

Chapter 7

(..of *The Cambered Panel Junk Rig*..)

Rigging the sail.

(..all those ropes!)



Malena, 1.4t, 32sqm



Johanna, 3.2t, 48sqm



Broremann 0.20t, 10sqm

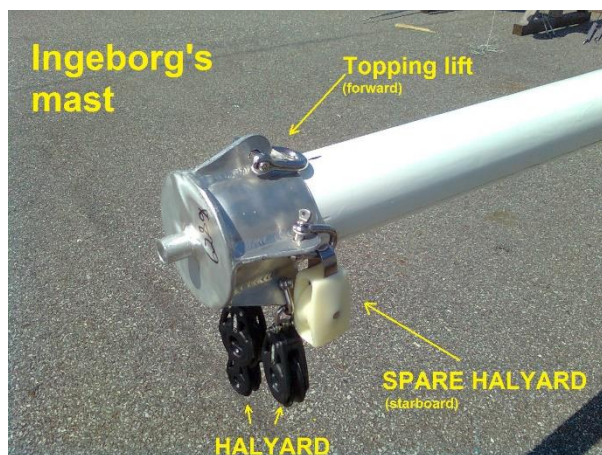


Frk. Sørensen, 0.74t, 20m²



Ingeborg, 2.15t, 35sqm

In this chapter, I will mainly tell how I have rigged my own sails, but may also show alternative ways of doing it. Actually, I think it is a good idea to read this chapter before one settles on a rig type. No doubt, this text will have to be updated several times, as I receive more feedback. I will frequently use links to other write-ups I have produced, to describe details. Since all of these sit on the same website, they will stay operational for as long as this chapter does. If you are a serious doer, I guess it makes sense to download these texts and store them. One never knows when a website might fold...



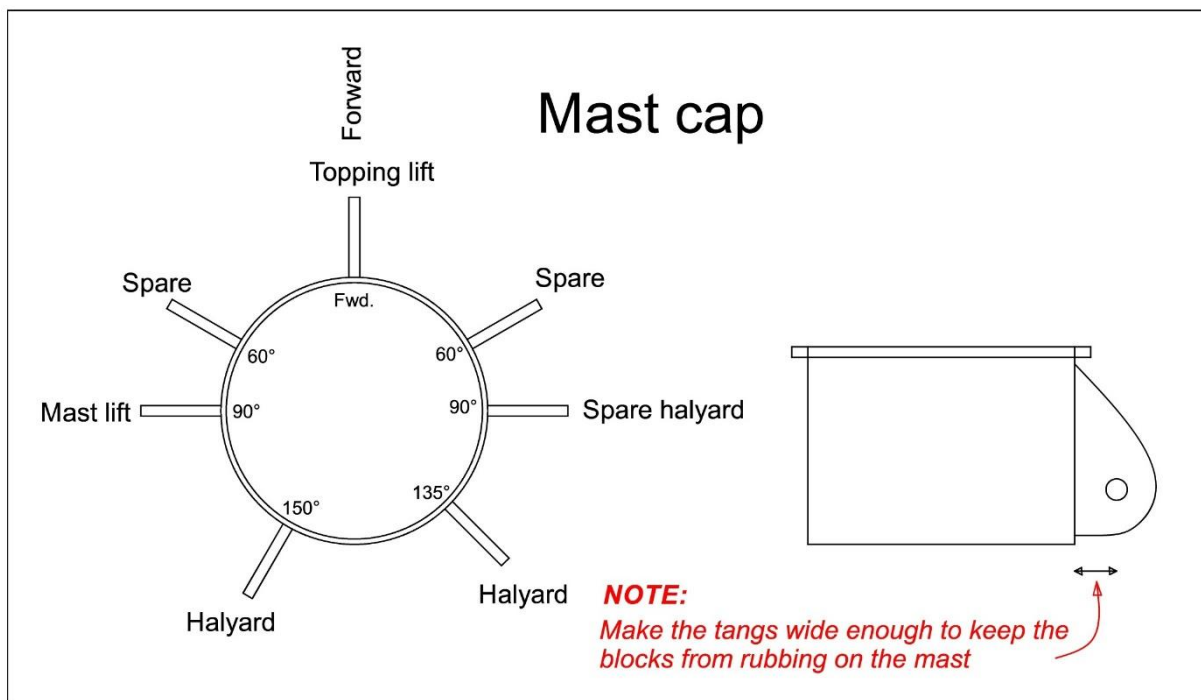
Aluminium mast cap (5mm thick)



Webbing type mast cap for 10sqm sail on Broremann.

Preparing the mast for first stepping.

