Sailing to Windward

"You must know yourself and your boat"

By Arvel Gentry

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Sailing a boat to windward requires, above all else, concentration. And this concentration, by the best helmsman, is more intense than a beginner can even hope to comprehend. A great helmsman can "feel" the boat. And he reacts instinctively with the proper twitch of the wheel or tiller, always keeping the boat "in the groove" and moving at its best. But what can you do to improve your windward steering?

First, you must know your boat. How does the boat react to varying wind and sea conditions? Is it sluggish and slow to respond, or is it quick to accelerate? How does this responsiveness change with wind speed? Does the boat tend to pound in short chop or does it cut right through it? Can the tiller be moved quickly in choppy conditions without slowing the boat, or must you move the helm slowly? How does boatspeed change with varying wind speeds?

The first task when steering to windward is to keep the sails at the proper angle to the wind; and a helmsman usually has two visual clues to help him. If he sails too close on the wind, his sails will luff. If he sails too far off, the sails will stall. A stall usually is detected by watching yarn or ribbon telltales placed about one foot behind the genoa luff. When the lee telltale twirls, the sail is stalled.

While both conditions, the luff and the stall, cause a reduction in the driving force out of the sails, there are usually several degrees of heading angle between the two conditions. If the helmsman wanders back and forth between the two extremes, he soon will be left far behind the other boats. Even if he always sails right on the edge of the luffing condition his boat performance still will be bad. The boat may hit a wave or some chop. Then, after it has slowed, it will be too slow in accelerating back up to speed.

A good helmsman must know when it is best to let the sails luff momentarily or when to bear off slightly for quick acceleration. He must know just where between these two conditions he will get the best steady state of windward performance. And equally important, he must know how to change his steering techniques with differing speeds and sea conditions.

A good helmsman always knows how close he is to luffing or stalling, and how rapidly he is approaching one of these conditions. While this does come with much practice and experience, I've developed a special tuft system that replaces the conventional single luff telltale to help shortcut this learning process.

On my boat, the crew uses a complete set of telltales on both the genoa and the mainsail to achieve total sail trim. But the helmsman steers watching only the tuft system shown in Figure 1 .This system consists of a line of four

Figure 1. Mainsail and genoa set up for telltales and tufts.

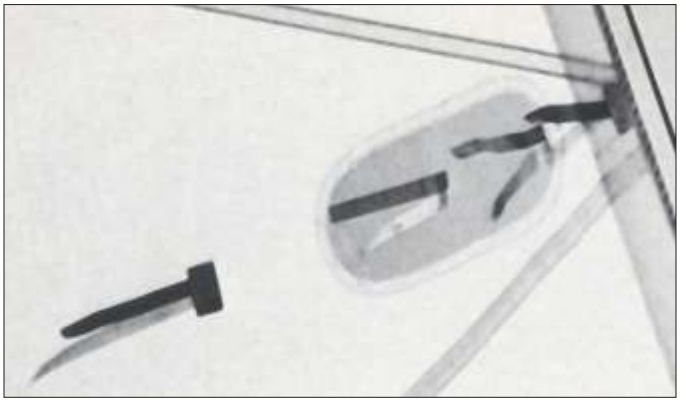

Figure 2. Close-up of tuft system. Genoa luff is to right.

short tufts placed end to end with the first one right up against the luff rope. (The aerodynamic principles behind this tuft system were described in the May and November issues of *SAIL*.)

This tuft system (Figure 2) is based on the fact that the lee-side flow will separate in the form of a small bubble right at the luff of a sail when the boat is headed slightly below the luffing condition. Behind this bubble, flow remains attached and the sail is not stalled. The row of short tufts simply shows the size of the bubble (Figure 3). Please note that these drawings only show the first 18" of the genoa, and the sail angle difference in the drawings is exaggerated to illustrate the effects of the bubble.

When the sail is precisely on the verge of luffing, the stagnation streamline (the streamline that divides the windward and the lee-side air streams) curves right into the luff rope, and the lee-side separation bubble does not exist. All the leeside tufts, even the one right on the luff rope, will lie down smoothly (Figure 3A). The windward side frequently will be separated but this is not so important as the tuft activity, or lack of it, on the lee side.

