

# Rig Selection .. excerpt from Bob Sterne's "How to Sail Fast"

The first step - and one that precedes any talk of tuning a rig - is to select the correct rig. As a rough guide, the optimum rig for beating is the one which will produce an angle of heel of about 30 to 35 degrees. If the boat is heeling less, it's underpowered and, if more, it's overpowered. Typically, however, the winds are not constant and a certain amount of overpowering is acceptable in the puffs. Ideally, the angle of heel should never exceed 45 degrees at any time, and certainly it's not a wise idea to try to tack when the boat is heeling more than 45 degrees. In fact it could slow down the boat dramatically since it forces the rudder to act more in the vertical than in the horizontal and push down the stern. One likely scenario is "going into irons."

On the other hand, if the boat is not exceeding about 30 degrees of heel in the puffs, it's probably time to choose a larger rig if possible. Try to pick the rig which keeps the boat sailing at about 30 to 35 degrees of heel with the sails trimmed for maximum drive.

If wind speeds were constant, this would be an easy decision to make. It's not. Generally it's acceptable to use twist or back winding to depower a rig in the puffs, but if you must sail with the trim this way all the time, then a shorter rig is indicated. The proper size rig with the proper trim is always better than an oversize rig which has been depowered. The problem is that the shorter rig will be underpowered in the lulls if you suit down too soon.

Knowing the exact conditions at which you should change sails is therefore of utmost importance. While it's very much a matter of experience, there are a couple of things you can do to better your chances of making the correct decision.

First, get a wind speed measuring device (anemometer) of some type and use it regularly. Use it constantly until you can estimate wind speed within about 10% and then use it occasionally to double check your guesses. Secondly, try different rigs during tuning sessions when you even wonder if a different suit would improve performance. The more you experiment \_ indeed the more you sail \_ the better the decisions you make will be.

The optimum rig for downwind work is usually the largest rig you can carry and still be able to control the boat in the puffs, and without diving to the point where green water (as opposed to spray) comes over the deck. Generally a boat will sail faster without trying to play submarine. The fact that the optimum rig for windward work and optimum rig for downwind may not be the same is really a design fault, but it further complicates matters. Take for example a Marblehead with normal draft, but carrying 16 lb. of lead. This extremely stiff boat would be able to carry an 80 inch luff rig to windward long past the point where it became a submarine downwind, unless it had an unusual amount of freeboard forward. But, by the same token, a normal Marblehead with only 4 lb. of lead would probably be hard to tack with an 80 inch rig in much over 5 knots of wind, but would probably exhibit no problems downwind at these wind speeds. It's this designer's opinion that the optimum boat should be stiff enough to carry a given rig to windward to about the same wind speed where problems start to occur downwind. Note that a variety of boats can fulfill this condition. It depends on the relationship of diving force/hull lift to heeling force/righting moment. Generally, the stiffer boats will require more excess

buoyancy (or extra lift) forward. Most of the time there's not too much that can be done about a boat that is too stiff or not stiff enough. An exception is when it's pretty close in which case a lb. Of ballast one way or the other may suffice. Larger changes are not usually a good idea, there are exceptions. It's my opinion that no less than four rigs are required to cover the range of winds that you should be prepared to sail in, namely 0 to 30 knots. The tallest rig should be optimized for about 7 knots or so, and handle puffs to 10. The second rig should be at its best in about 10 knots, with puffs to 15. The third rig should be capable of being tuned for maximum efficiency in about 15 knots, and should be able to handle puffs to about 22 knots. The fourth rig is a reduced area storm suit, showing maximum efficiency in about 20 knots, and should still be controllable in puffs to 30 knots. Generally, you will find that the mast for the storm suit will roughly equal the length of the boat. If you regularly sail in winds of over 30 knots, you will need an even smaller suit.

If this seems like a large number of rigs, just ask the skipper of a big boat how many sail changes he would make between 0 and 30 knots. Most of the high performance yachts will require a similar number of changes as do our models. This is because there is a 100 times increase in wind pressure from 3 knots to 30 knots. If we graph the angle of heel versus wind speed for 0 to 30 knots, for the above four idealized rigs, we will first notice that between 10 and 50 degrees of heel, the curves are virtually straight lines. Note the areas of overlap, where either of two rigs can be used. These are necessary because of fluctuations in wind strength, and make it easier to have the right rig.

Most skippers won't change down until control becomes a problem. I suspect that we all carry our tall rigs too long. When going to weather, the excessive heel makes control difficult. It creates more leeway, because the fin is not as efficient when heeled. It even increases the drag of the boat because the downward force of the sails increases, which makes the boat in effect heavier. Off the wind, the down force causes the bow of the boat to dig in, which increases the resistance dramatically. This may lead to a vicious circle of events in which the increased drag leads to bow down trim, which leads to increased down force, which leads to diving, which can nearly stop the boat, pulling the rudder out of the water, and causing a broach, or going into irons. With a shorter rig fitted, the boat will usually plane better, because of the reduced down force, while to weather the better balance and reduced leeway will usually increase the speed made good. In any case, the moment you have a control problem, or diving downwind becomes excessive, RIG DOWN. You can't race if you can't control the boat. It's much better to be bit slower (although this will rarely occur) than to sit in irons, or fill your radio up with water. Remember, you have to finish to win.