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Winner of "The Links2Go Key Resource award"

1. RIG SELECTION

In this first of a five Chapters on tuning a model racing yacht, we'll look at rig selection. In the next sections are features on mast position, how to obtain proper trim to windward as well as how to alter that trim when sailing in non-optimum conditions.

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 keeling 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.

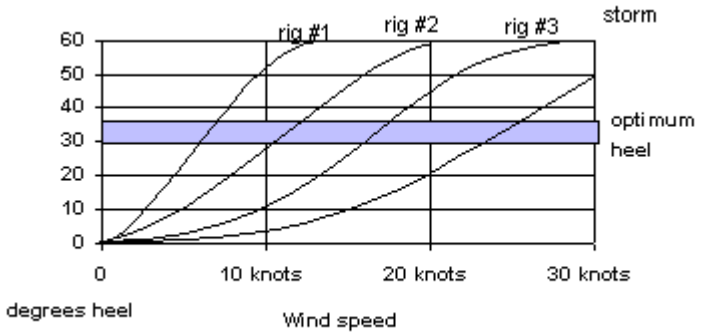
If wind speeds were constant, this would be an easy decision to make. It's not. Generally it's acceptable to use twist or back winding to depower a rig in the puffs, but if you must sail with the trim this way all the time, then a shorter rig is indicated. The proper size rig with the proper trim is 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.

2. MAST POSITION

Above, we looked at how to choose which rig to use for any given amount of wind, using the angle of heel to windward, which should be 30 to 35 degrees for optimum performance. Ultimately, if all else fails, any loss of control should be the final warning to reduce rig size. We saw that if you have about four rigs, and if they are of optimum sizes, you can have maximum performance nearly all the time, from 0 to 30 knots of winds. The only exceptions are in very light airs and when you are trying to carry a tall rig just a bit too long. These situations will be covered in future articles. For now, we'll focus on determining the best mast position.

The first thing that you need to do to tune your boat, now that you have selected your rig, is to determine the proper mast position. This is also the last thing you should do, after you have the boat all trimmed out. In other words, tuning is a circle. When you are all finished, you should go back to the beginning and check everything again. Remember, one change may require as many as half dozen others. Now, what is the proper mast position? It's probably different for every rig, and for every 10 degrees of heel. To understand this, you must go back to the basics of trim for sailing to windward.

Traditionally, a boat should carry a slight weather helm when sailing close hauled. This enables it to point as high as possible, and to "hunt" out its own lifts when they occur. By slight, I mean that it should not require you to constantly hold the helm down, but the boat should sail several boat lengths without luffing in steady winds, gradually coming to the point where the windward jib telltales will flutter, and will require you to bear off very slightly. This is optimum helm for sailing to windward. It gives the boat "life" and "feel" and forces you to become part of the boat, making these corrections exactly when (or even before) they are needed. If the boat has too much weather helm, you will feel as though you are fighting it. In fact, that's exactly what you're doing. If it sails as though it is on rails, then it may have either neutral helm, or a slight amount of lee helm. In this condition the boat may not point well, particularly in light airs. If the boat has severe lee helm, it cannot be made to point, and in light weather you're going to get killed. If you've noticed

the relationship between pointing ability and weather helm, congratulations. You have just answered your questions from those days when you said "my boat won't point."

Weather helm is caused by two opposing sets of forces acting about the Centre of Lateral Resistance (CLR) of the boat. There is a set called the "lee couple" and a set called the "weather couple," depending on which way they want to make the boat turn. If the "lee couple" is less than the "weather couple," you have weather helm. The lee couple consists of : side force x "lead." The weather couple consists of : driving force x "shift", plus pressure on the lee bow. The "lead" is the distance that the Centre of Effort (CE) of the sails is ahead of (leads) the CLR, measured along the centreline of the boat. The "shift" is the distance that the CE is displaced sideways (shifted) from the centreline, which in turn is the height of the CE times the Sin of the angle of heel. If the "lee" and "weather" couples are not equal, the difference must be made up by the rudder. The amounts of side force and driving force are related to wind speed, sail shape, and sail area, but for fixed conditions we can ignore their variations. The pressure on the lee bow is related to boat speed, shape, and leeway, but again we will ignore it. The things we have easy control over, and that make the largest difference are the "shift" and the "lead."

