

## HOW TO TUNE YOUR RIG

The goal of a properly tuned rig is to have a mast that is straight athwartships, have control of sail shape, and get proper helm balance in a variety of conditions. Most importantly, the resulting mast tune should not impart any excessive strain or loads on the spar and rigging or the structure of the boat. The basic adjustments for tuning a rig are actually quite easy and straight forward and not the mystery that some people might make them out to be.

To begin with, we should define the difference between fore and aft tune and transverse tune. Fore and aft tune basically refers to rake and mast bend. Transverse or lateral tune refers to setting the mast up straight sideways and setting up the uppers to minimize lean.

Let's begin with rake, which is determined by headstay length. Rake affects helm by moving the center of effort of the sails relative to the center of lateral resistance. A longer headstay gives more rake which gives you more weather helm. A starting point for arriving at the correct rake is to measure the designed rake of the sailplan. A typical 40' boat would have about 15-18" of rake. To calculate rake, hang a plumb bob from the main halyard and measure from the aft side of the mast along the cabin top to the plumb bob. This should be done with the backstay tensioned at about 60%. The actual amount of rake you end up with may vary depending on the normal conditions you sail in and may be a compromise between what is optimum in light air vs. heavy air.

The second aspect of fore and aft tune is mast bend. A certain amount of mast bend is desirable. Mast bend is determined by the relationship between the masthead position, deck partners and mast step. If we have decided on the proper rake, then the masthead position is fixed and we have the deck partners and mast butt positions to adjust to induce mast bend. By either moving the mast forward in the deck collar or moving the mast butt aft in the step, we can induce some bend into the rig. Another factor that can affect mast bend is the angle at which the butt of the mast is cut off. If the mast is resting on the forward or aft face, the resulting moment will have a major effect on bend. We normally radius the butt of the mast

Page two

so that the spar will bear near the center axis of the section thereby minimizing the bending moment regardless of the angle of the spar to the step.

Other factors that control mast bend are double lower shrouds, babystays, and inner forestays. Double lower shrouds can be tuned to increase or limit mast bend. Babystays are typically used on boats with single in-line lowers and pull the rig forward down low in the same way as forward lowers. Inner forestays with a staysail can put a large bending moment in the spar and are usually opposed with running backstays or aft intermediates.

Spreader sweep is also a big factor in mast bend, but this factor is a design feature of the spar system that is not an owner variable since most spreaders are fixed rigidly to the spar. Swept aft spreaders will facilitate some mast bend and in-line spreaders will restrict mast bend.

So what does all this talk of mast bend mean-why is it important? A certain amount of forward bend is healthy, making the spar more stable and less likely to pump in a breeze. Most mainsails require a certain amount of mast bend to set properly and as the breeze increases the combination of more backstay tension and more bend will flatten the main. This will keep the boat standing more upright and ease the helm.

Another consideration here is headstay sag. Being able to control the amount of headstay sag with an adjustable backstay device will allow you to optimize the shape of the genoa for a range of wind strengths. With an adjustable backstay, particularly hydraulic types, it is extremely important to establish a maximum backstay load not to be exceeded and some lower reference points. A good limit is 30-40 percent of the breaking strength of the backstay wire or rod. This allows some margin of error in the system in the case of shock loading.

Now we will discuss lateral tuning which is probably the most important tuning process and often the most confusing, particularly with multiple spreader rigs. Keeping the mast straight athwartships over a range of wind strengths and sea conditions is essential to keeping the rig in the boat.

Page three

As well as keeping the spar straight or in column, we are also interested in having the upper shrouds tight enough to minimize how far the mast leans over the side. This will help reduce weather helm. Although the effect is small, most boats have too much weather helm in fresh air, and it's important to minimize it any way we can.

The first step in lateral tuning is to center the mast in the boat. The backstay and upper shrouds should be relatively loose at this point to minimize bending the rig. Pull a 100' steel tape up on the main halyard and measure to the chainplates or to a point on the gunwale on each side. Adjust the upper shrouds until you get the same readings port and starboard.

At this point check to see that the spar is firmly secured in the partners with wood wedges or preferably hard rubber wedges. They should be very tight so the mast cannot work or move at the deck.

The next step is to tension the upper shrouds at the dock. Make sure the turnbuckle threads are lubricated to prevent damage from galling. A dry lubricant is preferred, such as Rig Lube or Bike Aid. The upper shrouds should be tightened as tight as you can get them with a 10" crescent wrench. Don't use a larger wrench or an extender as you can damage the threads. Additional tensioning must be done under sail. The lowers and intermediates should be fairly loose, or just tight enough to keep the mast straight.

If the boat has discontinuous rigging, it is important that the diagonals be very loose before tensioning the verticals. They will tension as the verticals are tensioned.

Now we are ready to further tension the upper shrouds under sail. In about 15 knots of breeze, put up the main and tighten the leeward upper shroud. Keep track of the number of turns while tacking back and forth until the uppers are snug on the leeward side with the boat heeled 20 degrees. Don't worry about the lowers or intermediates at this stage, the object is to just fully tension the uppers.

Page four

Another method for tensioning the uppers without sailing is to heel the boat over at the dock using a halyard. The halyard must lead through a fair lead block at the masthead and have a clear lead directly abeam. This method saves time and also allows adjustment of the lowers and intermediates but one should exercise caution tuning this way.

Now that we have the target tension on the upper shrouds, we are ready to straighten the mast with the lowers and intermediates. With a single spreader rig, simply tension the lowers until the mast appears straight when sighting up the sail track or groove. This should be done under full sail in 15 knots of breeze. If the boat has double lowers, generally the forward lower will be tighter than the aft lower. The forward lower does most of the work supporting the mast laterally. The aft lower acts primarily to limit mast bend as the backstay is tightened in heavy air. At the dock, the lowers will be a good deal looser than the uppers. Under sail on the leeward side, the lowers will flop around a lot, and it is a good idea to use a shock cord lashing to take out the slack and prevent fatigue.

Multiple spreader rigs are more complex, however the tuning process is essentially the same. After the uppers are secured, start with the D1 shrouds (lowers). These should be tight enough to prevent sagging to leeward at the first spreader in 18 knots of breeze.

The next shroud up in a double spreader rig would be the D2 or the intermediate. The adjustment of the D2 is very important as it has a large effect on the transverse bend in the upper part of the spar. It should be set up fairly loose in the beginning of the tuning process and gradually tightened to eliminate sag at the second spreader.

If the D2 is too tight, the upper spreader is pulled to windward and the masthead is relatively to leeward. Many people view that as the tip falling off, with the solution to tighten the uppers, when the correct adjustment is to ease the D2. This situation is undesirable as the angle between the upper shroud and the spar at the upper tang is reduced.

The final fine tuning adjustments of the diagonal shrouds should be done at 20-30 degrees of heel since the adjustment is relatively insensitive at low loads.