

*Kites for Connoisseurs* is a collection of plans for kites designed by Andreas Ågren. These kites often have a unique technical twist. The plans can be found at *http://windman.se/kite-plans* and they may not be used for commercial purpose without written consent.



**Rondevoo 5-2** is an ultra light wind kite made as an homage to **Ron Arztmann**. In 2020 Ron gave me two pieces of light weight ripstop: *Bainbridge AirX 500N* at 30 grams/meter and *AirX 400N* at 26 grams/meter. At that time I didn't have any suitable project in the pipeline, and after he passed away I thought I needed to create something very special, so I just kept waiting for an idea.

The name *Rondevoo* came first and after that the idea of an ultra low wind kite with dual leading edge. The design is basically like an Indonesian/Indian fighter kite, built with experiences from the *Ronbus* 5-3 kite, but with a higher aspect ratio: 2.4, and with vented front sail.

#### Featured design details

- *DLE* Dual Leading Edge the front panels are vented in the bottom.
- KUF Soft Kick Up Front the front half of the spine is bent upwards.
- *ISD* In-Sail Dihedral the rear panels have extended trailing edges.
- HAR High Aspect Ratio 2.4.
- *SP* Single Point three separate tow points for ultra low wind, low wind and medium breeze.

Rondevoo 5-2 is intended to be built in very light materials, such as *Bainbridge AirX* 500N/400N, *Icarex PC31* or *Skytex 27* and with a frame of *Skyshark* tubes, such as *P90* (5 Skyshark pieces for the bent cross spar and 2 Skyshark pieces for the spine, hence **5-2** in the name). Dimensions: 402 x 166 cm.

# Material

- Light weight ripstop, like: Icarex PC31 or Bainbridge AirX 500N/400N or Skytex 27
- Skyshark tubes: 6 pieces P90 + 1 piece P2X
- Internal ferrules for Skyshark tubes
- 3 mm carbon tube or carbon rod, 2 x 200 cm
- 3 mm ferrules, 4 pcs
- 1.5 mm fibreglass rod, 2 x 50 cm

# Sail

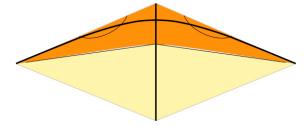
The four panels on one side are all different: A and B have a curved spine edge for the soft kick-up front, C has a straight vertical spine edge and D has a slanted spine edge for the in-sail dihedral. The provided templates of the four panels of each side are in full size: the thick grey lines along the edges indicate seam overlapping, hems and sleeves. The inside of the grey lines represent the actual size of the sail.

Since all seams are straight, a folding-over double straight seam (plain seam with a single stitch) have been used throughout.

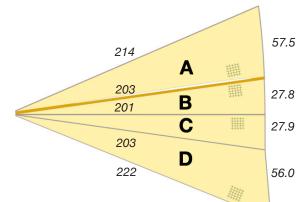
- 1. Cut out the panels A D for both sides. Note the grain directions, especially on panel A: it is parallel with the side facing panel B because of the venting.
- 2. Starting from bottom with panel D: sew together panels D, C and B. Fold the seam allowance upwards (onto C resp. B).

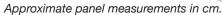
- 3. Chalk a guide line on the back side of panel B, 25 mm inside the free long side of panel B, for the sleeve of the second leading edge support; the 3 mm carbon tubes/rods.
- 4. Cut 4 x 10 mm holes in the to-be sleeve, 3 mm from the upper edge, for entry and exit of the support 3 mm carbon tubes/rods.
  - a. At the wing tip: Entry hole 12 cm from the wing tip.
  - b. At other end: Exit hole 6 cm from the spine edge.

- End caps and one split end nock
- Dacron for reinforcements and pockets
- Velcro
- 1 small alu O ring or D ring
- 1 small stainless steel ring, Ø 6.1 mm
- Small rubber ring
- 2 lobster claw hooks, ~35 mm of solid brass



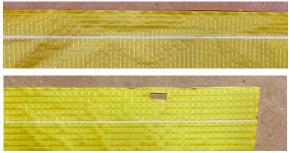
Rondevoo 5-2 with frame. Size: 402 x 166 cm Weight (with AirX 500N and Skyshark P90): ~295 gr.