The "shift" can be changed in two ways. We can fit a different height of rig, which works by changing both the height of the CE, and also the angle of heel. Taller rigs will increase weather helm, and vice versa. Alternatively, we can alter the trim of the sails to change the angle of heel, with more heel giving more weather helm. This is the basic reason that a boat rounds up to weather when you sheet in, which can be used to great advantage in rounding mark, or in doing penalty turns. It will also kill you if you try to bear off when the boat is heeled very far without sheeting out.

The "lead" can also be changed in two ways. If we bear off without sheeting out, the CE moves aft slightly, and the "lead" will decrease, increasing weather helm. This is why a boat can be tuned to sail like is "on rails". If it heads up, the CE moves forward, causing lee helm, and the boat to bear off. If it bears off, the CE moves aft, causing weather helm., and the boat to head back up. The boat is in perfect tune (helm-wise) for that course. The problem is that course is not necessarily as high as the boat can point, and is more likely to be a few degrees lower. Boats that are "on rails" can be a joy to sail, but be careful, because they tend not to point quite as high. The other method of changing the "lead" is to move the mast. Moving the mast aft decreases the "lead" and increases weather helm. Likewise, forward is lee. Mast rake has the same effect. We now have a method of altering our boats' weather helm to suit our requirements.

I have a basic rule that I try and remember when I am having problems with helm and/or pointing ability. THE AMOUNT OF HELM IS DEPENDENT ON THE POSITION AND SHAPE OF THE LEACH OF THE MAINSAIL. If it is too far forward,

the boat won't point. Too far aft, and there is too much weather helm. If it has a lot of twist, the angle of heel will be less, the CE will move ahead, and the mast may have to be moved back to compensate. If it is strapped down hard, the boat will heel like mad, and the CE will move aft, causing the boat to head up. The mast may have to move forward to restore balance.

When you are sailing the boat at its optimum 30 to 35 degrees of heel, experiment with various mast positions until you find the optimum. Remember, for determining this position, the sails should be trimmed for maximum efficiency and drive. As a starting point, this means that the center third of the mainsail leach should be parallel to the centreline of the boat, and when viewed from behind, the jib leach should parallel the main leach, far enough out to prevent back winding. This will give you a centre point for your mast step, and you should have about an inch of adjustment left in either direction. This will allow for a variety of wind conditions and sail trims. The amount of "slight" weather helm that your are after should virtually disappear when you move the mast ahead about ½ inch, and the boat should point nearly as high and feel like it is "on rails", providing the angle of heel stays between 30 to 35 degrees. I find that each additional 10 degrees of heel will require the mast to move ahead about ½ inch to maintain the same helm and vice versa. But you should confirm this for your boat. Don't forget to re-check for every rig you have. If you can't remember them, write them down in a notebook. This is an excellent idea in any case, and not only for the mast position, but for everything else about tuning the boat as well.

3. Sail Trim to Windward.

In the previous chapters, we talked about how to select a rig and find the proper position for it to produce a boat which is heeling about 30-35 degrees, and carries slight weather helm with the proper sail trim. Now, I will try to explain how to achieve this Trim.

The first step, after stepping your chosen rig, is to adjust the Backstay. In general, you need more tension in heavier winds, in order to keep the Jibstay tight enough to preserve the proper shape in the Jib Luff. If the Jibstay is too loose, it will sag too much, and the Jib will be very full in the front section, and the boat won't be able to point properly. In addition, the Backstay also bends the mast, which produces a flatter Mainsail shape, particularly in the upper 2/3rd of the sail. In a fractional rig, with adjustable jumpers, you have some control over the shape of the upper 1/3rd of the Mainsail. More Jumper tension will increase fullness, and vice-versa By balancing the Backstay and Jumper tensions, you should be able to achieve sufficient Jibstay tension without too much mast bend. If not, your mast is either too flexible, the shrouds are too loose, the are not swept far enough aft at the deck, or there is

insufficient luff round cut into the Mainsail. At the lake is not the time to find this out. This type of tuning should be done at home.

