Kites for Connoisseurs

Acrux (train)

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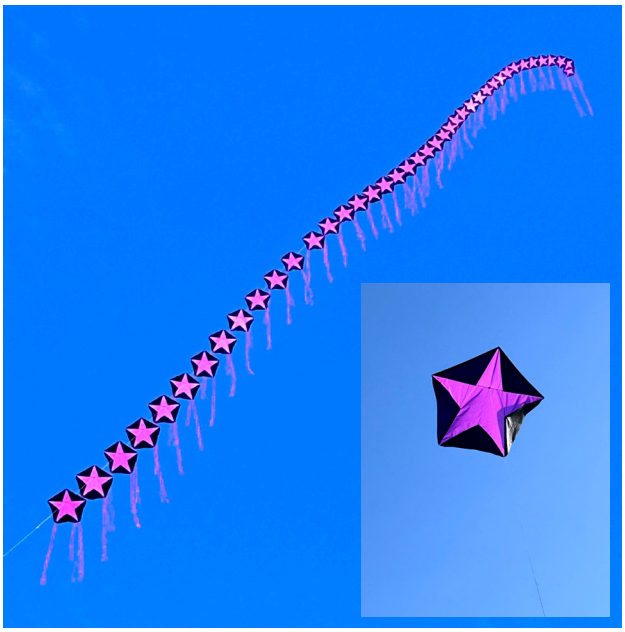
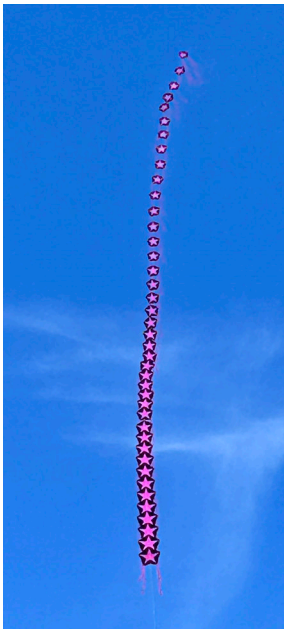
WINDMAN BIEGOLMAI

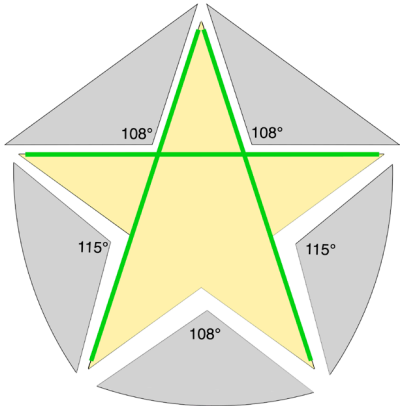




Acrux is a pentagram/pentagon kite primarily intended for kite trains, although each kite element can also fly by itself. A single tail free Acrux element flies stable on its own (see picture insert), but when trained, sometimes elements flip to upside down and don't recover easily. For that reason it is recommended to add a double tail. Here the tails are split in five narrow strips, representing the five points of the pentagram. The train element is 40 cm high in this description just to fit the size of a kite bag, but it can also be upsized to at least 70 cm.

The train element can be made using either a 160° dihedral (an STL file for 3D printing of the dihedral "*Train Knee*" is included in the set) or with a straight cross spar and increased in-sail dihedral (120° instead of 115°). The 160° 3D printed dihedral has a hole in the middle for the train line, which makes it easy to create a train with a through-going line. For a straight cross spar or a dihedral with no hole in the middle a more complicated train line method has to be used.

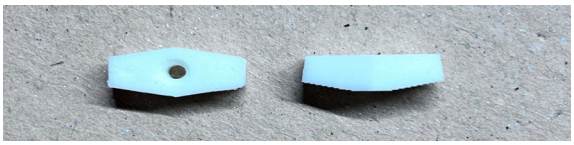
In the pentagon, the edges of the side and rear panels are curved to better maintain a pentagon shape when catching the wind.



