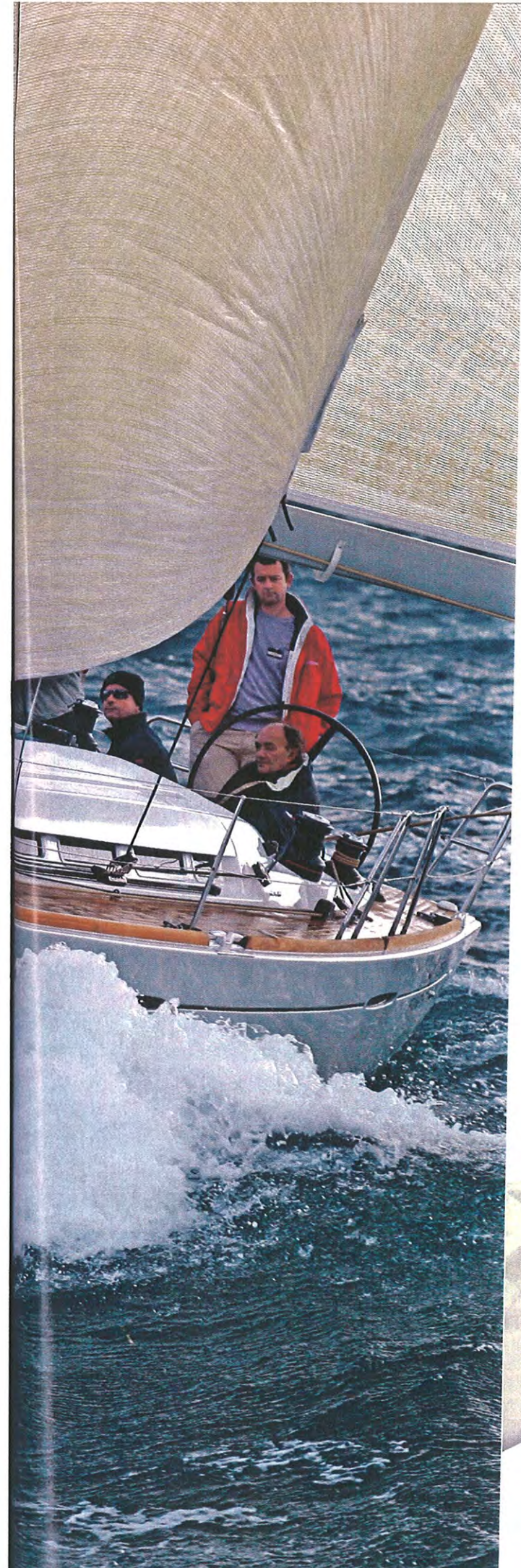


TECHNICAL TACK SAILCLOTH

Woven or laminate?

Time for new sails? You face a bewildering range of sailcloth choices. Chris Beeson discovers some surprises in modern fabric development



Many of the new boats I test, particularly those with performance aspirations, have an expensive wardrobe of membrane sails – hi-tech fibres laid along the loadpaths from head, tack and clew, and sandwiched between two layers of clear Mylar film. These sails don't stretch at all. They hold their shape exceptionally well and they're much lighter than regular Dacron sails. That adds up to better performance – to show new boats in their best possible light. The world's best racing yachts all use membrane sails.

The problem is that membrane sails have a short lifespan. Look after them extremely well – never allow them to flog, make sure they don't chafe on anything, that no sharp objects puncture the film and roll instead of flaking them – and you'll probably get three seasons of regular competitive use out of them before they begin to delaminate. Once they delaminate – when the

Mylar film and the hi tech yarns are no longer stuck together – or the yarns break, they're finished. They can't be permanently repaired so you need a new sail. It's an expensive way to go sailing, and that's fine if you have the money. As Robert Kühnen, marketing vice-president of sailcloth manufacturer Dimension-Polyant, says: 'We like racing sailors. They need more sails.'

