Tech Talk *with Don Campbell*

In this issue Don discusses three technical aspects of sails.

I will discuss three technical aspects of sails in Tech Talk and if you have questions, then we can go on further. The first is the way they work and while I mentioned a bit about that in the balance sections last year, there is always more to consider. I will assume that you have been able to understand how the forces work perpendicular to the tangent to the curve of a sail. However, the sail profile and orientation of the curves change with height and so the resultant of all forces needs to be calculated in three dimensions. This gets to be confusing for some of us and I don't know an easy way to visualize this except to say that a beach ball surface might be as good a proxy as any, where you can imagine a sail shape drawn on that surface. (Just use one sail at a time).

To get good sail shape so that we do get forces pulling for us in constructive ways, we need to be able to control the shape of the sail surface in the winds we have available. This means that you have specified to your sailmaker the normal winds you sail in and he has done his best to cut a sail for you to be able to get the most out of that wind speed. For Toronto, that average wind speed might be between 11 and 14 knots but the sailmaker will have chosen a specific wind speed, like 12 knots. That means that you need to have sail controls to set the sail shape for that wind speed, and more to allow you to change sail shape for every other wind speed than the designed one, if you are to maximize the energy transferred. If you don't want to maximize the energy transfer, you at least want to utilize some of the energy and incur some of the energy transfers. To allow us to do this, fortunately, sailors of the past and naval architects have given us various sail controls. The hardware companies make it easy for us to use these controls. There are at least 8 controls for foresails and 10 or 12 for the main. And with sail shape, to maximize the transfer, very small adjustments (as little as two inches on the genoa sheet) make a big difference to boat speed. "Just about right" will not do for those of us who want performance. The easiest way to see these differences is with a good knotmeter and compass. The one shows changes in boat speed and the other shows changes in pointing. I have a knotmeter that measures in 100'ths of a knot, and while I don't worry too much about accuracy at that level, it does give a very good indication of the relative differences at very small increments. As a skipper, I always know whether I am speeding up, staying at constant speed or slowing down. For course made good (CMG) , GPS is the best tool, but there are times when one needs to foot off for acceleration and that does not show well on CMG plots. GPS speeds are often relative to the ground and boat speed is a function of speed in the water. Therefore, knotmeters are a better guide for boat speed than GPs units.

The correct setting for a sail under load is the one that allows all of the telltales to fly straight aft with the possibility that those on the windward sail surface of foresails can lift to 45°. This is the indicator to say you have laminar flow across the sail membrane. Your sailmaker ought to have telltales in at least 3

places aft of the luff on a foresail and as many as four on the leech of the mainsail. These are the tools that are there to use to show you when you have his sail working as well as you can. They are the tools that show the deflection of the air currents around that foil that you cannot see otherwise. If you don't have telltales, take the sail in to your sailmaker and have him add them or add them yourself at the places where they have been lost.

To trim to the genoa telltales, if the leewards are rising, let the sheet out and if the inners are rising, pull the sheet in. In other words, take the sail towards the ones which are not flying. Once the sail is set and the course is determined, you can steer to the wind changes. If the windwards are rising, steer downwind and if the leewards are rising steer upwind. Steer away from the telltale that is not behaving. It has the same effect as the trimming rule. The main telltales are to fly straight aft and you may have to juggle settings of controls if the main is off the centerline of the boat so that weather helm is reduced. Twist will play a part on these settings on both sails as well.

Controls:

The principal control for a foresail is the sheet. It is the line that we use to set sail shape tension and to adjust the sail to get the tell tails flying. Tension on the sheet is the primary way we adjust foot tension and therefore curve on foresails. This sheet is usually controlled by a winch and so it matters how easily you can adjust things using the winch and whatever cleats you use. Having a system that allows a 2" slip every time you cleat it is not an easy system to work with and the technology to-day with self tailing winches far outdoes those winches that were originally fit on most Albergs. These new winches are easy to use and control the line to the millimeter, for even the fairest of cruising crew and almost of any age. Other controls on the foresail are halyard tension, which sets the entry for the angle of attack, cunningham which may be used to take up any slack or stretch of the halyard if the halyard is rope, headstay sag which sets draft depth and curve on the angle of entry, lead position which sets the position of the tension of the sheet, track position , whether inside or outside, which sets the slot placement, barber haulers, which set the position of the sheet tension on downwind situations, and whisker poles which are rigid struts for clew placements. There are often leech lines and now foot lines added to foresails to fine tune the lengths of these two lengths.

The most used controls of this list are the halyard and sheets and between these two, and lead placement, you should be able to adjust the tensions on the sail to get the 3 levels of telltales flying. You will normally find that even on Alberg 30's there are differences in wind directions and strengths within the first 40 feet above the water. Thus, you may want to have the top of the sail with a different setting than the bottom, so you may want a bit of twist. Change the car location to get this. All you can really do is play with the controls in the wind you have to get those 3 layers of tell tales all flying. Then you will have the sail working as designed and built and the boat will be moving well. As I have said previously, this foresail is more effective than the main by a factor of 1.5 to 1.8, so you really want this sail working well. The faster you go the more the angle of attack can be lifted so you will be pointing better too. The

foresail is always in undisturbed air so gets the first and best shot at transferring energy from wind to boat. Use it well.

The controls on a mainsail are far more than on a foresail. While the principle controls are the same: sheet and halyard, there are very different jobs here for the sheet. The only things the main sheet does is keep the position of the boom on its arc stationary and keeps the angle of the boom somewhat controlled vertically. There is no tension on the foot of the mainsail controlled by the sheet. The foot tension is controlled by the outhaul. Then you have backstay adjustment again but that really sets the orientation of the boom on downwind courses and tips off the top of the sail. One may still have a cunnigham on a mainsail and it can be for halyard sag or luff tension if a sail has stretched too long to get between the black bands for race sail size adjustment. There is a boom vang to control the boom lift on downwind courses and that may be supplemented by having the mainsheet on a car that rides on a track. There are reefing points in a mainsail to control the effective sail area without changing draft position in the cut of the sail. (There is no equivalent with roller "reefing"systems for the foresail because the draft moves forward once you start rolling and sail shape is changed considerably.) Mast bend changes sail shape (but this is not a very plausible control with AL30s). Mast rake will set the balance points and to some degree change sail orientation so change sail shape too. The traveller can set allowable sail shape particularly the shape between sails and be used to offset weather helm. Battens are yet another control to set sail shape. This can be done by using different length or strength battens or by adjusting the tension on the equipment you have for holding battens in place. Particularly with full battens, you may find that a weak batten up top is required on light air days to allow twist to be a smooth transition curve. You may also find it possible to add draft by shortening the adjustments and make things flatter by lengthening the adjustments.

It should be obvious now that there is a necessity to have the controls on the foresail working in conjunction with the controls on the mainsail to maximize thrust. To get this, you will have both sails at a point just greater than a stall and that is the sail set that allows you to go as fast as you can. It is a very fine line because over trimming will stall the boat, but being right next to that point allows for maximum energy transfer and maximum speed which gives maximum pointing ability. My question to you is "Are you using all of your sail controls to get some fun out of your boat?"

As always, I invite questions and comments from the readers. You can reach me at dk.campbell@sympatico.ca

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