The next step is to adjust the Mainsail. First, set the luff tension, by means of either the Halyard or Cunningham, just tight enough to remove all puckers or horizontal wrinkles in the luff of the Main. Too much tension will cause a vertical fold just behind the mast, so beware of that. Next, adjust the outhaul at the clew of the Main so that the sail about a foot above the boom has the desired amount of fullness. Generally this is about 10% of the chord width at this point. Then, set the Main Sheet so that the boom is about an inch or so off the centerline with the winch all the way in. Adjust the Vang so that the Leach of the Main half way up is parallel with the centreline of the boat. Stand about 2 boat lengths behind the boat, and line the backstay up with the mast, so that your line of sight is on the centerline of the boat. You should see the leeward side of the bottom batten, and the windward side of the top batten, but the 2 center battens should be pointing nearly straight at you. The actual amount of twist is hard to describe, and varies with different wind conditions. In lighter air, or in puffy conditions, or in rough water, you need a bit more twist. Repeat the Sheet and Vang adjustments until you are satisfied with the result.

Now it is time to adjust the Jib. Again, the first thing to set is the Luff Tension. The same method is used as for the main, with only enough tension to remove wrinkles. Next, again, is the Outhaul, again a similar procedure. Now, if you have a Jib Trim, set it in the middle of its travel. Make sure that the winch is fully in, and adjust the Jib Sheet so that from your vantage point 2 lengths behind the boat, you can just see the reinforcing patch in the Clew of the Jib past the side of the Mainsail. Something like a .25" to a .5" outboard of the Main is about right. Next adjust the Leach Line (i.e. Jib Topping Lift) so that the twist of the Jib matches the twist of the Main. From behind the boat, you want the curve of the Jib Leach to match the curve of the side ' of the Mainsail. When you are satisfied, recheck the Jib Sheet. Check that the Jib Trim will bring the Jib in far enough to backwind the Main, and ease it far enough to open the slot so that you can -she about I" or more of the Jib Leach past the Mainsail. Take one last look at the rig as a whole, and try it out.

Once on the water, you have added one more variable. The boat moving through the water, and hence the air, is generating its own wind. This combines with the true wind to become the apparent wind, which is always coming more from the bow of the boat than the true wind. In addition, because of the velocity gradient, or the fact that the higher off the water, the stronger the true wind, the apparent wind is from different directions at different heights above the deck. At deck level, it is shifted more forward, because a greater percentage is due to boat speed. At the top of the rig, it is closer to the direction of the true wind, i.e. further aft, and it is also stronger. It is this difference in wind direction over the height of the rig that requires us to cause our sails to twist. Ideally, every part of the sail should be meeting the apparent wind at the same angle, so that the maximum drive is obtained. If there is not

enough twist, the top of the sail will be stalled relative to the foot. If too much twist, the top of the sail will luff before the bottom. This is where the telltales come in.

Head the boat up, with the sails close hauled, just the way you set them on the dock, until it is pointing as high as possible without luffing. Check the helm on both tacks, and if it is grossly incorrect, relocate the mast or change rigs, and start again. If it is fairly close to neutral, or a slight amount of weather helm, you are ready to proceed. Sailing close hauled, watch the Jib Telltales closely. Without letting out the sails, bear off very slowly until the Leeward telltales just become - agitated. Take careful note if the upper or lower telltale is the first to be affected. If it is the upper, you need more twist in the Jib. If the lower, you have too much twist. You can double check by turning up slowly until the Jib just begins to luff. If the upper telltale stalled first, then the Jib should start luffing first at the bottom, and vice versa. Unless both telltales stall together, and the Jib luffs evenly from top to bottom, bring the boat back to the dock, and correct the Jib Twist. If necessary, reset the Main twist to match the Jib. Keep trying until you get it right.

