The Right Rode

by Steve Dashew
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When I was just getting my feet wet sailing offshore as a kid in the late 40s, my Dad acquired some post World War II nylon rope for use as dock lines and anchor rodes. The impact then was comparable to the advent of roller furling in more recent years. Compared to the stiff, scratchy, mildew-prone, not to mention weak natural fibers we'd been using, nylon was a revelation. It has stayed the de facto standard since.

Over the years we've always used nylon for anchor rodes and dock lines on the yachts we've built for our clients, and suggested it in our books as the material of choice. However, last year something occurred that has changed our thinking on this subject. While doing research for a new book on heavy weather tactics, *Surviving the Storm*, we encountered several instances where new nylon rodes had failed when used in conjunction with parachute anchors under storm conditions. In all cases the failures were at loads well below the catalog breaking strength of the rode, and external chafe did not seem to play a part in the equation.

One example is the experience of *Wandering Star*, a heavy displacement 34-footer, en route between the Pacific Northwest and the Marquesas Islands of French Polynesia. She was caught in hurricane, and during the early phase lay to a 5/8" rode of three-strand nylon. Within a half an hour of setting their parachute anchor, the rode failed about 20 feet off the bow, where chafe was not an issue. In another situation, the 45-foot *Freya* was riding to a parachute anchor in a compression zone storm just north of Auckland, New Zealand, when their 3/4-inch three-strand rode failed ten feet off the bow.

In both cases we discussed the chafe protection and attachment points on the boat with the skippers, and looked at the structural capability of the parachute anchors. The inescapable conclusion was that the rodes had failed at somewhere between 45 and 60% of rated strength in tension, with chafe not being an issue.

Further investigation with rope manufacturers revealed several startling facts. First, the rated strength of nylon drops by 15 to 20% when it is wet, as compared to the catalog breaking strengths (which are dry rated). Second, when nylon is repeatedly cycled at a high percentage of its breaking strength, typically above 50%, it generates substantial amounts of internal heat. This internal heat degrades the structural performance of the nylon, by as much as half, and is thought to be a common cause of failure at high loads. This internal heating process is worse when the rope is wet.

Third, when you consider the stretchiness of nylon it has much less chafe resistance than other materials such as polyester (Dacron). Dick Hildebrand, Vice President at Yale Ropes indicates that in some conditions "polyester line is as much as ten times better than nylon in dealing with chafe."

Bill Fronzaglia, Director of Engineering at New England Ropes told us that nylon can lose as much as 50% of its abrasion resistance when wet (as compared to when it is dry).

And Mike Dahill, production manager at New England Ropes, pointed us to an MIT study done after Hurricane Gloria, prompted by the experiences of *Cruising World*'s Technical Editor, Ralph Naranjo. This study has led to the adoption of polyester mooring pennants (as opposed to nylon) precisely because of the internal heating and chafe issues previously mentioned.

If nylon is the wrong material, what should we be using?

Let's consider, for a moment the ideal anchor rode. The number one issue for us is reliability. This means good chafe resistance and adequate energy absorbing ability. The rode has to be easily handled, flake without getting kinked, and take up a minimum amount of storage space.

Traditional thinking would add elasticity to the equation. But we have come to feel that above a modest amount, elasticity causes more problems than it solves. Consider the issue of sailing at anchor. Unless you have a riding sail of some sort, when it starts to blow almost all boats tack back and forth on their anchor when connected to the bottom by a nylon rode. Change to chain, which doesn't stretch, and the sailing is substantially reduced.

This shearing back and forth can double the load on the rode. That higher load leads to more stretch. When you get to the end of one "tack" with the rode stretched tight, nylon acts like a slingshot, accelerating the boat back in the other direction, exacerbating the shearing problem even more. Elasticity is a definite negative here. These higher loads from the tacking lead to more stretch, which makes for a greater sawing action anywhere the rode touches the boat, or bottom. Finally, the shank of the anchor is being pulled back and forth, which reduces holding power.