With the mast in hand, one needs some way of attaching the halyard etc. to the mast top. My preferred way has been to make some sort of mast cap of steel or (better) aluminium. For smaller rigs, I have just made it out of webbing and fixed it to the mast with a couple of hose clamps. In the latter case, one should add a fez-type cap to it, to protect the webbing from the sun. All my mast tops have been of wood. To avoid rot, I never screw or bolt a mast cap onto the mast, I just fix it with some sort of glue or putty. The mast cap is of course fully welded to be water-tight. When making it from steel, one can simply weld on chain links to work as tangs. When making from aluminium, I have found it easy to cut out the top lid and tangs with a jigsaw, and then hand over the bits to a welding shop, so they can do the welding. By making the top lid a bit oversize, it makes it easy to weld it to the tube with a strong and watertight outside weld. This setup has worked well on both Johanna and Ingeborg.



The sketch above shows the tangs needed on a JR (I gather you are by now familiar with the ropes needed in a JR. If not, keep *Junk Rig for Beginners* at hand). In addition, you may want to prepare the mast cap for fitting lanterns, antennas and a weather station up there. Be my guest. (Here is *Junk Rig for Beginners*: <http://goo.gl/vzGLzi>)

Dressing the mast and fitting the halyard.

First, one has to decide on the amount of purchase (or gearing) the halyards needs to let one hoist the sail. To give you an idea, here is what I have used:

- For my Broremann, I simply used a single-part halyard.
- For the 20sqm sail of Frøken Sørensen, a three-part halyard was used, and that worked well.
- On the 32sqm sail of Malena, I used 4-part, and I could hoist that by hand fairly easily.
- Johanna had a whopping 48sqm sail, so I gave her a 5-part halyard. It was still a struggle to hoist the sail, partly because the blocks were on the small side. A self-tailing direct-drive winch enabled me to crank up the last 2-3 panels.
- To hoist the 35sqm sail of my present boat, Ingeborg, I once more fitted a 5-part halyard, this time with high-quality ball-bearing blocks of ample size. This lets me hoist the sail manually, although it is a healthy exercise - but then I am 30years older than when I gave Malena her first JR...

There is little use in going higher than 5-part halyard, as the accumulated friction in all the blocks will eat up most of what you gain. In addition, there is the risk that friction will prevent the sail from coming down by itself.

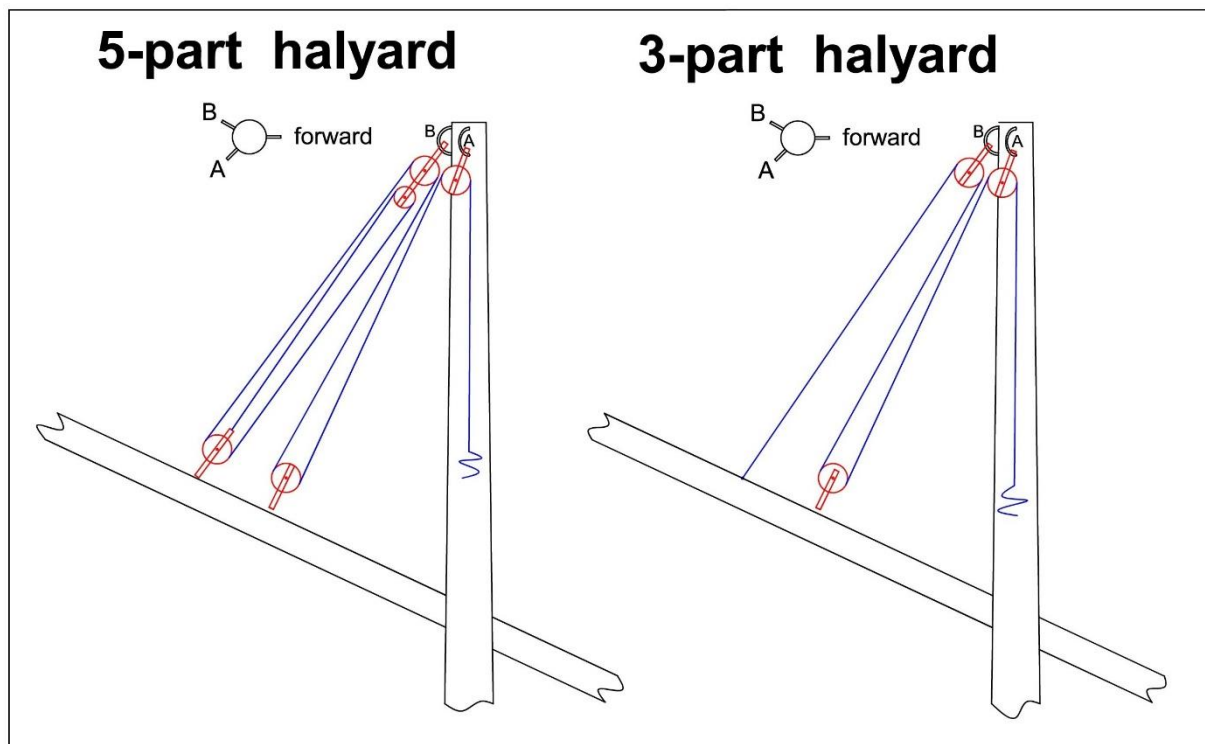
Fighting friction everywhere, is important, and becomes more so as the size of the sail grows. This is not the place to save money on cheap blocks and stiff, ragged ropes. In addition, try to make the halyard run as directly as possible from the mast back to the cockpit. Every new bend is a friction point, and rope clutches are bad in this respect.