For cruisers, membrane sails are a non-starter – they're too fragile to make them economically viable

and, by definition, performance is not as critical as it is to racers. So when it comes to buying new sails, do you choose Dacron or the

How long does Dacron hold its shape? 'An hour'

fancy new cruising laminates? First let's look at Dacron, and there are a few surprises in store.

Dacron (or Terylene) is polyethylene terephthalate (PET), a polyester also used to make plastic drink bottles. Its strength is durability. Curious to know what advantage cruising laminates had over Dacron, I asked Peter Westfal, a sailmaker for Elvstrøm in Denmark, how long woven polyester sails – the basic Dacron used for entry-level cross-cut sails – hold their shape. 'About an hour,' he replied. I asked if he was exaggerating. He said no. After an hour, it's not going to be significant but after three or four seasons of regular use, the shape will be noticeably baggier.

The reason for that is in their build. The sails supplied with most new boats use cloth with heavier-denier yarns, less densely woven, as it's a faster, cheaper way or achieving cloth weight. As a result, more resin is needed to stiffen the cloth and once the resin is beaten out, it can no longer hold its shape and performance is affected. 'Fair enough,' you might say, 'I'm in no hurry!' But the problem is that, while you can still reef baggy sails, you can't flatten them to spill the power, and you end up over on your ear, at best. Trying to deal with the problem by tightening halyards only stretches the sail even further out of shape. With repairs to seams, tears and hardware, and recutting to flatten the sail close to its original shape, a Dacron sail will last as long as any other fabric around today, but as the cloth gets a softer and softer 'hand,' or feel, and with the various protective coatings long since degraded to nothing, ➔



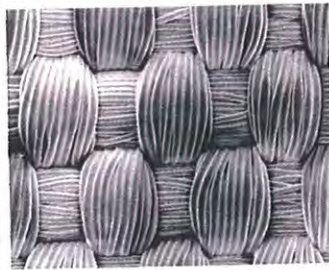
Toby Hoad of Kemp Sails shows how soft Dacron becomes once the resin is lost

Main photo: Performance sails make sense on a performance boat, like this Bénéteau First 45. But do you really need them?

you're flogging a dead horse and paying to do it. It's time for some new ones.

So how about some whizzy new cruising laminates? First, laminate sails are not so new, having been pioneered over 30 years ago for the 1977 America's Cup. These are essentially lower-tech membrane sails with added protection. Instead of yarns laid along the loadpaths, these use a scrim, or mesh, of yarns, sometimes polyester, sometimes higher-tech fibres, laid on one layer of film, or sandwiched between two, with a protective layer of taffeta on either side. These fibres could be Pentex (also known as PEN, a modified polyester with 2½ times less stretch), or high-modulus polyethylene yarns such as Dyneema. Other alternatives include carbon and aramid fibres like Technora and Twaron.

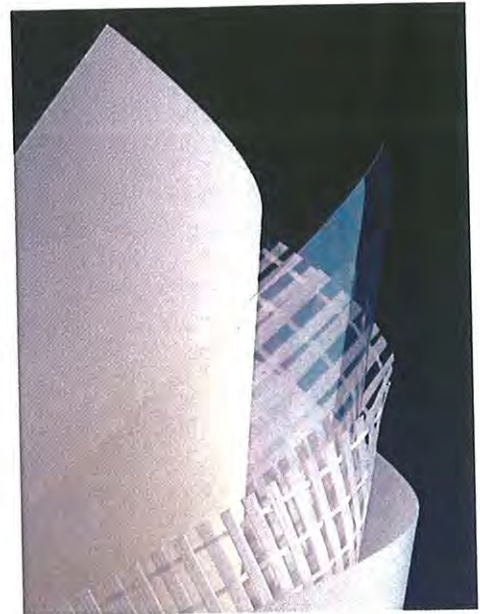
Like membrane sails, cruising laminates are much lighter than standard Dacron and will hold their shape exceptionally well, but the taffeta protects the sail, extending its life. The problem is that, when a laminate sail delaminates, or its yarns break, that's it. Like membrane sails, they can't be effectively repaired. Exactly how long they'll last depends on use but if well looked after, five seasons would be a good innings.