Principle of Acrux sail.
The spars are indicated with green lines.

Material for one 40 cm element.

- Ripstop in light colour.
- Ripstop in dark colour.
- Carbon fibre rods:
  - 1.0 mm: 120 cm
- Dacron - 6 x 30 mm
- Dihedral:
  - 3D printed “Train Knee”, or
  - Standard “Eddy”
- End caps (slim type)

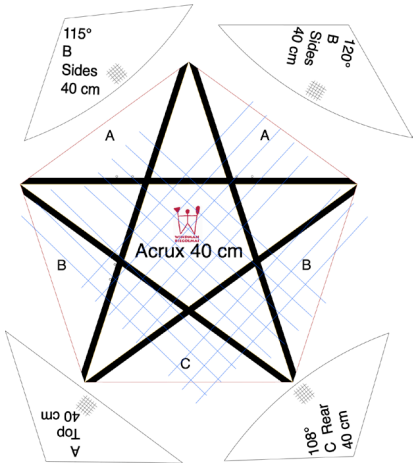


3D printed 160° dihedral (“Train Knee”) with hole for through-going train line. The STL file for 3D printing of the dihedral comes in two versions: for 1.0 mm rod and for 1.5 mm rod.

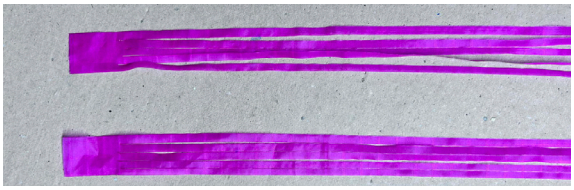
How to make an Acrux element.

A full scale template for an Acrux 40 cm element comes as a JPEG to be plotted and as a PDF to be printed out on six A4 pages. There are blue criss-cross diagonal lines to help aligning the pages correctly. The star/pentagram includes an 8 mm overlap for the pentagon side panels.

1. Cut out the parts according to the template panels, observing the grain direction:
   - The star/pentagram.
   - Two panels A for the leading edges of the pentagon.
   - Two panels B for the sides of the pentagon. The angle between points is 108°, but to create an *In-Sail Dihedral* the angle for the side panels has been increased to 115° (120° for straight cross spar).
     - If using a 160° dihedral for the cross spar use the panel with 115° sector angle.
     - If using a straight cross spar use the panel with 120° sector angle.
   - One panel C for trailing edge.
2. Cut a pair of tails ~75 cm long and 2.5 cm wide, but split in 5 narrow strips of 5 mm, leaving a 2 cm long base in one end.

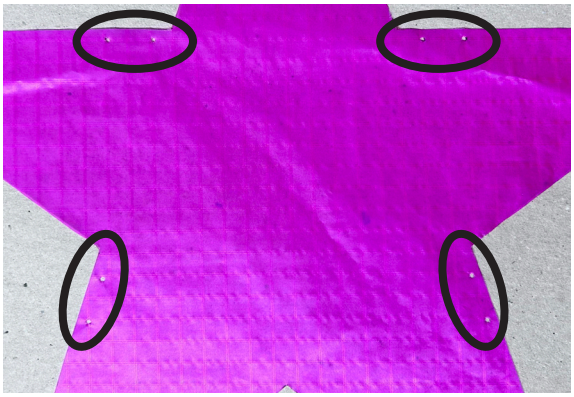


Acrux templates,



2 cm base.