Now that you have the Jib twist correct, it is time to check the Slot. The proper adjustment for moderate winds is to pull the Jib in until it just backwinds the Main, and then let it out a bit. Experience here is the key. If the Jib luff s a long time before the main, it is probably sheeted out too far, or the Main is over sheeted (i.e. in too close). If the boat feels lively but won't point high enough, the problem is usually the Jib. If the boat will point- reasonably, but feels slow, ease the Main. If the Main luffs before the Jib, you are way off, bring it back to the dock and check the basic settings. The Jib should luff just before the Main, but only just. If the boat will point OK, but feels sluggish, open the slot a bit. The more air through the slot, the more power, but if the slot is too large, pointing suffers. Now you have the relative sheeting angles correct, and the Slot is the proper width and shape.

Now check the mainsail. Is it luffing anywhere along its length. If so, the Twist is incorrect. With the boat close hauled, bear off slightly, and check to see that all the Leeward telltales stall together. If not, correct the twist. Now, look at the windward telltales on the Main. If all the other telltales lay flat on the sails, but one windward one keeps lifting, then the Main is a bit too full at that point. In theory, you should correct this, but when I get to the point that all the jib telltales, both leeward main telltales, and the lower main telltale are all flying, and the top of the Main is not luffing, I tend to leave the one remaining windward telltale which is halfway up the main, just agitated. If you bear off just a degree or so, it will lay down, and you can use this to keep you "in the groove".

Now that you have your sails set to provide the maximum speed consistent with the highest possible pointing ability, it is time to reassess the helm. Does the boat have too much weather helm, are you constantly fighting it? If so, move

the mast ahead and start all over again. If the problem is due to too much heel, then shift to a shorter rig. Does the boat have lee helm? Any amount of lee helm is bad news for pointing ability. Move the rig aft; or fit a taller rig, if the heel angle is too low. Ideally, the boat should be neutral helm in the lulls, slight weather helm in the constant wind, and controllable weather helm in the strongest gusts. One other thing: is the helm the same on both tacks? If not, your rudder is not properly centered.

Assuming that you now have your boat performing at its optimum, try it against someone that is consistently a good tuner. Play with the Jib Trim to see if you can get that little extra edge on boat speed and/or pointing ability. When you are making the best possible VMG, i.e. speed made good to weather, bring the boat ashore, and study it. Make notes. Be critical. Recheck everything. Test again. You want to be able to repeat these settings in a minimum of time the next time the wind conditions are like this. Try and get a mental picture of what the rig looks like when it is just right. You will be surprised how close you can come without even putting the boat in the water, after some experience. Often only one or two small changes are all that will be needed after first trials. When in doubt, look at the rigs of the better skippers, and try to emulate what you see. By the time you need to differ from what they are doing, you will have the experience to make those decisions. Ask questions if you are not sure, but try to make them specific, rather than general. Asking "Does my main have too much twist ?" will usually get you a better answer than "How does this look?"

What do you do when the wind changes ? If the change is relatively small, say a knot or 2, probably nothing. Any more than a 2 knot change will require retuning at least the Twist of the Rig, possibly more. If the heel exceeds 45 degrees, or is consistently less than 25 degrees, change rigs. If the helm becomes excessive, or if the boat won't point, moving the rig, and a major retune is in order. These are not really difficult decisions, because there are reasonably rigid guidelines to follow. The problems come in gusty conditions, when there really is no ' one proper rig or way to tune it. Then it becomes a compromise, in twist, rig position, even rig selection Experience here is the key. The only advice I can give is that if control is a problem in the gusts, you should probably rig down, but if you can maintain control both off wind and to windward through sail trim and mast position, you can probably stay with the rig you have. It will be the right rig in the lulls. The mast position should be far enough forward to prevent excessive weather helm in the gusts, which you can further control with the Jib Trim, by back winding the Main. Added twist in the Main can also help. These items, and proper tuning for light airs will be covered in a future article.

