

# Kemp Sails

## Radial Sails

Until the early '80s, sails were usually made to a cross-cut design - that is, with their panels running horizontally from leech to luff. Most are still made this way - and for good reason: it's a simple, reliable and relatively economical method of construction which is best suited to the majority of readily-available fabrics.

### A word of explanation...

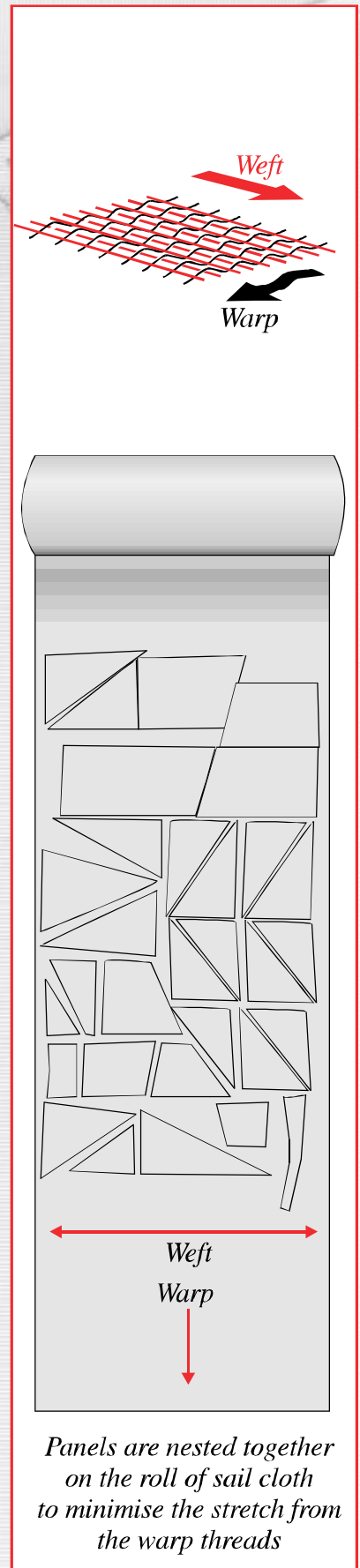
Its weakness is in failing to align the threads in the cloth with the sail's stress pattern - which, as shown in the diagram overleaf, runs in curves from corner to corner. To understand the problem, imagine that you're facing a roll of sail cloth, and pulling the end as you would a length of kitchen roll from its holder. The fill (or weft) threads are the ones running across the roll from left to right - in the weaving process, they're pulled tight, straight across the loom. Being straight, they have the greatest resistance to stretch.

Weaving between the fill threads at right angles, along the length of the roll, are the warp threads - which, because of their natural tendency to straighten under load, are more prone to stretch. So most sail cloth tends to stretch more along the warp than along the fill - but, like any woven fabric, it's most stretchy when pulled at 45 degrees to the threadline. And when a sail stretches too easily, its shape becomes difficult to control. What's more, after a while it won't return - so it's time either for a re-cut or new sails.

### Radial solutions

With radial sails, you can bring the panels into line with the stress pattern. This way, the loads run through each panel at a relatively constant angle, instead of crossing them at different angles as they do with a cross-cut sail. You can see from the diagrams on the other side that this works better with tri-radial designs (panels radiating from head, tack and clew) than with bi-radials (head and clew only). But there's a potential problem: since the warp threads (along the length of the panel) tend to stretch more, is there really a net gain? The answer is no, not really - unless you use what's known as a 'warp-orientated' fabric, which is specially woven with a greater number of stronger warp threads in relation to the fill. Only then can a tri-radial sail give you a better, more stable and longer-lasting shape.

That's why, for our radial sails, we only use warp-orientated cloths - of which there are currently only a handful in woven form. With laminated fabrics, you have a much wider choice. Either way, cloths suitable for tri-radial sail construction are more expensive - which is why some sailmakers still quote for radial sails using cheaper, fill-orientated cloth. It may make the quote look attractive - as though you're getting a 'high-tech' sail at a relatively low price - but we won't compromise our sail construction in this way. As ever, it's important to compare quotes on a like-for-like basis!



