Upright and Unwavering
By Thomas Anderson

No two sailboats are alike, and each and every one requires individual attention and tuning. The goal aboard every boat, however, remains the same: to properly support the mast and keep it standing in such a way that efficient, effective sail shape is easily obtainable while minimizing factors that promote distortion. With that in mind, let's examine the steps required to tune the rig of a midsize, sloop-rigged cruiser racer.

Dockside Coarse Tune
The most important step in mast tuning is to make sure the top of the mast is centered athwartship. To accomplish this, start with all the rigging loose and, if the spar is keel stepped, with the partner chocks removed. Adjust the headstay and backstay until they're both snug and the mast is perpendicular to the boot top on the waterline. Tighten the cap-shroud turnbuckles until they're fairly and equally snug. (If necessary, count or measure the exposed threads.) The lower shrouds and intermediates should still be slack.

To confirm that the top of the mast is centered, take the shackle end of the main halyard to the toerail and cleat the halyard tail off. Using the same amount of hand tension, compare how the shackle reaches the rail to port and starboard at the same distance aft of the stem. Confirm this observation by measuring down to the chainplates in the same manner. If there are discrepancies from one side to the other, adjust the upper-shroud turnbuckles until the halyard reaches equidistantly to port and starboard.

A better but more labor-intensive method utilizes the same measurement principle. Sight up the mainsail track from side to side to determine if it is straight and true (quickly tune the lower shrouds, if necessary). Hoist a volunteer to the spreaders with a tape measure. Have him/her hold the tape on the centerline of the mainsail track while you measure down the chainplates and rail. This is the most accurate method for centering the mast.

To continue, again sight up the mainsail track to ensure that the track is reasonably straight from side to side. Don't worry about fore and aft trim just yet – we'll assume it's in the ballpark. Then measure from the mast out to the upper shroud on each side. Shim the mast at the deck partners so that the measured distance is equal on both sides. This should place the mast in the center of the collar; if it doesn't, determine the source of the misalignment. This may take some detective work, as nothing on a boat is guaranteed true. Ultimately, if the collar isn't on centerline, carry on and chock, as the measurements require. A small discrepancy is no big deal. However, if the mast step or chainplates seem way out of position, consult with your rigger or designer.

Now tighten the upper shrouds on both sides equally until they are medium tight. Sight the track again to make sure the middle of the mast isn't kinked, curved, or squirming out of column. If it is out of column, tighten the appropriate lower or intermediate shroud with the minimum amount of tension required to pull the mast back into column. Then tighten the upper shrouds equally until

you've reached your desired tension. Reasonable tension for a midsize cruiser/racer on well-maintained turnbuckles can

be achieved with normal size tools and little or no extra force. If you hold the upper shroud at head height and push/pull the stay sideways, you should be able to deflect it about 1 1/2 to two inches.

Next, tighten the lower shrouds. An appropriate starting tension is hand tight plus one turn. It's better to err on the loose rather than the tight side. On boats with double lowers, the forward lower should be tighter than the aft lower. (The forward lower should pull the mast forward in the middle to insure that it doesn't bend backward when in a seaway or reefed.) For the aft lower, hand-tight tension is a good starting point. Note: Deck stepped-masts will require more tension on the lowers than through-deck masts.

If your mast has more than one pair of spreaders, it's now time to tighten the intermediates. Over tightening the intermediates is easy to do and must be avoided. Intermediates that terminate at the spreader tips may actually be loose at the dock. Intermediates that lead over the spreader and down to the deck will need to be tighter than the forward lowers but looser than the uppers.

At this time, tighten the backstay to about half of its maximum tension. Sight the mast track again, both side to side for out-of-column misalignment and fore and aft for excessive mast bend. If either condition exists, it can be corrected by adjusting the lowers or intermediates. If possible, it is better to correct the condition by loosening one side rather than tightening the other. Don't adjust the upper shrouds.

Now is a good time to chock the mast fore and aft. If you sail a racer/cruiser, the mast should have a nice, fair bend to it. Chocking can later be adjusted, when under sail, to fine-tune the mast bend to the mainsail shape. The chocks should be snug on all four sides but not hammered home. You can now tighten the backstay to full tension and repeat the mast sighting. If you're satisfied that the mast is straight, cotter pin or lock the turnbuckles. No need to tape yet but be careful not to tear anything.