In recent years, new fabrics have been developed that bridge the gap between standard woven polyester cloths, such as Dacron, and cruising laminates. Some cloths have much heavier-denier polyester yarns in warp and fill, creating a square pattern that looks like a magnified version of the rip-stop pattern you find in spinnaker cloth. These were first seen 20 years ago and common examples are Dimension-Polyant's Square and Bainbridge's Ocean Premium Plus. These weigh a little more and feel a little stiffer but hold their shape much better than standard woven Dacron and have the same longevity. The heavier-denier yarns act as rip-stop too, should a hole develop.

Another recently developed cloth uses high-modulus Dyneema yarns, but instead of being laid up as scrim sandwiched between layers of film and taffeta, as they would be in a cruising laminate sail, the Dyneema

Left: Good Dacron uses heavier denier polyester yarns woven very tightly. Right: Laminates, like Contender's ACL, use a scrim on Mylar film between two layers of taffeta



is woven into the cloth. This means you get white sails with the familiar Dacron hand and the same longevity, but the Dyneema yarns ensure that the sail retains its shape much better than a polyester sail would. The cloth, called Hydra Net, was patented by Dimension-Polyant but the patent has since expired, so other, similar cloths should soon be available.

Hydra Net is a fill-orientated cloth designed for use in cross-cut sails. For radial sail construction, there is Hydra Net Radial, which has more warp-orientated Dyneema than fill-orientated. Austrian Open 60 sailor Norbert Sedlacek has been using sails built from Hydra Net for 10 years, covering over 240,000 miles with them, including the last Vendée Globe, in which he finished

11th with sails built from Hydra Net Radial. That's last place, but the point is he finished – 19 others didn't. Most of these were due to structural hull failure, but there was at least one retirement (*Artemis*) due to sail degradation and one other (*Aviva*) whose sails looked like they'd never make it to the finish.

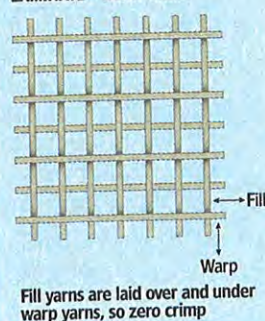
Right: Norbert Sedlacek's Open 60 sailed 240,000 miles in 10 years with sails made from Dimension-Polyant's Hydra Net

↓ JARGON BUSTER

WARP, FILL & BIAS

Sailcloth is made from two sets of yarns known as warp and fill, lying at 90° to each other, with warp yarns running along the roll of sailcloth, and fill yarns across it. The cloth is woven by shuttling fill yarns back and forth across the loom, weaving between the warp yarns. As with ladies' tights, the thickness of the yarn is expressed in denier: a heavier denier yarn is a thicker yarn, which makes a thicker cloth.

LAMINATE – ZERO CRIMP



Standard woven polyester sails have the same denier warp and fill yarns so they can handle warp and fill loads equally well. For low-aspect, cross-cut sails (low aspect being a foot:luff ratio of up to 1:2.5) on boats up to 40ft, this is a suitable entry-level cloth. Some cloths will have a heavier fill yarn than warp yarn, making them fill-orientated – better suited to load along the fill yarns. Fill-orientated yarns are used in high-aspect (1:3 and over) cross-cut sails. Radial sails need a square-patterned or warp-orientated cloth, as the general direction of loading is along the warp.

Bias is the direction at 45° to warp and fill. Controlling stretch along the bias requires a very tight weave and correct resin treatment. Laminate sails' fill yarns lie over or under the warp yarns (see left) to create a 'scrim' or mesh. Because they're laid straight and not woven, they don't need stretching to reach their crimp point (see Crimp, right). This is why membrane and laminate sails resist stretch so effectively.