In this article, I have tried to tell you how to tune a boat under optimum conditions, i.e. steady airs, smooth water, and with the proper rig size for the amount of wind present so that the boat is neither underpowered, or over powered. I realize that this is seldom the case, but unless you understand what

is right, you can hardly be expected to make it wrong when conditions are less than ideal. Remember, too, that you may not be able to achieve exactly the degree of control over your sails you desire because the standing rigging is not properly adjusted. Overbend wrinkles in the Main, i.e. diagonal creases running up from the Clew to the Mast, are a common ,example. Remember, tuning begins at home, with a well prepared boat.

4. NON-OPTIMUM CONDITIONS

I have explained how to tune a rig when the conditions were the optimum for the rig, i.e. the boat was neither underpowered or overpowered.. Now, I will attempt to explain how to set up your boat for conditions which are not ideal.

It is an interesting fact that the type of tune that you use for very light conditions and when you are overpowered is very close to the same. The reason for this is that you wish to create a tune that puts the boat in a "low leeway" mode, i.e. where the side force is at a minimum, and more of the force is directed forward. In brief, this means flatter sails, with more twist, and sheeted out further.

In light conditions, there is very little energy in the moving air, and if your sails are too full, the flow will not stay attached to the leeward side of the sails, but will separate causing at least part of the sail to stall. The same thing occurs if you operate the sails at too high an angle of attack to the wind. This is why the sails must be flatter, and sheeted further out. In addition, the wind gradient is more important, with a larger portion of the apparent wind being generated by boat speed down low on the sails, and therefore the sails will need increased twist. You should still strive to have the Jib telltales stall together, as they did in normal conditions, however, this will require more twist to achieve. Also, check the upper, leeward telltale on the Main, and make sure that it is not stalling before the Jib telltales. If so, increase the twist in the Main. You want either all three leeward telltales (both Jib and upper Main) to stall together, or in very light conditions, even a bit more twist so that the lower Jib telltale stall slightly before the others.

The optimum sheeting angle in light airs will depend a lot on your boat, but the best advice is don't pinch. Keep the boat moving as fast as possible. It is better to sail slightly further at higher speed in light winds. You want to keep the slot open, so that you have lots of air flowing through it to increase the power of the main, and indeed having more difference in the sheeting angles of the Jib and Main in effect increases the camber of the entire rig, if you view both sails as working together, without having either sail set too full.

When you are attempting to carry a rig just a bit longer than you probably should (don't we all!), then you have a quite different problem, too much power and heeling force. As the wind speed increases, a flatter sail will generate sufficient power to drive the boat, and at the same time, it will

generate less heeling force, and therefore less leeway. The place to start is with the Mainsail. Increase the backstay tension until you just start to get diagonal creases running from the clew of the Main to some point halfway up the mast. Notice where these creases are running to. It is this point where the mast is bending too much for the luff curve cut into your sails. If the jibstay tension is sufficient, decrease the backstay tension until these wrinkles just disappear. If you want more jibstay tension (club is lifting in the puffs), then you need more control over the mast in the fore and aft direction.

If the wrinkles point at the spreaders, try moving the shroud attachment back at the deck, to pull the centre of the mast aft. If the top of the Main, at the Jibstay attachment point is too flat, try tightening up the jumpers. You may have to do both. You are trying to achieve enough Jibstay tension that: a) the Jib doesn't get too full right behind the luff in the puffs, and b) the clew of the jib doesn't lift too much in the puffs, depowering the jib and causing excess weather helm.

One note here about sails. The shape of the luff curve in the sails is one of the most important parts of how the sails will work as a "team". In light winds, the Jib luff must be cut essentially straight as there will be no sag in the Jibstay. However, as wind speed increases, the Jibstay WILL sag, and it is up to you and your sail maker to come up with the right combination. Since on a fractional rig the Jibstay tension is directly related to the mast bend, obviously the amount of luff round in the Main must work properly with the amount of luff hollow cut into the Jib. You must experiment with things like jumper tension, spreader lengths and angles, shroud attachment points, etc. to get the optimum from your sails.