As the boat heads off a bit, the stagnation streamline moves slightly around to the windward side of the luff rope. This causes high, leading edge velocities and low pressures as the air makes the sharp turn around the luff. After the air gets around to the lee side, it immediately starts to slow down and its pressure starts increasing. The boundary layer does not like this increase in pressure, and it separates. If the turn around the leading edge has not been too sharp, the flow soon will reattach itself to the sail and continue aft to the leech (Figure 3-B).

The farther off the wind the boat is heading, the larger the separation bubble gets. Finally it bursts and the entire lee side of the sail separates and the sail becomes stalled (Figures 3-C and D). The number of twirling tufts tells you the size of the bubble. They also tell you how close you are to the luffing condition (no bubble at all), and how close you are to the stall point. By watching the changes in the tufts you also can tell *how rapidly* you may be moving toward one of these unwanted conditions.

When you first start sailing with this tuft system, don't try to use it to steer the boat. Sail the boat as you usually do, and then after you think you have the boat in the groove, see just what the lee-side tufts are doing. Are they all lying down smoothly, or is the first one slightly agitated? The reaction of the tufts to different conditions does vary slightly with different boats or sails, so I'll just show how they work on my own boat.

On my genoa, the three tufts can twirl before the sail stalls completely. In medium winds, the best windward performance occurs when only the first lee tuft is slightly agitated.

In heavier air, over 15 knots, the genoa is kept on the verge of luffing a good deal of the time and all the lee-side tufts are lying down.

When boatspeed is lost because of wave action or lack of concentration, head the boat off slightly until the first two tufts twirl. Quickly glance at the knotmeter and as soon as speed is back up, bring the boat back onto the wind until the tufts either lie down again, or the first one is slightly agitated.

The basic concept in high winds is to keep the boat upright and to control exactly how the bow strikes each wave or chop. By watching the wave and chop patterns you will start to see situations where the proper changes in the boat's heading will improve windward performance.

There are several ways to handle waves and chop. At times you may have to bring the bow up to meet a short wave that might stop the boat. The sail may luff momentarily and the speed might drop slightly. You then must head the boat off to accelerate back up to speed. Watch the tufts when you do this so you don't stall the sail. Also keep an eye on the next wave so that it doesn't hit you while you are heading too far off the wind. In fact, it might be necessary to stay high for a second short wave before you bear off to accelerate.

Often you will find that only small changes in the bow position allow you to pass over the edge of a new wave without slowing the boat, and this maneuver actually helps you get to windward.

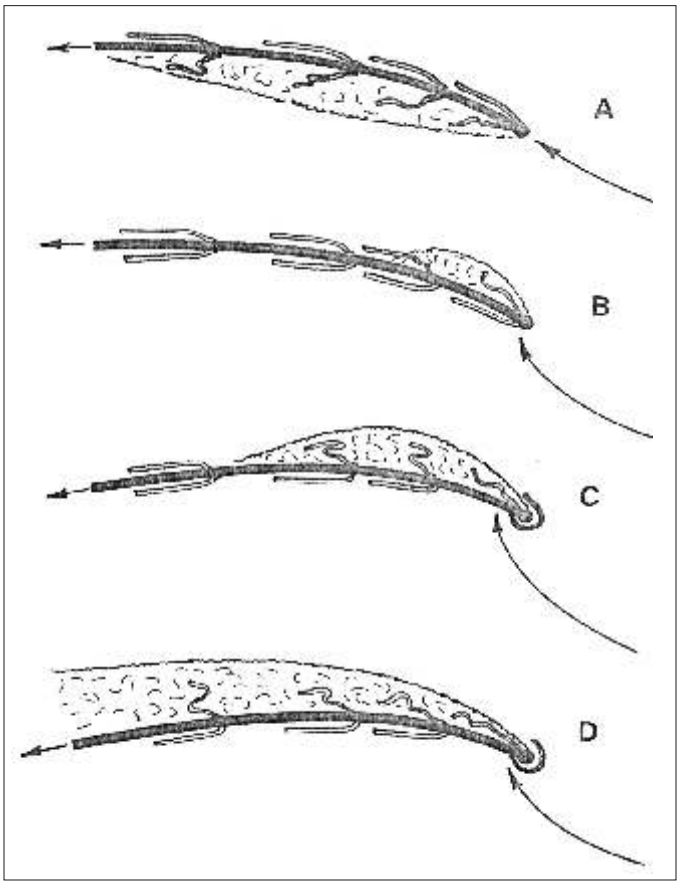

Figure 3. Tuft system stages.