HI-TECH FIBRE CHARACTERISTICS

	Good	Bad
Carbon:	Stretch resistance UV resistance	Flex resistance
Aramid:	Stretch resistance	Flex resistance UV resistance
Dyneema:	Stretch resistance Flex resistance UV resistance	

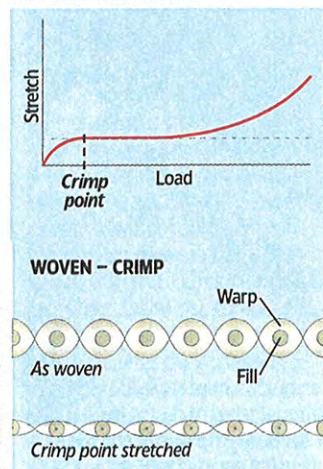
Looking at the characteristics of these hi-tech fibres, Dyneema seems to be the ideal fibre to enhance polyester sails because of its resistance to stretch, flex damage and ultraviolet light. The problem is that it doesn't deal well with the heat involved in the processes used in finishing woven fabrics, and the yarns are so slippery that they resist resin. By using heavier-denier Dyneema yarns and a patented system, now expired, on a finishing process that is Dyneema-friendly, Dimension-Polyant incorporated Dyneema into a woven fabric – Hydra Net. The result is a fabric that looks from a distance like a standard Dacron sail, but combines the durability and hand of Dacron with the stretch resistance of Dyneema. Hydra Net has proved itself over thousand of miles and many years aboard Noerbert Sedlacek's Open 60.

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CRIMP

When they leave the factory, woven fabrics have a certain amount of stretch built into them. As the fill yarns pass above and below warp yarns, the warp yarns are distorted slightly by the fill yarns. As the warp yarns are loaded, they straighten. After this point, the crimp point, the cloth can bear load.

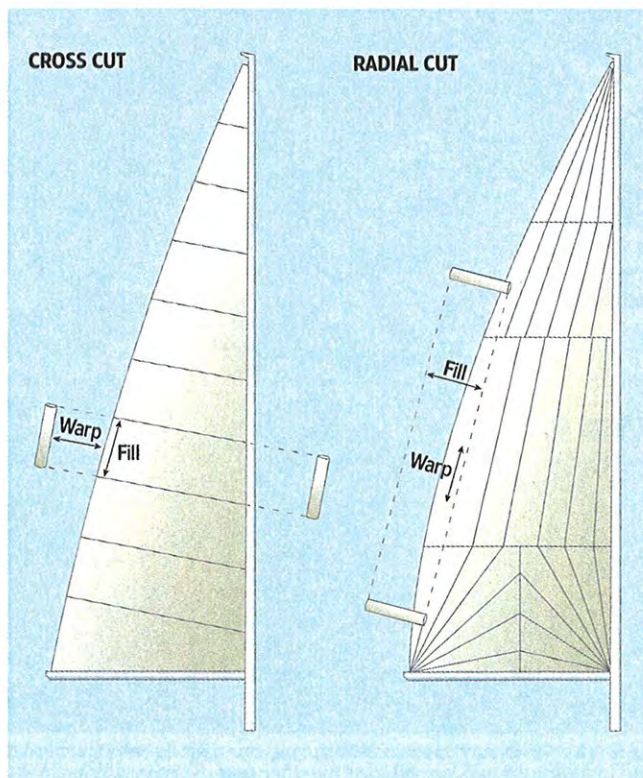


CROSS-CUT OR RADIAL?

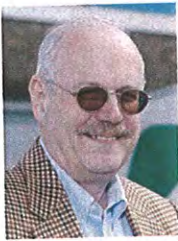
Cross-cut sails are the most economical to build because they have the fewest number of panels, which means the sailmaker wastes less cloth. Only having a few panels means you have fewer seams, so they're also less labour-intensive to make, but the sailmaker has fewer options to cut shape into the sail.

Radial sails have dozens of seams, so the sailmaker has much more control over the sail's shape. Also, because the panels are cut so that the loadpath runs along the stronger warp yarns used for radial sails, stretch is reduced.

The downside of radial sails is that they are much more difficult to make, requiring computer cutting of panels, and there may be as much as 20 per cent more cloth wasted because of this. The waste and extra time involved in making radial sails is the reason why they are more expensive to build.