Upwards folded seam allowances as seen from top (panel B).



4b. Exit hole for 3 mm tube/rod 6 cm from the spine edge.

- 5. Fold the long side so the edge runs along the guide line and sew the 1.25 cm wide sleeve, with the seam as close to the edge as possible.
- 6. Panel A is sewn onto the front side of panel B in two sections: at the spine and at the wing tip. The space in between the two sections is open between the two panels. While sewing make sure that the seams don't interfere with the sleeve on panel B. The width of the resulting sleeve should be enough for 3 mm ferrules.
  - a. Reinforce the inner corners of the cut-out on panel A with dacron roundels, 2 cm in diameter, and trim the inner corners.
  - b. Put the joint panel D, C and B on top of panel A, with the front side of the panels facing panel A (the cut out holes upwards and the inner corner reinforcements, made in step 6a, facing the table), the sleeve on panel B in line with the edge with cut-out on panel A, and the top corner of panel A directed towards the bottom corner of panel D.
  - c. Align the edge of the spine side section of panel A with the upper edge of the sleeve (with the cut out hole 6 cm from the edge).
  - d. Sew a seam that runs along the edge of the hem, just <u>outside</u> (close to the edge) of the sleeve seam.
  - e. Align the edge of the wing tip side section on panel A with the upper edge of the sleeve on panel B in the same way, and the wing tip with the wing tips of the other panels.
  - f. Sew a seam that runs along the edge of the hem, outside (close to the edge) the sleeve seam.
  - g. Fold panel A upwards.





Reinforced inner corners, trimmed for the cut-out.



The sleeve of panel B aligned with the spine side section of panel A.



First seam along the edge of the sleeve (below the sleeve seam).

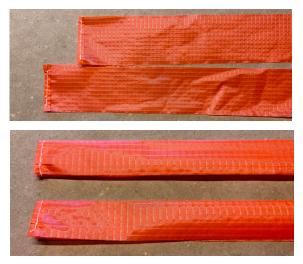


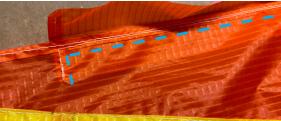
- h. Still from the backside of the sail sew the second seam just along the outer (top) edge of the sleeve on both sections.
- i. Before continuing: check that a 3 mm tube/rod with ferrule can be inserted in the sleeve all the way.
- 7. Repeat 2 6 for the other side.
- 8. Sew the two sail halves together, starting from the top corner (panel A).
- 9. Hem (5 mm) the whole leading edge (both sides of panel A).
- 10. Hem (5 mm) the whole trailing edge (both sides of panel D).
- 11. Sleeves for the cross bow should be sewn on the leading edge, starting 12 cm from the wing tips.
  - a. Cut two pieces of 5 x 85 cm and hem both short edges of the sleeve pieces.
  - b. Fold the sleeve piece along the 2.5 cm middle and make a <u>sharp</u> crease.
  - c. Make a mark on the leading edges on panel A, 12 cm from the wing tip.
  - d. With the back side of the sail <u>upwards</u> align the sleeve end with the mark, wrap the sleeve piece around the leading edge and align the crease with the leading edge, 3 mm <u>outside</u> the edge.
  - e. Sew a seam that starts with closing one short end, then runs along the leading edge and finishes by closing the other short end.

- f. Fold the sleeve piece over along the crease and sew a seam on the long side.
- g. Repeat for the other side.



Second seam just inside the top of the sleeve. Dashed blue line indicates the seam just below.





Dashed blue line indicates seam, closing short end and continuing along the leading edge.



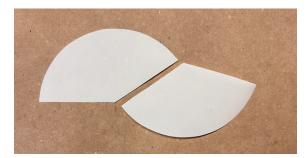
Seam along the leading edge, then closing other short end.