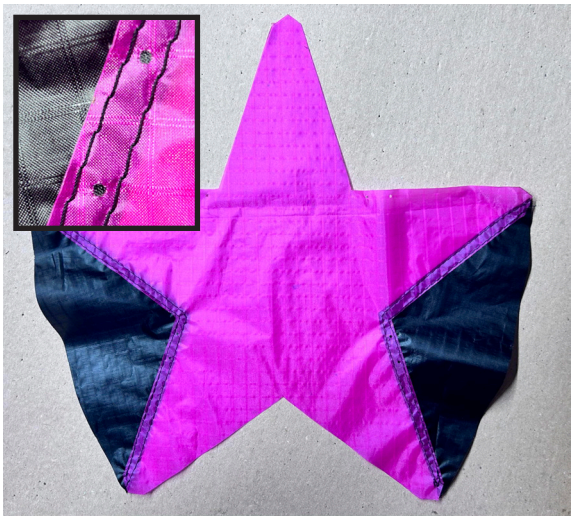
3. Punch 1.5 mm holes on edges of the star as “sleeves” for the spars according to marks in the template, 4 mm from the edge.



“Sleeve” holes.

The edge panels should be sewn with double (parallel) seams on the 8 mm overlapping to allow use of the ”sleeve” holes.

4. Start with sewing the side panels B on the star, using either the 115° panel for the 160° dihedral or the 120° panel for straight cross spar.



5. Sew the rear panel C onto the star.

6. Sew the leading panels A onto the star. The panels will protrude 5 mm outside the star to allow hemming the leading edge.

7. Trim the corners of panels A and hem the leading edges of panels A, aligning the hem crease with the short, slanted edge at the point.

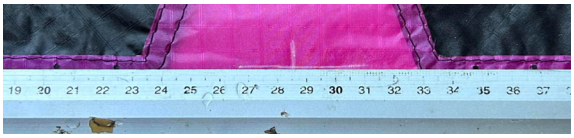
Left side, front view, of panel A trimmed.

Top of panels A trimmed, back side view.

Panels A hemmed.

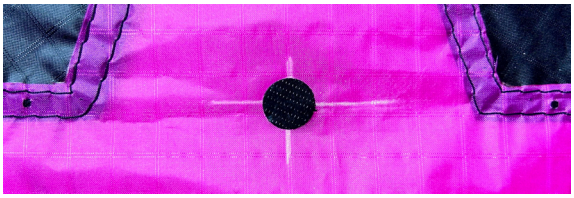
Complete skin.

8. Mark the position for the train line with a hair cross on the backside:
   a. Draw a short vertical line from the star top.
   b. Draw a short horizontal line aligned with the middle of the overlapping.



Chalked hair cross for line.

9. Punch a 12 mm round piece of strong fabric adhesive tape and put it centred over the hair cross (on the backside) as line hole reinforcement.


Line hole reinforcement.

10. The hair cross is still visible from the front, so even if the fabric roundel is not exactly centred over the cross it is easy to punch a small hole for the line exactly at the cross intersection.

11. Fold the base of the tail strips three-folded so they become 7-8 mm wide and sew them onto the overlapping seams to panels B, at the rear edge.

12. Cut 6 pcs 10 x 30 mm of dacron for pockets of the 1.0/1.5 mm carbon rods (including end caps).
If using “chubby” end caps make the pockets a bit wider: like 12 mm.

13. Sew the pockets for the spars.
   - For all pockets: align the long edge of the pocket with the inner edge of the overlapping (inner edge of pentagon panels.
   - For top pockets: align one corner of the pocket with the leading edge of panel A.


Top corner pockets.

   - For the trailing edge pockets (that will partly be on top of the tail base):
     • Align one corner with the slanted corner of the star point.
     • OR: for pre-cut rods of 40 cm (or other lengths depending of element size): put end caps to one rod, insert the rod in the top pocket and make a mark where the bottom of the trailing edge pocket should be.


Trailing edge corner pockets, covering the base of the tail.

- For the cross spar pockets: Align one corner with the slanted leading edge.

Side corner pocket.

Spars.
The spars should be 1.0 mm carbon rod. For element sizes over 40 cm the spars should be 1.5 mm.

