https://www.wepaflyer.de/cgi/shop.cgi/glasfiber-xrif-vol-o1-5mm/?site=wepaflyer-de&details=008531;conpag=p005993 € 7.95

Spiral wound 1.6 mm x 200 cm fibreglass rod from Metropolis Drachen. Though it nominally is 1.6 mm it fits in the mini Eddy connector.

Spiral wound 1.5 mm x 200 cm XRIF fibreglass rod from Wepa Flyer. The other rod types (with smooth surface) from Wepa Flyer break easily at the head curve.

Note: You will get a full set of five rods from Metropolis Drachen for the same price as one XRIF from Wepa Flyer.

***1.5 mm Eddy connector*.**
The online shop Wepa Flyer in Belgium has proved to have the perfect Eddy connectors required for the WannaBees:
- Mini 1.5 mm Eddy connector
  - https://www.wepaflyer.com/cgi/shop.cgi/eddy-v-kruisstuk-15-1-5mm-mini/?site=wepaflyer&details=009759 € 0.50

2021-11-21