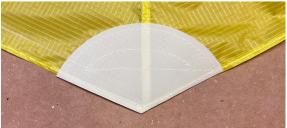
## **Reinforcements and pockets**

The sail needs dacron reinforcements for all four corner pockets and for the leading edge batten pockets.

- 12. The top corner and the bottom corner have different angles, due to that the top has the kick up front and the bottom has the in-sail dihedral \*). Check the actual angles before cutting the dacron.
  - a. Cut one circle sector with a ~140 145° angle and a radius of 8 cm of dacron for the top corner.
  - b. Sew the circle sector at the top corner of the sail.
  - c. Cut a second circle sector with a ~125 127° angle and a radius of 7 - 8 cm of dacron for the bottom corner.
  - d. Sew the circle sector at the bottom corner of the sail.



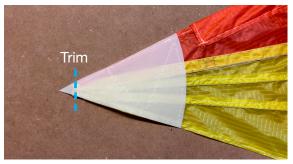






- a. Cut two circle sectors of dacron with a  ${\sim}45^{\circ}$  angle and a radius of 12 cm for the wing tips.
- b. Sew these 45° dacron circle sectors onto the wing tips, aligning the sector sides with the sail edges. The sector centres will protrude slightly outside the sail, but just trim the protruding part.





- 14. Leading edge batten reinforcement.
  - a. Cut four semi circles with a radius of 3 4 cm of dacron.
  - b. On both sides of the top corner make marks on the leading edge 35 resp. 75 cm from the top corner.
  - c. Sew these four semi circles onto the leading edge with their centre at the marks.

\*) All quadruples should have an angle sum of 360°. This doesn't; why?

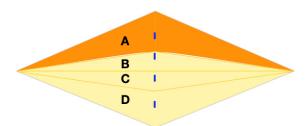
- 15. For the three alternative tow points sew dacron reinforcements, 2 x 3 cm, on the exact middle of the sail, with the top edge of the dacron:
  - 20 cm from the top corner (for medium breeze)
  - 40 cm from the top corner (for light wind)
  - 46 cm from the top corner (for ultra light wind)
- 16. There must be dacron sleeves for the spine at the centre of the sail where the panel sides meet in order to keep the spine tubes in absolute correct position sidewise. The sleeves must be tight in order to keep the spine tube firmly in the correct position sidewise, but still wide enough to let the tube with end cap go through the two lower sleeves.

The four pieces should be sewn with the top edge:

- In the middle of panels A (27 cm from top corner).
- On top edge of panels B.
- 6 cm below the top edge of panels C (centre of the sail).
- In the middle of panels D.
- a. Cut four pieces of dacron, 4 x 5 cm.
- b. Sew one of the 5 cm sides 4-5 mm on one side of the sail middle line/seam.
- c. Sew the second seam 4-5 mm on the other side of the sail middle seam, 4 mm inside the dacron piece.

(*Tip: use a 10 mm carbon tube to get the correct diameter of the sleeve on panels C and D.*)





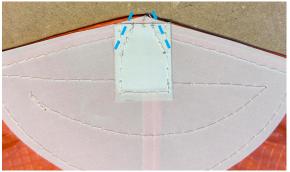
Approximate positions of the four spine sleeves.



Sleeve on panel C just below the centre of the sail (the top of the sail to the left) with the dacron folded straight up. Dashed line indicates sail middle seam.



The sleeves must be tight in order to keep the spine tube firmly in the correct position sidewise, but still wide enough to let the tube with end cap go through.



The slanted steering seams indicated in dashed blue.

- 17. Sew a pocket, 3 x 6 cm, for the top of the spine spar onto the dacron reinforcement.
- 18. Depending of what kind of spine tube is used it might be wise to sew two seams slanted towards the centre bottom of the pocket, so the top of the spine tube always will be guided into correct centre position.