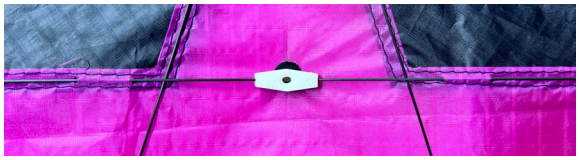
If using a 1.0 cross spar and it tends to break, replace it with 1.5 mm.

The STL file for 3D printing of the dihedral comes in two versions: for 1.0 mm rod and for 1.5 mm rod, and both of them can easily be drilled up to a 0.5 mm larger diameter.

14. Fixate the two vertical spars just inside the overlapping through the “sleeve” holes and put end caps on the spar ends. Adjust the spar length if necessary.

Vertical spars inserted in the “sleeves” at the star edge.

15. With 160° 3D printed dihedral:
    a. Cut the spar in two pieces of 19.5 cm.
    b. Insert the pieces through the “sleeve” holes and over the vertical spars.
    c. Put end caps on the outer spar ends.
    d. First insert the spar ends in the pockets and then the dihedral.
    e. Adjust the lengths of the spars so the hole in the dihedral is aligned with the centre of the punched hole in the sail and the entire spar is without tension. There should not be any tension in the cross spar: check from front that it is not curved upwards on either side.



Train line.
There are many ways to put elements into a kite train and quite a few things to consider.

A. Through-going line or separate element lines.
B. Distance between elements.
C. Line thickness.

A1. Through-going line.
The line is going uninterrupted through several elements, loosely attached to each element.

A2. Separate element lines.
Shorter line pieces are tied to each element and then each line piece is tied to the next.

B. Distance between elements.
The choice of distance between elements is entirely of individual choice, but there are a few things to consider:
For air flow reasons the minimum distance should be 1.5 times the length of the element.
If the elements are all different it will probably look better if the distance is longer so each element is individually visible.
If the elements are identical it might give a better effect if the distance is kept at a minimum.
If the elements have tails the length of the tail should be added to the minimum distance.

C. Line thickness.
The pull on the train line increases with the number of elements, and the line thickness/ strength depends entirely on the pull of each element.

The top five elements only need a thin line (< 20 kg or normal for a kite of the size), and it should be kept thin to make launching easier.

As the number of elements increases, the strength of the line should also increase, say by each 20th element. What strength is required depends of course of what type of element is used. The ***Acrux*** is a light wind kite with not so much pull, so the strength should maybe be doubled after each 20th element

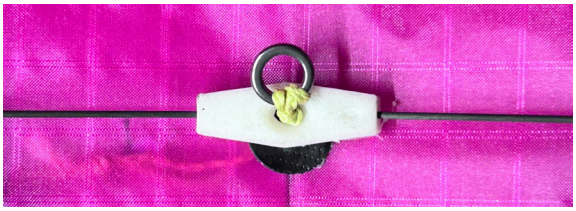
Through-going line.
For a through going line, the easiest way is to use the 3D printed dihedrals (STL files included in package) with a hole in the middle. A stopper must be tied in the line on the upside of the element to keep that element in place vertically. A stopper should also be attached just under the element to prevent the element from sliding down the line when packing.

The beauty of a through-going line going freely through holes in the element is that the element can rotate around the line without twirling the line.

It is of course possible to use an uninterrupted line for the whole train, but for maintenance reason it might be better to split the line in segments of five elements.

Pulling line for a five element segment.
16. Decide the distance between each element.
17. Multiply this by 5 and add 30 cm for top and bottom elements and cut a piece of line in that length.
18. Tie a small stainless steel fishing O-ring to one end of the line. Fishing tackle rings have smooth edges and will not tear the line.