↓ HOW IT'S MADE



Dimension Polyant's sales and marketing vice-president, Robert Kühnen

We visited Dimension-Polyant's plant in Kempen, in Germany's North Rhine-Westphalia, to find out how sailcloth is made.

Woven

Looms have been part of the cloth production process since weaving began and, though heavily mechanised now, the loom still plays a pivotal role in manufacturing. Computer control has made the process much less labour-intensive.

Before computers were introduced, one weaver and one spooler would look after four looms. Now, one operative looks after 25 looms.

Once woven, the greige, or unfinished, cloth goes through up to 15 finishing processes. Much of the quality and durability of the finished sailcloth depends on this series of treatments. Temperature, mechanical pressure and tension, and the concentration of chemicals are all computer-controlled and critical to the nature of the finished sailcloth.

First is washing. The yarns are lubricated before weaving, for smoother running, and the lubricants must be washed out.

After washing, the cloth goes into the tenter frame where it is clamped into place to limit warp and fill shrink during drying. The

cloth is then treated with resins.

Sailcloth with high resin content is very stiff and resistant to stretch in all directions – compare your resinated polyester sails to your untreated polyester sailbags, for instance. Cruisers usually choose a less resinated cloth, which has a softer hand, so it's easier to handle, less of a nail-breaker, and less awkward to stow. Resins degrade with time, which is a major reason that sails lose their shape. A UV-resistant coating is also applied, which can extend life significantly.

Cruising laminates

At the core of a cruising laminate sandwich is the scrim, which can be made of carbon, aramid or polyethylene fibres. Basic cruising laminates will have a bi-axial scrim but these are not woven. Instead,

yarns in one direction are laid on top of those in the other direction. This eliminates crimp. The more performance-orientated laminate sailcloths also have a diagonal scrim to reduce stretch in the bias.

The scrim is coated in adhesive and then passed through an oven to burn off the excess solvent. Then it is sandwiched onto one layer, or between two layers, of Mylar film. Cruising laminates are then covered with a layer of woven polyester taffeta to reduce abrasion and soften the hand of the cloth, improving its feel.

A UV-protective coating is also added at this point.

Laminates are prone to mildew because the film prevents air ventilating through the sail. An anti-mildew treatment is part of the production process.



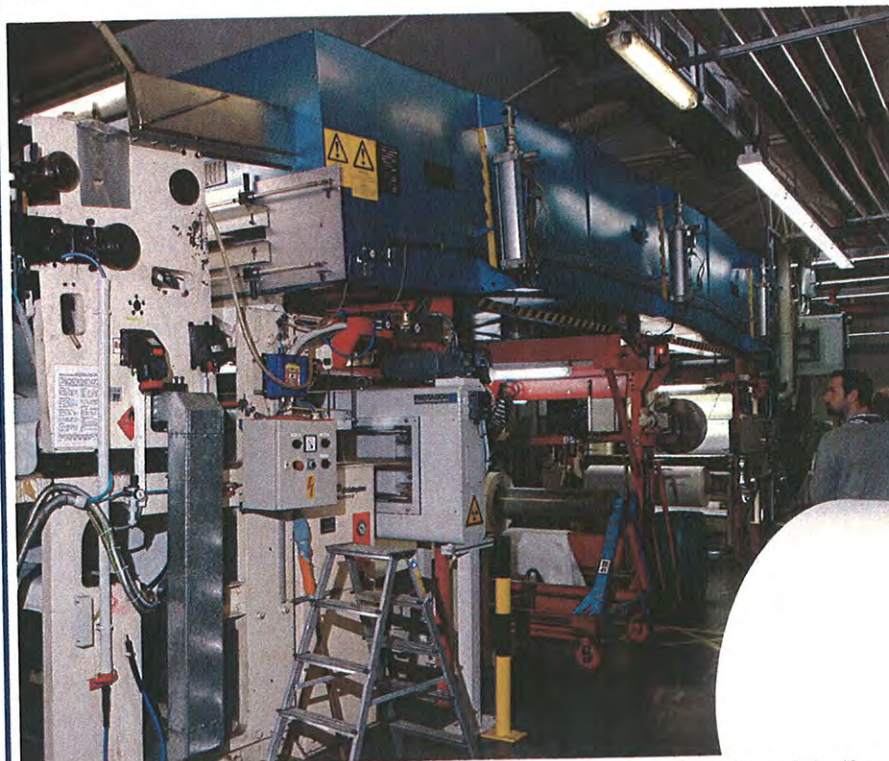
Warp yarns are still hand-threaded onto the 'sticks' that move up and down in the loom