When under way, use hydraulic backstay adjusters to achieve about one-third of the breaking strength of wire, a reasonable backstay tension. If you have any doubts, contact a rigger or the boat's designer for guidance. You may be able to utilize more tension on rod-rigged and well-built boats. When checking the gauge, make sure you're reading tension and not pressure. Backstays with no means of measuring tension should have the same or slightly more load than is applied to the upper shrouds.

Generally speaking, it's difficult to overload rigging with normal-size tools. If the effort to move any turnbuckle seems to great for the tension developed, disassemble the turnbuckle (be careful with deck-stepped masts; if in doubt, rig a halyard as a temporary stay), clean the threads, inspect for thread wear, grease, and reassemble.

Mast Rake

Mast rake – not to be confused with *mast bend*, which we'll discuss shortly – is the angle of the mast to the waterline in the fore-and-aft plane. The amount of rake in the mast has a direct correlation to the feel of the helm. If your boat has too much weather helm, reducing the mast rake should help tame it. At the dock we set the mast up with zero rake – the goal is to have the mast stand perpendicular to the boat's painted waterline.

When we tighten the backstay, we'll induce a modest amount of rake, a good starting point for most boats. Rake can be determined by hanging a high-density weight from the main halyard to act as a plumb bob. The boat must be sitting on her lines to get an accurate idea of how much rake is present.

With the plumb bob hanging near the deck and the boat on her lines, measure the distance from the halyard to the aft edge of the mast. This is the approximate amount of rake. Some boats, including many models in the J Boat line and the more modern IMS designs, will go to windward better with lots of rake. Seldom is a mast raked forward of plumb. If your mast is plumb and the helm is still heavy, the problem may stem from excessive heel angle (too much sail area) or from overly full sails with too much draft. For headsails, a loose headstay could be the culprit. For mains, the trouble may be insufficient mast bend. Then again the sails may just be old, tired and bagged out.

The opposite condition, lee helm, is insidious and often hard to recognize. It occurs in light air and at low angles of heel, and often goes unrecognized as the reason for poor light air performance. The best way to tell if your boat has lee helm is to sail to windward. When settled in, let go of the helm and see which direction the boat tracks. At a minimum, the boat should track straight ahead, ideally turning slowly into the wind. If the boat turns to leeward, increase mast rake. (Altering the sail plan – swapping headsails, or reefing or unreefing the main – can also affect weather helm or lee helm.)

Fine-Tuning Under Sail

To refine the dockside portion of the job, you must head out and hoist some canvas. Working to weather with a moderate amount of heel (about 15 to 20 degrees), first check the leeward upper shroud for tension. Generally, it's unnecessary to tighten the upper shrouds past the dockside tune, but if they are really loose to windward, it's ok to take a few turns on the turnbuckle (make sure to take up the same number of turns on each side). Excessive tension isn't required, but standing rigging that is to loose will accelerate fatigue of the shrouds and spreaders.

Next, sight up the mast track from side to side to see if the masts track sags off to leeward. If this condition exists, identify which shroud supports the section in question and adjust appropriately. If it appears that the top of the mast is falling off to leeward and the leeward upper shrouds aren't too loose then the intermediate and/ or lower shrouds are two tight and the middle of the mast is actually being pulled to windward. Again, adjust as necessary.

It's wise to adjust shrouds when they are not under load, so tack before adjusting the turnbuckles. Replace the cotter pins after every adjustment. Also to keep the mast centered, remember to take up or wind off an equal number of turns on both sides.

If you replace your standing rigging, note that the new stuff will "settle in" over a period of sails, especially under windy conditions. It may be necessary to repeat the tune up process several times. Relock or pin the turnbuckles after each adjustment.

Mast Bend

Mast bend, a sail-shape control adjusted by the backstay and used to control the depth of the draft in the mainsail, is different from mast rake. More mast bend will flatten the main; less will make the sail fuller and more powerful. From the rigger's point of view, mast bend is desirable in moderate amounts to help prevent the mast from pumping and inverting (bending backward). Half of the fore-and-aft dimension of the mast section is an appropriate amount of bend for cruising rigs.

Once you are satisfied with the results, lock the turnbuckles and tape them to protect the crew, sails and rigging. Mast tuning is an ongoing process and can be regularly adjusted for different wind velocities and sea conditions. The proper tune up for light air may be different from the one for heavy air. It's ok to experiment with different setups, but remember that every change will affect other elements of the system. Your sailmaker is always a good source of information when it comes to fine-tuning your rig.