Once you have the Main set as flat as possible without getting "overbend" wrinkles, with lots of backstay tension and the Main outhaul set at full flat, you will undoubtedly have to tighten the boom vang to reset the twist. Try to achieve a twist so that in the lulls, the top, leeward telltale of the Main is stalling along with the Jib, but that in the puffs, which are trying to overpower the boat, the Main leech twists off more, even to the point of luffing a bit in extreme puffs. Note, however, that if you are sailing this way all the time, you have the wrong rig on the boat!

Now that you have the Main set at full flat, adjust the Jib. If the water is relatively flat, you can set the Jib relatively flat as well, and you won't have to have too big a slot. Close the slot up until the Main is just being back winded in the puffs, but not in the lulls. This will help to control excess weather helm in the puffs. If the waves are quite large, however, then you must adjust the Jib fuller, to maintain the power to punch through the waves. The bigger the waves, the fuller the Jib. As you make the Jib fuller, you must sheet it out further, or you will backwind the Main, causing it to collapse just behind the mast. This is extra drag, and should be avoided, except as mentioned to depower the boat in extreme.. puffs. All through this range of adjustment for

the Jib, you should always strive to set the twist so that the upper and lower telltales stall together. The Jib pulls you through the water, please make sure that ALL of it is working!

Now that you have set the sails properly for heavy winds, just a brief word on what to do in extreme puffs. When you are trying to weather hard puffs with the wrong rig on the boat, you will experience extreme heel, and therefore extreme weather helm. If you have to correct this with the rudder, you will be going SLOW, so try to do it with the sails. If you have a Jib trim, try pulling it in, while simultaneously easing the sheets. In effect what you are doing is keeping the Jib sheeted "normally" and easing the Main in the puffs. The Main will be back winded more, and the top of it will luff a bit, both of which-will decrease the angle of heel, and therefore the leeway, while increasing your control over the boat. If you don't have a Jib trim, just ease the sheets a bit and bear off slightly in the big puffs.

One further non-optimum condition bears mention, and that is light winds and waves, a killer combination. The waves bounce the boat all over the place, robbing what little precious drive the sails can deliver. Under these conditions, try a LOT of twist in both sails. The idea is that at least PART of the sail will be working all the time, and some skippers claim a sort of "propeller" effect from the extra twist. I don't know the exact reasons, but it does work! Don't flatten the sails too much in these conditions.

I hope that these four articles have helped you improve your boatspeed in all conditions. One passing thought..... if you aren't using telltales on your sails, WHY NOT?

5. SAIL INTERACTION to WINDWARD, and the JIB TRIM.

I am quite sure that all of you are aware that when you alter the setting of either the main or jib sheet, that because of the interaction of the two sails you are affecting both sails at the same time. I don't believe, however, that most of you realize how these interactions really work,,, and I feel that if you understand the basics, then you will be better able to tune your boats.

First of all, you must forget the idea that the jib increases the efficiency of the main. The air flowing over the lee side of the main would actually be moving faster without the influence of the jib. In fact, the jib decreases the power available from the main, and the narrower the slot, the greater this effect. The exact opposite, however, applies to the jib. The airflow is faster over the lee side of the jib than it would be were the main not present. The main, therefore, increases the power of the jib. In addition, because of their close proximity, the jib is sailing in a continual "lift" caused by the main, while the

main is constantly being "headed" by the jib. This sounds terrible, but in reality all it means is that the main is sheeted tighter than it would be if there were no jib, while the jib is sheeted more freely. The result, of course, is that the jib provides more drive, and less heeling force, while the main provides less drive, and more heeling force, per square inch of area. The net result is that while sailing to windward, the jib is much more efficient than the main. Before you run out and build a jib 'unarig', let me remind you that were it not for the main, the jib wouldn't look nearly so good. The performance lost by the main is (nearly) regained by the jib. In addition, the increased airspeed. over the jib, plus its "lift" helps prevent luffing, while the reduced pressure change over the main caused by the slot, plus the "header" helps prevent stalling. Therefore, the two sails interacting can have more camber, and hence more power, and can point higher, than one larger sail.