Areas of  
greatest load

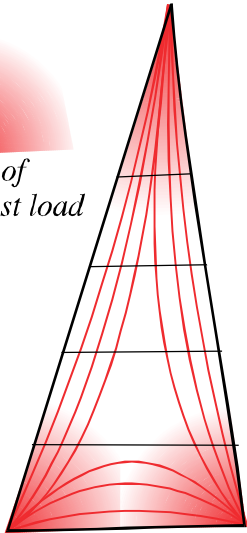


Diagram 1

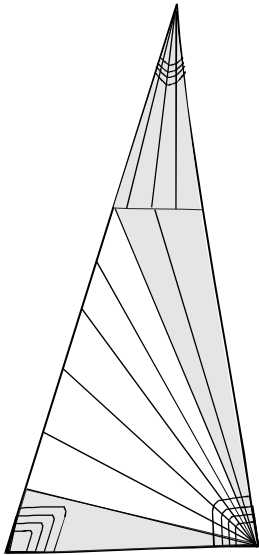


Diagram 2

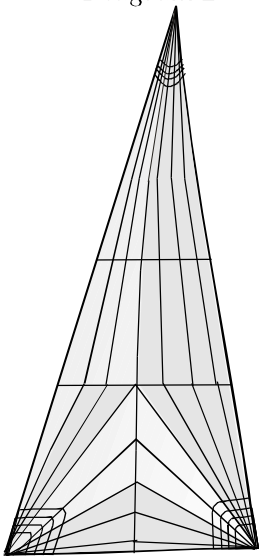


Diagram 3

#### Diagram 1

The stress lines on a sail run in catenary curves from corner to corner, crossing each panel in a cross-cut layout at a different angle

#### Diagram 2

In a bi-radial sail, the panels radiate from the head and clew.

#### Diagram 3

Panels radiating from head, clew and tack in a tri-radial design ensure the best match of panel alignment to stress curves - but some high aspect-ratio sails are still best made with a cross-cut layout.

As we've explained overleaf, a radial sail offers potential advantages. But that's not to say you necessarily need one. As a rule, any sail made with fill-orientated fabric should be cross-cut - and cross-cut designs are perfectly suitable for both mainsails and genoas on most small cruising boats. The bigger and racier you go, the greater the advantage of radial cuts - for example, if you regularly race at club level with a fairly sporty 26-footer, you'll probably be better off with radial headsails.

As you move up the size range, radial genoas become worth having sooner than radial mainsails, largely because of their higher tack loads. And it's these tack loads which make tri-radial designs more efficient than bi-radials - especially bi-radials with only one horizontal seam. Like any form of radial sail made with fill-orientated cloth, such designs may look sporty, but they probably won't hold their shape as long as cross-cut layouts.

We also tend to advise that you steer clear of radial sails if you plan long-distance cruising to more remote parts of the world, where sailmakers won't always have the right types of warp-orientated cloth for repairs. On the other hand, radial cuts can be useful in less obvious situations - like the design of in-mast furling mainsails, for example. Radial design lets you 'step' the cloth weight, using heavier material in the highly-stressed leech, and lighter fabric for the main body of the sail. This way, the overall weight is reduced - and so is its bulk, which means it takes up less space inside the mast and will furl up more easily.

### Rolling radials

The 'stepping' technique also makes radial panel layouts ideal for roller genoas - as the wind builds, you roll up the lighter cloth in the luff, leaving the heavier leech to cope with stronger conditions. In fact we use graduated cloth weights in our non-furling radial sails, too - in the same way, they put the maximum strength where you need it, and help keep the weight to a minimum.

We hope this sheet has helped clarify a few points about radial sails. The only way to decide which panel design will be best for you is to talk to us. We'll look at all the options, and advise which is most suitable. We'll also tell you why - because we believe it's important for you to understand what you're buying.