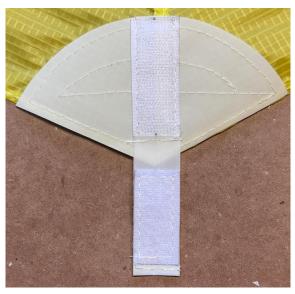
- 19. An adjustable velcro pocket is required in the bottom corner.
  - a. Cut 60 mm of the hook (hard) part of a 25 mm wide velcro strip.
  - b. Sew this velcro as a sleeve onto the reinforcement at the rear corner, leaving a gap of 1 cm to the corner point. The width between the seams should allow the spine tube with end cap to go inside.
  - c. Cut a 25 x 80 mm piece of dacron.
  - d. Fold over 5 mm at one end of the dacron tape and fasten it with a seam as a strap.
  - e. Take 60 mm of the loop (soft) part of 25 mm velcro.
  - f. Sew the velcro loop part onto the dacron tape starting just at the strap.
  - g. Sew the other end of the dacron tape onto the corner reinforcement, edge to edge with the hook velcro. The loop velcro on the dacron tape should face upwards.



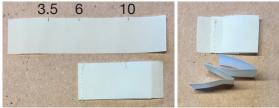
Dashed lines indicate seeams.



Dacron strip with the sewn strap to the right and the velcro loop part next to it.



- 20. The cross spar needs pockets on the dacron reinforcement on both wing tips. To be prepared for material shrinking/stretching depending on relative air humidity a double pocket should be sewn at each wing tip. This will allow shifting pockets depending on the environment.
  - a. Cut two pieces of dacron, 3 x 13 cm.
  - b. Make marks at 3.5 cm, 6 cm and 10 cm.
  - c. Fold the dacron strips at the 6 cm mark.
  - d. Sew a seam at the fold.
  - e. Fold the dacron strips "backwards" at the 3.5 resp. 10 cm marks to make the double pocket.
  - f. Sew a double pocket with the "bottom" of the outer pocket 10 mm in from the wing tip with the edge aligned with the leading edge of the sail. (The 3.5 cm part closest to the sail.) The inner pocket will then come 15 mm inside the outer pocket.



Dacron strips. One strip folded at 6 cm mark and a seam sewn across to hold the fold.

Dacron strips folded at the 3.5 and 10 cm marks to create the double pocket.



Alternative pockets for cross spar on wing tip. The lower corner of the pocket has been trimmed with the sail wing tip edges.

- 21. The arced 1.5 mm fibreglass rods ("battens") need pockets, 1.5 x 4 cm, at the leading edge.
  - a. At the reinforcements nearest to the middle of the sail the pockets should be tilted 50° outwards to the wing tips.
  - b. At the reinforcements furthest from the spine the pockets should be tilted 50° inwards to the middle of the sail.
- 22. The 3 mm carbon tubes/rods in the sleeves on panel B need adjustable velcro pockets at the wing tips.
  - a. Cut 20 mm of the hook (hard) part of a velcro strip.
  - b. Sew this as a sleeve onto the reinforcement at the wing tip corner. The edge of velcro should be aligned with the edge of the dacron reinforcement facing the entrance hole for the 3 mm tube/ rod sleeve.

The closing part has to be "unnecessary" long to allow flexibility in different relative air humidity environments with stretching/shrinking of the ripstop.

- c. Cut a 25 x 100 mm piece of dacron.
- d. Fold over 5 mm at one end of the dacron piece and fasten it with a seam as a strap.
- e. Sew 80 mm of the loop (soft) part of 25 mm velcro onto the dacron piece starting just at the strap.
- f. Sew the other end of the dacron tape onto the corner reinforcement, edge to edge with the hook velcro. The loop velcro on the dacron tape should face upwards.
- g. Repeat a f for the other side.
- Sew a 10 x 20 mm piece of dacron as a tunnel/ sleeve in the middle of the sail where the sleeve halves meet. This tunnel acts as a stopper to prevent the carbon rods/tubes from sliding upwards.
- 23. The kite needs holes for tow point strings.
  - a. On each of the three tow point reinforcements mark the exact middle line of the sail (where the sail halves meet).
  - b. In the middle (1.5 cm down from the top) of the reinforcements make marks for the holes: they should be 2 mm on each side of the middle line.
  - c. Burn (with soldering iron) or punch the holes.
  - d. Cut three pieces of string for the tow points, 20 cm long.
  - e. Insert the strings from front through the tow point reinforcements and round the back.
  - f. Tie a figure-of-eight knot 2 3 cm from the sail on each of the three tow point loops. The loop on the backside must be big enough to let the spine tube pass through freely. Trim excess string.