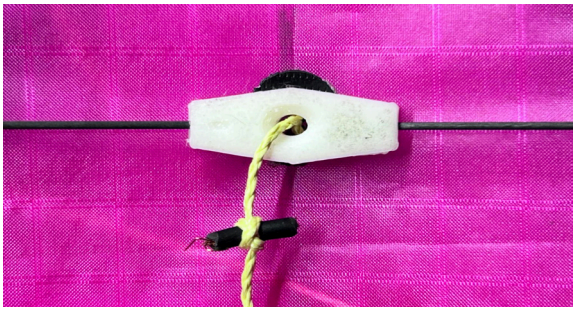
19. From that O-ring make marks on the line equalling the decided distance between elements.
20. Pull the line from the top element through the dihedral and the hole through all five elements in the segment.



Fishing tackle O-ring tied in top of segment line.

21. Cut five 1 cm long pieces of electric wire. Electric wire has a core of copper so the stopper cannot break.

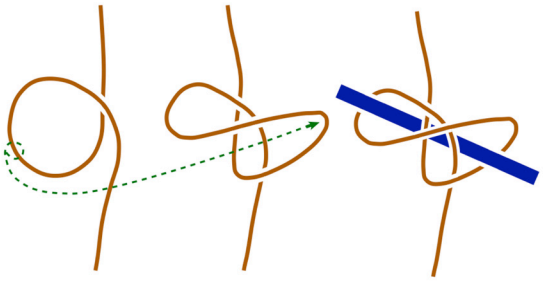
22. Make sure the first mark after the top element is just above the second element.



Stopper of wire tied with constrictor knot.

23. At this mark tie a piece of electric wire using a constrictor knot.

Constrictor knot tied in the hand around wire.



Make a loop. *Pull the bottom of the loop across.* *Insert wire through the double loop and tighten.*

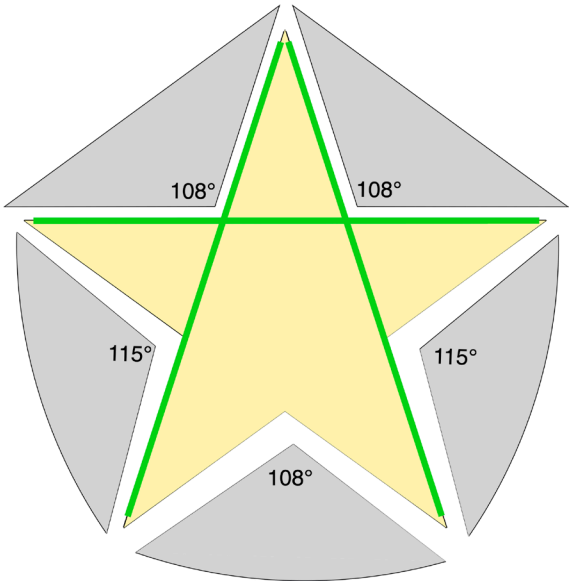
24. Repeat for the following three elements, always making sure that the next mark is just above the next element.
25. At the end of the line below the bottom element tie a loop with a strap so it can easily be tied to the next segment, using a lark's head.
26. Tie a stopper on the underside of the bottom element as close to the element as possible, again using a constrictor knot.

    The down side stopper can very well be of the same kind as the upside stopper, even if it might be considered overkill, since there is no real loading on the down side stopper.
27. Repeat the under side stopper for the other four elements in the segment.

Long loop with a strap ("lark's tail").

Separate element lines.
If using standard “Eddy” dihedrals the extra hole in the dihedral is horizontal, but it still can be used for tying the line to the dihedral, and in this case it is best to use the alternative with *Separate element lines*.

The Acrux element does not have a regular spine but two longerons running from the top corner to each of the bottom corners. As there is no central spine that would go through the Eddy dihedral and center the dihedral, the dihedral has to be centered using only the line. For a 1.5 mm. dihedral the spine hole (horizontal hole) is probably too small to let the line go through twice (as it has to do for balance reasons).