It is very important that you begin to think of the two sails acting as one large airfoil, one that has a tremendous range of adjustment. Keep in mind, however, the important part that the jib has in driving the boat. At all times, you must keep the jib from stalling or luffing. Use jib telltales, and WATCH 'EM CLOSELY. There are times, however, that you may intentionally stall or luff the main, which I will cover later. For the present, let us try to distinguish what to expect when you make an adjustment to either the main or jib sheet. In all cases, I am assuming that you are starting from the proper sail trim. In each case, I will mention both the effect on the sail you are adjusting, and on the other sail.

Easing the Mainsheet. When you ease the mainsheet, you are re -arranging the forces acting on the main in the forward direction. You will therefore reduce the heel, and increase the drive. This is especially useful. in a puff in heavy conditions, when your rig is a bit too tall, and you want to keep the boat on its feet. It will also reduce the weather helm considerably, and also the leeway, because of the reduced heel, The "lift" being provided to the jib will decrease, and both it and the main may luff. This will require that you bear off to keep the boat driving. In other words, you can't point as high with the --main eased out,. but the boat will heel less.

Hardening the Mainsheet.

This is virtually the opposite case. When you tighten the mainsheet, you will increase the heel, and decrease the forward drive.

The weather helm, and the leeway will increase. The amount of "lift" felt by the jib is increased, and both the jib and main may stall. This will require that the boat be pointed higher, and this in turn further reduces the drive available. Oversheeting the main, is therefore to be avoided, with the exception of situations requiring that you really must pinch. Be forewarned, however, that you cannot keep this up for more than a few boat lengths, before speed

suffers, and leeway increases to the point that you will loose more than you gain. In light airs, don't pinch at all.

Easing the Jib sheet. This will increase the jib's drive, while reducing its heeling force, much as easing- the mainsheet did for the main. In addition, it will increase the suction on the lee side of the main (its "power"), therefore increasing both its drive and heeling force. The change in heeling forces nearly cancel , and the result is a net increase in forward drive from both sails. The catch is that the main is "headed" less, leading to an increased tendency to stall. There will also be an increase in weather helm, due to the Centre of Effort moving aft. Generally, this is exactly what you want in light airs,. providing you can accomplish it without stalling the main. You may have to bear off to avoid luffing the jib.

Hardening the Jib sheet,

Again the opposite situation, where the jib's drive will be decreased, while its heeling force will be increased. The suction on the lee side of the main will be reduced, thereby reducing both its drive and heeling forces. The main will be "headed" more, and may be backwinded, forming a "bubble" just behind the mast. This reduces heeling and drive even further, and also moves the C. of E, ahead, and reduces weather helm considerably. This depowers the rig without affecting its pointing ability.' .. In fact, you may be able to pinch quite well, providing you have sufficient wind to keep up your speed.

By now you may have the idea that changing the relationship between the main and the jib could be a useful way to tune the boat for different conditions. This, of course, is exactly the idea behind a Jib Trim. It should not be used, however, as a substitute .for poor tuning techniques. The boat should be trimmed 'for the average conditions at the time, so that the Jib Trim is just that, and is not used instead of changing rigs, or rig position, when this is the proper course of action. A properly adjusted Jib Trim will enable you to ease the jib in light airs, or to harden it up in a puff. It should never be adjusted so that it is always being kept at one end of its travel. This ties in with its biggest asset, which is finding the proper relationship between main and jib during a tuning session. When this is found, then the necessary adjustments should be made so that the Jib Trim can be returned to its middle position again.

When you are using a Jib Trim, bear in mind that any change to the jib sheeting angle will probably require a slight course correction to keep the jib from luffing or stalling. In addition to jib luff telltales, you should have some about half way back on the main. When the sails are trimmed properly, all telltales should flow smoothly. By coordinating the Jib Trim with the Sail Winch, you can do things like ease the mainsheet, by first hardening the Jib Trim, and then letting out both sails until the jib returns to normal. In heavy puffs, you may well sail with the main luffing, and the windward telltales collapsed. By reversing the procedure, you can pull in the mainsheet until it is on the verge

of a stall to pinch effectively, although not. for long. The jib trim is probably the easiest auxiliary control to learn how to use, and combined with telltales on the sails, can become almost foolproof