

Preserving the Rig

The Class Executive and Technical Committee's have taken note of various rig failures and made an effort to analyze these failures so we can pass preventative information along to the owners. The analysis involves getting a report from the owner, pictures if available, and input from Hall Spars on cause.

The J105 is an unusually robust boat and it has been observed that owners tend to become relaxed with how they set the rig up for racing. I doubt that any of us would go cruising with our rig set at 23/7/-2, yet many of us do this regularly when racing. The fact that we can set the boat for intentional mast bend, and still have a mast at the end of the day, creates an attitude that we can do anything and nothing bad will happen. The purpose of this article is to introduce some reality into the decision process.

Mast Common Sense

The forces causing stress in the rig can be measured and analyzed but life doesn't need to be that complicated. Rather we can protect our masts with some common sense. This won't prevent every accident but by our analysis would prevent a high percentage of the problems.

1. Mast failure almost always happens in the presence of high winds and waves. These two things go together, but it is the shock action of the waves that multiplies the stress seen by the mast. When the boat slams off the back side of a wave, or into the front of the next wave, the force is transferred directly to the rig. Imagine a 8600 pound object free falling six feet to a sudden stop. If the mast is properly supported this effect is minimized.
2. The mast is supported by the inherent strength of the aluminum extrusion plus the shrouds, headstay, and backstay. The absence of any of these components reduces the ability for the mast to stay in one piece.
3. Tension the shrouds to match the conditions. The best measure of rig tension is to look at the leeward shrouds when sailing up wind. If they are firm or just slightly slack then the rig has enough tension. If the shrouds are flopping around tighten them immediately, keeping in mind that the rules (7.9) prevent adjustment during a race. The J105 rig is primarily supported by the triangles formed between the mast, shrouds and spreaders. When the rig is loose the mast has corresponding freedom to move around. When the mast moves more than a certain amount it will break.
4. The practice of sailing down wind with a slack backstay (and therefore a slack headstay) removes two of the key supporting elements. When sailing in heavy winds and waves (particularly down wind) the headstay and backstay need to be firm. Inducing some aft bend (with the backstay) in the mast prevents pumping and improves stability.
5. Rig pumping occurs when the supporting forces are unable to hold the mast in column. The mast can therefore invert both for-aft and port-starboard. This results in lots of fatigue stress and if the motion exceeds the modulus of elasticity, breakage. When the rig is pumping a slow motion camera would show waves of motion going through the mast.
6. Use the vang with caution. It is normal to tighten the vang a lot up wind in heavy air. The tight vang makes the boom very rigid and transfers all the sail loads

- directly to the mast-deck junction. This is particularly true down wind as the spinnaker halyard transfers force to the main sail and through the vang to the attachment point at the bottom of mast. If other supporting members do not pick up this load the mast will break off at the deck right below the vang.
7. Do not over tension the rig. Too much of a good thing can be bad. The result can be compression failure where the mast collapses like an accordion.
 8. Do not over tension the backstay. It is possible to bend the top of the mast far enough that it becomes permanently bent or fails. Hall recommends (J Boats Tech Bulletin 4/27/01) no more than 9 inches of bend. Bend is measured by stretching the main halyard to the gooseneck and measuring the space between it and the mast. When failure occurs the mast will break just below the attachment for the uppers. The best solution is to tighten the head stay for heavy air. This is fairly easy to do and will enable a tight head stay without the need to over bend the mast.
 9. Replace the rig components periodically. Things wear out and the rig is no exception. Most of us regularly replace halyards and sheets for prevention of failure and the same mentality should apply to the rigging components. There isn't a magic formula to tell when to do this but assume that boats that sail in light air need rigging less often than boats that sail in heavy air.

The Boom

There have been a few broken booms. These breaks always occur just aft of the vang attachment fitting. The triangle formed by the tight vang, boom, and mast, makes the front half of the boom very rigid. When the boom is tacked or jibed a shock load is applied and the subsequent force is all concentrated on this point.

This problem seems most prevalent when there are large swings of the boom such as down wind jibes or beam reach tacks like those we normally do before the start. The big swing coupled with quick motions makes for big stress on the boom.

The best fix is to ease the vang before the start and at the windward mark. When this is done the main sail is allowed to act as a shock absorber and the point of maximum stress is moved aft to the main sheet attachment points. We are not aware of any booms that have broken back there.

Another important point is to trim the main sheet before a heavy air jibe so that the boom isn't totally square but maybe at a 45 degree angle to the center line. In that position, the boom will come over easier and will pick up less force when it slams over to the other side.