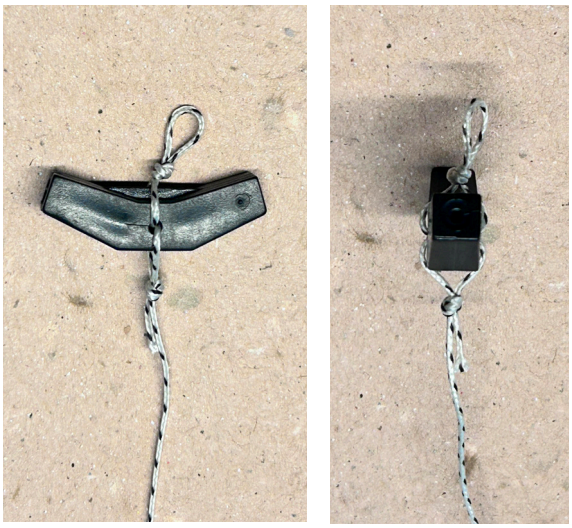
The spars (green) in an Acrux element. No central spine.

28. Drill up the spine hole in the Eddy dihedral to 2 mm.

29. Cut the decided element length on a line and add 30 cm; 15 cm in each end for tying connecting knots.


Standard 1.5 mm ”Eddy” dihedral.

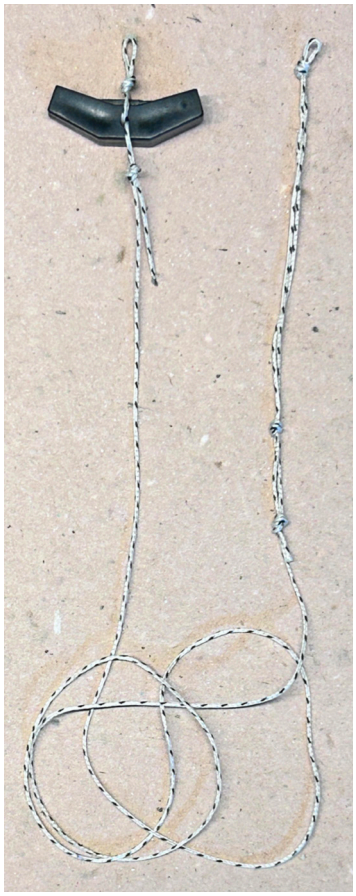
30. In one end of the string fold a loop of 15 cm and 1 cm from the loop end tie a figure-of-eight knot that will act as an anchor knot for the line of the upper element.
31. Place the knot on the upside of the dihedral and pull the longer line part through the horizontal spine hole.
32. Pull the shorter line part through the horizontal spine hole from the opposite direction and tie the line parts together with a knot just below the dihedral.


Top of separate element line.

33. At the other end of the line tie a 15 cm long loop.

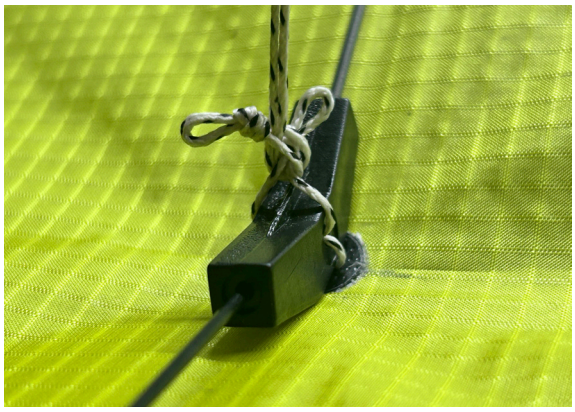
34. 1 cm in on that loop tie an overhand knot to create a “strap” (”lark’s tail”) that will make it easier to remove the line from the next element if necessary.

End of separate element line.



Complete separate element line.

35. Tie the element line from one element to the next element line, around the anchor figure-of-eight knot, using a lark’s head.



WomBag for an Acrux train.
Wombag, a bag in pentagonal shape for launching and packing of a 40 cm Acrux train, is included in the plan for the WomBag bag, #20 on ***http://windman.se/plans***.

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