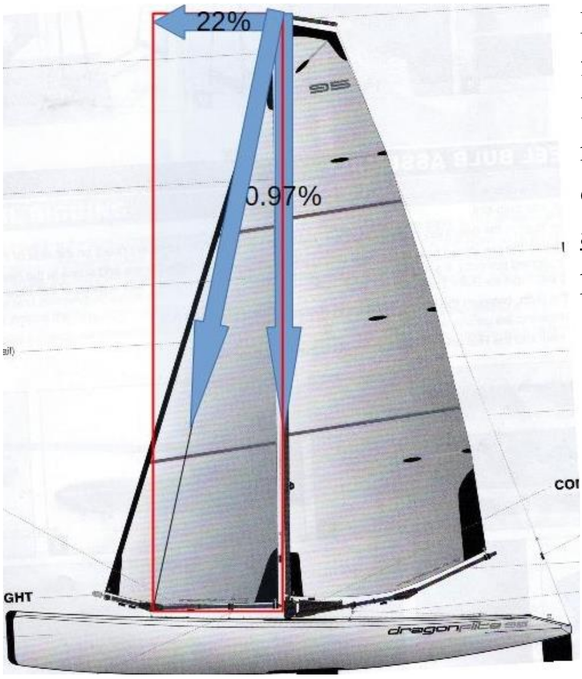
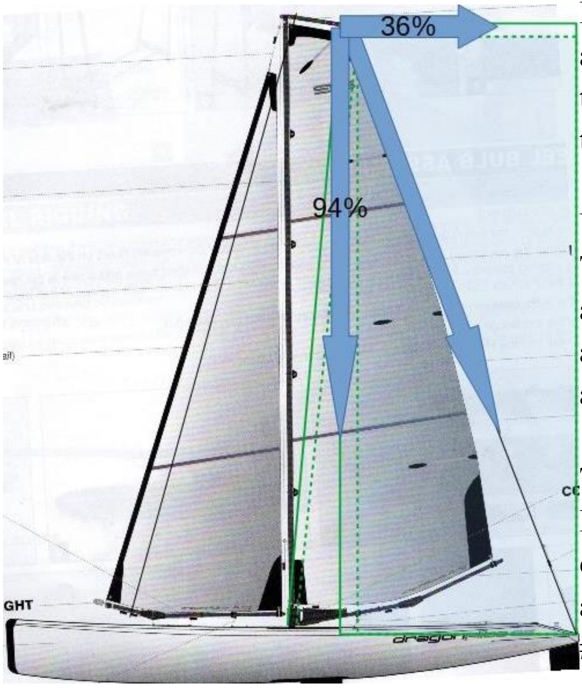
What it comes down to is *for tuning purposes*, the D-95 has two masts with different responses to loading.



Mast #1 is tuned with compression and moderate forward tension The forward tension is 22% of the trim load and the compression is 97%. Given the forestay masthead attachment point is ahead of the mast, tuning only the forestay (backstay slack) should *bow* the mast aft with the center of the bow somewhat above its mid-point because of the stepping arrangement.



Because of the crane, Mast #2 is tuned in compression and torsion. Rather than *bowing,* it acts as a pinned, tip-loaded cantilever and *bends* from the deck to the tip.

Unlike Mast #1, this loading and bending is non-linear. The masthead and crane tip move both aft and down as they are loaded. Each increment of tuning load one adds creates a new panel equation and distribution of aft and down loads.

Tuning only the backstay (forestay slack) can bend Mast #2 about twice the amount it will bow under equivalent load. This is because the pull aft is greater and because Mast #2 bends as one long lever and Mast #1 bends as two facing levers half as long.

These are the mast deflection curves with forestay loading only (red) and backstay only (green).

From these we can see the actual mast is “balanced” between two load states and that the defection dynamic is greatest in the upper third. This and the cross-over between the two trim states is likely the source of the “S” curve refered to by some. I need modulus information on the mast to go further with that. In any case, the combined deflection of the two mast results in a slight rake – about 3 degrees.

But what does it mean for tuning (and intuition)? There are three broad choices:

Trim the forestay (backstay near slack) and use the back stay to pull things into quasi-straight.

Trim the back stay (forestay near slack) and use the forestay to pull things into quasi-straight.

From my experimenting, it seems better to trim each incrementally until the mast is quasi-straight. Why?

Mast# 1’s (the column) behaviour is entirely governed by it’s rigidity and application of down load. As the forestay is tensioned, this mast could theoretically bow in any direction subject to the uniformity of its internal structure and the attachment point for the load and its base mounting. Loading the front tip of the mast will *incline it to bow aft*. – its modulus may prevent this from occurring to a serious degree. But it is certainly a significant degree for sail tuning.

Mast #2 (the tip loaded cantilever) offers a highly efficient and predictable distribution of load. Short of failure, bending is the only response for a cantilever to a static tip load. As the backstay is tensioned, the crane tip moves both down and aft. And a new panel emerges that optimises the load distribution. The shape of the bend can be influenced by the mast tube’s uniformity but it’s a pretty miniscule influence. Loading up the back stay *will bend* the mast.

This is why a small adjustment to the forestay tension can effectively straighten the mast. As the each component of load on the forestay increases, the tip-down load only slightly increases the chance for bowing. The forward component moves the mast tip and crane forward (through both geometry and offset of load).

This is why adjusting the forestay tension a small amount can generate more than expected mast straightening.

However.

There is little aft bowing to be had when 97% of the forestay load is directed downward. So this technique may work best to by tensioning the backstay until only the slightest bend can be seen and then applying forestay tension until the bend is negated – and then repeating these steps until the rig’s tensions “feel right.” Putting the max desired tension on the backstay first may result in a bend that the forestay tension cannot compensate for without inducing noticeable bowing or “S” curving.