The pair of leading edge batten pockets on each side of the spine are tilted 50° towards each other, with one corner at the centre of the dacron semi circle.



The hook velcro pocket facing the entrance hole for the 3 mm tube/rod (encircled).

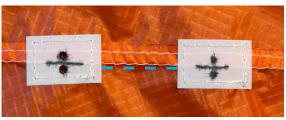


Closing part of velcro pocket.

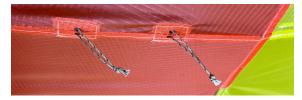




22h. The stopper tunnel in the middle of the sail.



Dashed blue line indicates the middle of the sail. One pair of the tow point holes burnt with soldering iron.



# Frame

The main frame consists of 7 light weight Skyshark rods, preferably *P90* (10.5 grams): Five for the cross bow and two for the spine. If P90 is used, a P2X (or corresponding) should replace the centre P90 in the bow for increased stiffness.

Both the first and the second leading edges need support; the first by two 1.5 mm fibreglass "arc battens", and the second leading edge (on panel B) by a 3 mm carbon rod or tube.

# First leading edge support

- 24. Cut two pieces of 1.5 mm fibreglass rod, each 50 cm long.
- 25. Glue end caps on both ends of both rods.

# Second leading edge support

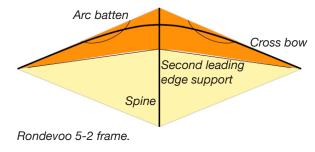
- 26. Prepare the 3 mm tube/rods: The total length of the rod on each side is about 193 cm (measured from the velcro pocket to the middle of the sail with 2 cm added), and it could be split up in either two or three parts. A tube/rod of standard length 200 cm can be split in three parts of more or less equal length: 65, 65 and 70 cm.
  - a. Use the 65 cm tubes/rods as inner pieces and the 70 cm tube/rod as the outer piece that is shortened to correct length at the velcro pocket at the first assembly, see step 49.
  - b. Glue a 3 mm ferrule on each of the four inner rods.
- 27. Cut a piece of 3 mm plastic tube, 8 cm long, for joining the 3 mm tube/rod on either side of the sail middle.

# **Tensioning strings**

Both the spine and the bow need tensioning strings: for the bow to make the leading edge taught as well as to fixate the bow to the spine, and for the spine to create the *Soft Kick Up Front*. The KUF tensioning string runs from the top of the front tube to the joint of the two spine tubes. The top of the front tube has a split end nock, and for attaching the tensioning string in the tube joint an "anchor" system, consisting of a small split or solid ring, or a solid 8 ring (jigging/tackle material that can be found in a sport fishing shop) or just a string of non stretch material is used, is attached to the internal ferrule.

To easily hook the tension strings to the anchor ring *lob-ster claw hooks* are recommended: They are easy to hook up and easy to release without an unnecessary extra tensioning. A lobster claw hook of ~35 mm of **solid brass** is the most easy to handle.

Other tensioning systems are of course also possible. Feel free to use your favourite method.







Thread the plastic tube on one of the tubes/rods for the time being, until assembling the kite.



Anchor system.

In this case: an O-ring attached to the spine with only a string, one lobster claw hook for the bow tensioning and one lobster claw hook for the kick-up front.



Alternative details for the tensioning anchor system. From left: split end nock (1), small split ring or small solid ring or small 8 ring (1), small rubber ring (1), O-ring or D-ring (1), lobster claw hooks (2).