Specially adapted looms allow Dimension-Polyant to weave Dyneema into Hydra Net



Many of the critical finishing processes take place in the huge tenter frame



The laminator wasn't in operation during our visit but this is where the scrim and the film used in laminate sails are bonded together and then sandwiched between layers of taffeta



After it leaves the loom, the unfinished cloth is washed to remove lubricants



Cloth that will become protective UV strips receives its anti-ultraviolet coating

TECHNICAL TACK SAILCLOTH

↓ WHICH SAILCLOTH DO YOU NEED?

'If you're an occasional club racer and you want to be in the top third, choose cruising laminates. If you want to be in the top three, choose membrane. For cruising, woven cloth is fine.' So says Robert Kühnen of Dimension-Polyant. He also points out that cruising laminates are so-called because the taffeta makes them too heavy for out-and-out racing.

The choice boils down to what type of sailing you do. If you have a heavy-displacement cruiser, the weight saving of laminate sails will be negligible, but they might preserve her ability to point to windward and could reduce heeling in gusts. For a light-displacement fast cruiser or a multihull, laminates might be the right choice – they'll boost her speed very slightly and the reduction in weight aloft may improve the boat's motion. They're cheaper than the hi-tech Dacron cloths and their performance lifetime is longer, but their physical lifetime is significantly less.

Among the woven products, performance is a factor, as is size. Yachts less geared towards performance will have lower-aspect mainsails and perhaps



Above: If performance matters, laminate sails might make sense. Below: Bainbridge's Ocean Premium Plus limits stretch but retains a manageable hand



overlapping jibs. A standard woven Dacron will be fine for a cross-cut main, patched to reduce chafe, but you might want a tougher cloth for your genoa because of the beating it's going to get during tacks. Yachts with higher-aspect mains can also use standard Dacron for cross-cut mainsails but only up to around 45ft, beyond which the loads are too great. Then, you will need a fill-orientated cloth.



Above: Your sailcloth choice depends on your boat, your ability, the type of sailing you want to do and your cruising ground

↓ CARE AND MAINTENANCE

Flogging: Sails that flog in high winds or slat in light winds are being subjected to very destructive forces. Trim your sails properly so that they don't flog, always make sure your leech lines are nipped up tight enough to stop the leech flapping and in light winds you're better off using a heavier sail that won't slat as much, or just rolling the sail away and motoring.

Chafing: Check your foretriangle area for threats to your sail. Use rollers on the lifelines either side of the stanchion and tape up the shackles or bottlescrews where the lifelines join the pulpit. Check the mast – is there anything that could tear your sail or foul a sheet, causing the sail to flog? Genoas are subject to much more abrasion than jibs, so cover all standing rigging with PVC tubes, use rollers above and below the spreader tips, and on the babystay – anywhere the sails chafe during tacks.

Stretch: Sailcloth manufacturers and sailmakers go to great lengths to make sure that a sail is built to resist stretch, but sails are still

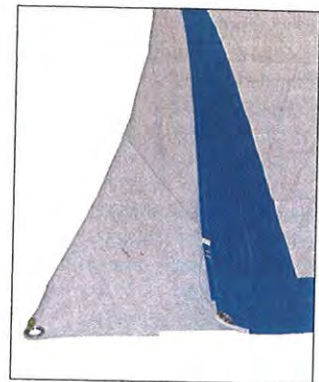
expected to stretch a little. Sailing in stronger winds, you'll tighten the halyard, outhaul, backstay and maybe the cunningham to flatten the sail. Don't forget to ease the tension out of those sail control lines before leaving the boat.