Of course there is some shock absorbing capacity from the elasticity, and this should help the anchor stay put. However, our gut feeling is that this is less of a positive factor than the shearing is a negative.

Now let's look at required structural capability more closely. There are several factors involved in staying connected with rope rodes. One is the ability of the rope to absorb energy. This is a function of the inherent strength of the raw material, the construction of the rope, the elasticity of the rope and finally, *the length of rope over which the loads are being absorbed*. The first three factors are fixed by whatever rope you are using. The amount of rode deployed, however, is within your control.

Dick Hildebrand of Yale points out that in the real world this works like it sounds. "If you are anchored in 20 feet of water on 140' of rode, you can double the energy absorbing capacity of your rode by doubling the amount of line you have out to 280'."

In effect, you can deal with the reduced elasticity of polyester line, and the resulting lower energy absorbing capacity, by simply veering more line.

Then there is the issue of chafe, perhaps the most important consideration of all. Dave Strauss, Sales Manager at Samson Ropes says that “When polyester line is loaded to 20% of its breaking strength, it stretches between 2.2% and 2.9% depending on construction. Double braid nylon, in same situation will stretch 5.3% and three strand nylon 10%.”

When you consider that chafe is directly proportional to stretch, you can see that by reducing stretch and line movement over chocks and rollers, you reduce chafe. Add in the inherent superiority of wet polyester to wet nylon in terms of chafe resistance, and in our opinion, polyester is by far the superior material to use.

Which brings us to the issue of correctly sizing rodes and dock lines. There are no *scientific* rules for sizing anchor rodes. Everyone goes by experience. For example, when we were outfitting a low windage 50-footer for a circumnavigation, we used 9/16" three-strand nylon. That seemed to work OK, and when we built a 62-footer, we went to 5/8" braid. For a 67-footer logic told us that 3/4" super stretch “brait” was the ticket, and for a 78 foot vessel we upped this to 7/8" brait. All of this by experience and scaling – which is the way almost everything to do with boat engineering works.

Rope manufacturers typically want you to operate below 20 to 25% of breaking strength for polyester and nylon (high modulus fibers, like Spectra, can be worked harder). Rope that is operated at a 20% load is going to last as much as two and a half times as long as one that is at 40%. So conservative sizing is important. But just what are the loads?

For anchoring, they are probably a lot lower than most of us think. Consider our experience with snubbers. We’ve always anchored on high strength lightweight chain. Because the light chain quickly becomes tight in moderate breezes, we’ve been in the habit of using very light, stretchy snubber lines.

When we started our circumnavigation we made up a snubber from an old piece of 3/8” three strand nylon. We anticipated replacing this every six months or so. Five years later we were still using the same piece - which indicates that overall, the loads are pretty light.

So how do you pick the correct size polyester? As you can see from the previous comments, our thoughts on this subject have changed. For normal cruising, i.e. tropical in the winter and temperate in the summer, where loads are generally moderate, we are prepared to size for the *normal* blows that occur. And if we’re caught in a severe blow, for a long period, we’ll accept the prospect of replacing the rode after the season due to excess high load cycles. For a fixed amount of space, we’d rather have more line of a smaller (but adequate) diameter, rather than less of an oversized but bulletproof material. This latter fact is based on the concept, as previously discussed, that you can increase the energy absorbing capability of a given line type by simply increasing its length.

On the other hand, as the risks of prolonged periods of high loading increase - typically with an increase in latitude - the rope size should increase.

How do you choose the right size of polyester rode for your own boat? The most conservative approach is to purchase the same size polyester as you would in nylon. You won't save weight or bulk this way, but you will vastly improve chafe resistance while reducing the tendency to sail at anchor.

For cruising where conditions are moderate, you may want to consider splitting the rodes, using the same size as you would be comfortable with in nylon, and carrying another coil that is one size smaller.

Steve Dashew is a yacht designer, boat builder, and author of eight books. His latest book, Practical Seamanship: Essential Skills for the Modern Sailor *is available from Beowulf Press (www.setsail.com or 800 421 3819).*