## Spine

- 28. Reinforce one end of both the two tubes by tying a thin string in 20 rounds.
- 29. Glue a long (~10 cm) internal ferrule into the reinforced end of the tube which will be in the bottom.
- 30. Glue an end cap to the non-reinforced end of the same tube.
- 31. Glue a split end nock in the other end of the other tube (without the internal ferrule).
- 32. The "anchor" system for the tensioning strings is attached to the internal ferrule. There are several possible alternatives for the details to be used for ferrule, for link and for anchor ring, see pictures to the right. Any combination of these alternatives can be used. Different combination are shown in this description.

The dimensions of the rings that will be used depends on what type of tube is used:

- For Skyshark P90 the diameter of the internal ferrule is 6.1 mm.
- a. If using an 8 ring:
- Bend the 8 ring slightly in the waist.

## Using Dacron strip

- b. Cut a 9 mm (or as wide as the base in the D ring) x 70 mm strip of dacron.
- c. Insert the dacron strip in the solid/split ring or in the smaller top ring of the 8 ring till the middle.
- d. Insert the dacron strip in an alu D ring (or O ring).
- e. Close the dacron strip with a double seam.

## Using string

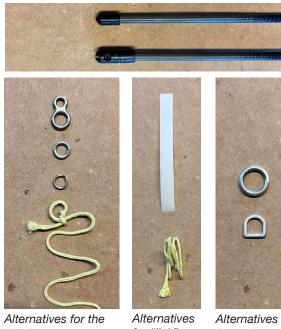
f. Cut 20 cm of a non strechy string and tie it double to the O/D ring and the ring for the ferrule.

#### With both Dacron strip and string

- g. Slide the ring down the ferrule till the tube. For an 8 ring: the bent part should be facing the free end of the ferrule.
- h. Lock the ring on the ferrule with a rubber ring.
- 33. Prepare the string to bend the spine top:
  - a. Take a 110 cm long string of non stretch material (like kevlar), tie a loose overhand knot some 20 cm from one end, pull that end (with the knot) through the ring a lobster claw hook and tie a quadruple (four rounds) Prusik knot around the string.
  - Secure the loose end from the Prusik knot by tieing it into the overhand knot to double that knot. Tighten the Prusik knot firmly.
  - c. Tie the other end of the string just under the nock of the top spine (see picture next page).



Tube for the spine: one with internal ferrule and both with reinforced ends.



Alternatives for the ferrule: - an 8 ring - a solid or split ring - a simple piece if non stretchy string (like kevlar). Alternatives for "link". - a dacron strip - a piece if non stretchy string.

Alternatives for anchor ring: - an O ring - a D ring

8 1

8 ring bent at the waist.



Using Dacron strip.

Using string.



The 8 ring locked with a locking rubber ring and a D ring tied in the upper hole of the D ring.





#### Cross bow

The centre part of the five tubes bow needs to be more stiff. For the Skyshark P90 tubes the centre tube should be replaced by a P2X/P300 or corresponding.

- 34. Glue long internal ferrules in one end of each of the four side tubes. The stiffer centre tube has no internal ferrules.
- 35. Glue end caps to the end of the two end tubes.
- 36. Reinforce both ends of the five tubes (except the ones with end caps) by tying a thin string in 20 rounds.

## Assemble the Rondevoo kite

#### The spine

- 37. Insert the bottom spine tube from the sail centre through the sleeves and velcro pocket without closing the velcro pocket.
- 38. Insert top tube from top through tow point loops and the spine sleeves.
- 39. Join the tubes making sure that the anchor ring and the rubber ring are in place.
- 40. Let the spine bending string (tied in step 33), just below the split end nock, run through the split end nock and insert the tube in the top corner pocket with the end of the string hanging out.
- 41. Close the velcro pocket.