UV: Over the course of a year, UV can take a big toll on your sails. However, most UV damage occurs while stationary, so the best way to look after your sails is to go sailing. Always use your mainsail cover and make sure it's big enough to cover the whole sail. Often the clews and head – areas of very high load – are left poking out, exposed to UV. Make sure your furling genoa is rolled tight enough so that only the UV strip is visible. If you're leaving the boat for more than a day, use a genoa sock to cover the UV strip.

Servicing: It's recommended that you take your sails to your sailmaker for servicing at the end of each season, for laundering, inspection and repair. Take all the hardware, sail slides for example, off the sail first because laundry is charged by weight.



Never underestimate the destructive power of UV



Tightening halyards to account for stretch can deform sails



Check your foredeck for chafe points and protect the sail



Mildew can be a tricky cosmetic problem with laminate sails

TECHNICAL TACK SAILCLOTH

↓ WHAT THE EXPERTS RECOMMENDED

We asked three sailcloth manufacturers to recommend a sailcloth for each of three hypothetical yachts, giving reasons on each occasion:

Yacht 1



8.5m (28ft), based in UK, sails nearly every weekend throughout the year with a long cruise to France or Ireland during the summer. Enthusiastic young husband and wife crew, used to race dinghies, enjoy sail trimming.

Dimension Polyant

As the boat is rather small the best options would be woven Dacrons, such as our AP/SF-Line or our Square-Line.



Bainbridge

We recommend CL-Diax-LSP Cruise laminate with Pentex as the load bearing fibre. It's designed to give the performance benefits of a laminate fabric whilst incorporating durable taffetas and a DIAx diagonal fibre. In that way, it suits the owners' racing background and gives them a sail durable enough for their long summer cruise.



Contender

The first option would be ACL cruising laminates, which will save some weight aloft, keep their shape through the wind range and will reward good trimming. ACL has taffeta both sides for good durability, but extra care is needed with laminates if they're to reach their maximum life.

This couple is likely to understand that and to be realistic about their expectations of performance and sail life expectancy. Premium Dacron might be an option, but given their background, cruising laminates are a better fit for the profile of these young sailors.

Yacht 2



11m (36ft), based in the Mediterranean, young family, RYA-qualified but new to sail cruising, without many sea miles logged. Four-week cruise in the summer and 3-4 weekends in the winter.

Dimension Polyant

This boat is bigger than the first, but as the sailors are not very experienced, I think our AP/SF-Line will be sufficient. Based on the boat size, Hydra Net or DC cruising laminates would be an option, but with regard to their sailing experience it would be overkill.



Bainbridge

We recommend Ocean Sailcloth – a great all-purpose cloth. Its tight weave gives a durable fabric with good UV resistance. It performs well enough to allow these new cruisers to play with sail shape but it's still forgiving when handling and stowing.



Contender

We would suggest our Supercruise Dacron range, easy to handle and highly durable – this family is new to cruising, so sail care is not their highest priority. Supercruise will withstand the general abuse that a less experienced crew will often inflict on their sails. It offers reasonable performance for a cost-effective price. No-fuss sails with minimal care required.

Yacht 3



12.2m (40ft), based in UK, retired husband and wife. Very experienced, they cruise extensively in the North Sea, Baltic, North Atlantic and Mediterranean.

Dimension Polyant

Boat size and description of the sailors would justify Hydra Net, our top woven line.



Bainbridge

Ocean Premium Plus – a performance-orientated woven polyester fabric incorporating high-tenacity fibres to give a very durable cloth, meaning the sail will hold its shape for longer. Addition of a true rip-stop reinforcement to prevent damage spreading, useful in the rugged northern European environment. This fabric also has a very nice feel, making handling easier – an important consideration for short-handed long-term or coastal cruising.



Contender

They want long-lasting, easy-to-handle sails with good shape-holding ability. These sails are likely to be reefed regularly, by a short-handed crew, and exposure to ultraviolet light will be a consideration. Our Premium High and Low Aspect Dacron styles will out-perform a cruising laminate in all these departments over time. Care and maintenance of Dacron sails in more isolated areas is also easier. ▲