If you see a smooth spot of water just ahead of a wave, you might bear off slightly to gain extra speed just before you head up sharply to slice through the water.

Steering through waves and chop is complicated by the pitching motion of the boat. This gets particularly bad when the wind begins to drop off, leaving behind a sloppy sea. Here you must search for the best compromise between having the genoa luff (or float) as the bow goes down, and having the sail stall when the bow comes back up.

You should try to avoid being too far off the wind for you will find that if you are, you will spend too much time with the sails stalled. In other words, if necessary, let the sail luff briefly. Then when the pitching stops, bear off slightly to accelerate back up to top speed.

In moderate winds and smooth water most steering problems involve finding the angle that is the best trade-off between boatspeed and pointing ability. This, incidentally, is where the tuft system works best. Once you find out just how much agitation (if any) should show on the first lee side tuft to get the boat in the groove, it should be a simple matter to keep it there.

Remember though, that pointing ability is determined by the actual path of the boat through the water and not the angle of the boat relative to other boats around. If you pinch too close to the wind you may seem to be pointing high, but slower speeds and excessive leeway may

produce poor windward performance.

Beating in light air presents a whole new set of problems, and concentration and a light tiller touch both are essential. Avoid rapid tiller movements, for this creates both increased rudder drag and higher hull drag; the boat now is being rotated by the rudder. When possible, let the boat do the work for you.

For example, if the wind shifts and the first two or three lee-side tufts twirl, don't head the boat up by pushing the tiller over. Instead, gently release the finger pressure that has been holding back the slight weather helm, and let the boat head up by itself. Then when the lee side tufts start to lie back down, gently restrain the tiller again to stop the boat's rotation.

If weather helm is not enough to do this and you must move the tiller yourself to get the right angle to the wind, then do it smoothly and gently and give the boat plenty of time to respond. Be patient.

Good windward performance, of course, depends on more than just the helmsman. The crew can help too. If it is at all possible, the genoa should *never* be cleated on a windward leg. A crew member should be on the winch at all times watching the sail distance off the spreader, the knotmeter, and the apparent wind speed indicator.

If he sees the boat is losing speed because of chop, he should let the genoa out so that it is several more inches off the spreader. As boat speed comes back up, he should bring the sail back in again. If the wind drops again, the sail should go back out. If the sea gets smooth and the helmsman starts to point up to take advantage of it, then the genoa should come in.

In some cases, this constant in-and-out genoa adjustment is best accomplished with the barber haul instead of the genoa sheet. In other cases the two should be moved together It even may help to move the main traveler or mainsheet to coincide with genoa movements. All these sail adjustments should be made smoothly and none should interfere with or counteract the actions of the helmsman.

It does help, when first practicing, to have the helmsman and sheet tender constantly talk to each other. But after a while, each one should be able to anticipate the actions of the other without any verbal communication.

Throughout all these maneuvers, the helmsman can use the lee-side tufts to tell just where he lies between the luffing and the stalled condition, and how rapidly he may be changing from one phase to another. However, for top performance, he should keep an eye on the tufts, on the water just ahead of the boat, and on the knotmeter.

Never look only at the tufts. Keep looking around so you can learn to anticipate what oncoming waves or chop will do to the boat. And curiously enough, the sensitivity of this tuft system actually may give you more time to spend looking forward and around rather than just staring at the sail luff all the time. However, even with this new sailing aid, long hours of practice and great concentration still are the keys to good windward sailing.

Of course you must remember that good boatspeed is never going to be much help if you are not sailing in the right direction. The helmsman always must keep his brain in gear and constantly at work on developing situations.

Better yet, he should have someone else worry about the tactics. That way he can concentrate only on how to steer to make the boat go fast.