#### The cross bow

- 42. Join the two side tubes on each side of the sail and insert them into the sleeves.
- 43. Join the stiffer centre tube with the side tubes. The entire cross spar is at this point more or less a straight line.
- 44. Insert one end of the cross spar into one wing tip corner pocket.
  - In high relative air humidity use the inner pocket.
  - In low relative air humidity use the outer pocket.

The (kevlar) string for bending the front part of the spine with Prusik knot.





The inwards ends of the cross bow P90 tubes with the stiffer P2X in the middle (without internal cross bar tubes. ferrule).

The outwards ends of the



Tubes joined with an 8 ring around the internal ferrule and an O ring tied to the 8 ring. The bent part of the 8 ring facing the spilt end nock.





cross bow again.

Kites for Connoisseurs - Rondevoo 5-2

Quadruple Prusik knot

The tube/rod should protrude ~2 cm outside the sleeve to allow for adjustments after first flights.

45. From the opposite corner push the cross spar up though the sleeve, carefully bending it till the end reaches the wing tip, and then insert the end into the corresponding pocket at the wing tip.

The bow shall cross the spine about 22 - 24 cm from the top. If too much above that point, move the bow to the outer pockets on both sides and vice versa.

## The support rods

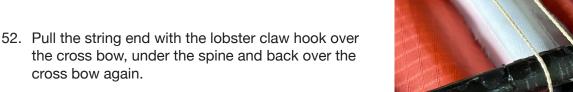
- 46. Insert the two 1.5 mm fibreglass "battens" (first leading edge support) as arcs in the pockets on either side of the middle.
- 47. Insert the 3 mm carbon tubes/rods (second leading edge support) in the sleeve on panel B through the velcro pocket and let them exit through the exit holes near the sail middle.
- 48. Insert the 3 mm plastic tube in the tunnel/sleeve in the middle of the sail and then insert both the 3 mm tube/rod ends in the plastic tube till the rods/tubes meet in the exact middle of the sail.
- 49. Adjust the length of the tubes/rods at the velcro pockets: there should not be any tension on the rod. It should not be so long that the rod bends when the velcro pocket is closed. The velcro pocket should just keep the tube/rod in place.

# Tension strings for cross bow and kick-up front

For both the cross bow tension string and the kick up tension string lobster claw hooks are used in order to guickly and effortlessly tension the strings as well as release the tension. The Prusik knots are only used for initial (and maybe later occasional) adjustment.

## Cross bow

- 50. Take 150 cm of a somewhat thinner string of nonstretch material (like kevlar) and tie a quadruple Prusik knot around a lobster claw hook in same way as described in step 33.
- 51. Tie the other end of the string around the D/O-ring.



20





Arc battens.

while bending it slowly.



53. Hook the lobster claw hook to the D/O-ring and stretch the string by adjusting the Prusik knot so the bow is pulled down and tensions the sail as well as tautens the leading edge. This should be about 2 -3 cm from original position. Too much tension will cause the wing tips to bend in.

## Kick-up front

- 54. Hook the second lobster hook with the string from the spine top in the D/O-ring.
- 55. Stretch the string using the Prusik knot.
- 56. Unhook the hook and move the Prusik knot closer to the top, then carefully bend the spine top and rehook the hook in the D/O-ring.

Repeat this step until the top corner is about 20 cm up. Adjust the cross bow tension if necessary.

The kite is ready to fly.

# Flying Rondevoo 5-2

The Rondevoo is designed for ultra low to low wind, but it can also fly in a medium breeze. For ultra low wind attach the flying line to the tow point farthest from the top and further up for stronger wind. In too strong winds the rather soft tubes in the bow will bend too much, though possibly a tow point in the very nose of the kite could increase the wind range. Normally the kite will fly straight at a good angle.

If the kite tends to steer overly to one side check that the leading edge on both sides is taut.





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One end of the string for bow tensioning tied to the O ring, the other end returning to the O ring through a lobster claw hook.

The second lobster claw hook for the kick-up front.



The front part of the sail is rather taut, while the back part of the sail is quite slack.



Kites for Connoisseurs - Rondevoo 5-2