By far the biggest challenge when dressing the (still horizontal) mast, is to reeve the multi-part halyard. To avoid ending up in trouble after the mast has been raised, I make use of a

‘dummy yard’; simply a 2-3ft long stick, onto which I tie the halyard blocks. Then I bring the stick to the mast top and position it in the hoisted-yard position and attitude. Now it is easy to reeve the halyard line and make sure there is no twist or ropes chafing on each other. When it looks good, I just haul the dummy yard back towards the base of the mast while the heap of halyard rope disappears into the blocks. At a metre above the partners’ position, I tape the stick to the mast and secure the rest of the rope.

The other lines are quite straightforward: The *mast lift* and spare halyard need no explanation. The (double) *topping lift* of the lazyjacks *), just as in *Practical Junk Rig* (PJR), actually consists of a long, single line, which is attached at its mid point to the forward tang of the masthead. The line is lashed together for about the first 30-60cm down the mast, where it splits to each side of the mast. All shackles at the mast top must be secured with twine.

*) Note: I use the term ‘lazyjacks’ to refer to the combination of ropes, which collect the boom and battens, and the sail catchers, either of the rope or canvas type. This is because on the bridle type LJ, it is difficult to distinguish one part from the others.



3- and 5-part halyards as used on Frøken Sørensen (3-part) and Johanna, ED and Ingeborg (5-part)

I like to spread the load a little on the yard. This also ensures there will be no twist in the halyard.

By using an odd number purchase, the standing end is always tied to the yard. This lets one replace a tired halyard simply by undoing its standing end, and then stitching the old and new halyard together, butt to butt. Now one can simply pull the old halyard through all the blocks and thus reeve the new halyard correctly, without going aloft, and even without thinking. I’ve done this once, and felt like a genius afterwards. Just make sure your stitching is well done...



Mast raised with dummy yard keeping the halyard sorted out.



Topping lifts or LJ on Ingeborg...

..and on Johanna...

The lazyjacks (LJ)

I am afraid I have to elaborate a bit on the lazyjacks before continuing.

In the early days, I used the bridle type LJ, as shown in PJR or in *Junk Rig for Beginners*.

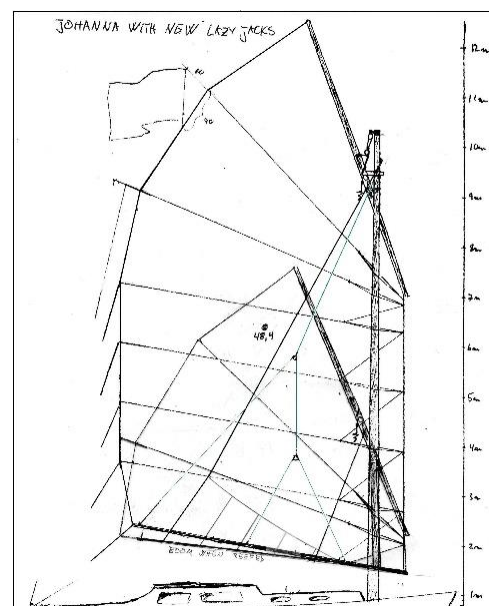
Nowadays I prefer the ‘*topping lift and sail catcher*’-type of LJ. This is easier to fit without repeated mast climbing. The two topping lift lines are the all-important ones when it comes to the integrity of the rig. If one of these were to fail, the whole bundle would then fall to the deck (unless the sail were fully raised). My practice is to use *standing topping lifts* of good size, 3-strand rope: I design the rig in the first place so there is plenty of clearance under the boom at the aft (clew) end. The topping lifts are set up to be just slack enough to avoid the lee topping lift cutting into the cambered panels with all panels set. This means that as the sail is reefed, the boom drops a few degrees (3-5°). This is actually a good thing: When studying the simplified sailplan on the next page, one may think that the yard will fall forward of the topping lift. However, in practice the entire sail has by then tipped aft, so the peak of the yard ends up on the correct side of the topping lift. Still, I find it prudent to add a light yard extension to avoid the yard getting on the wrong side of the topping lift.

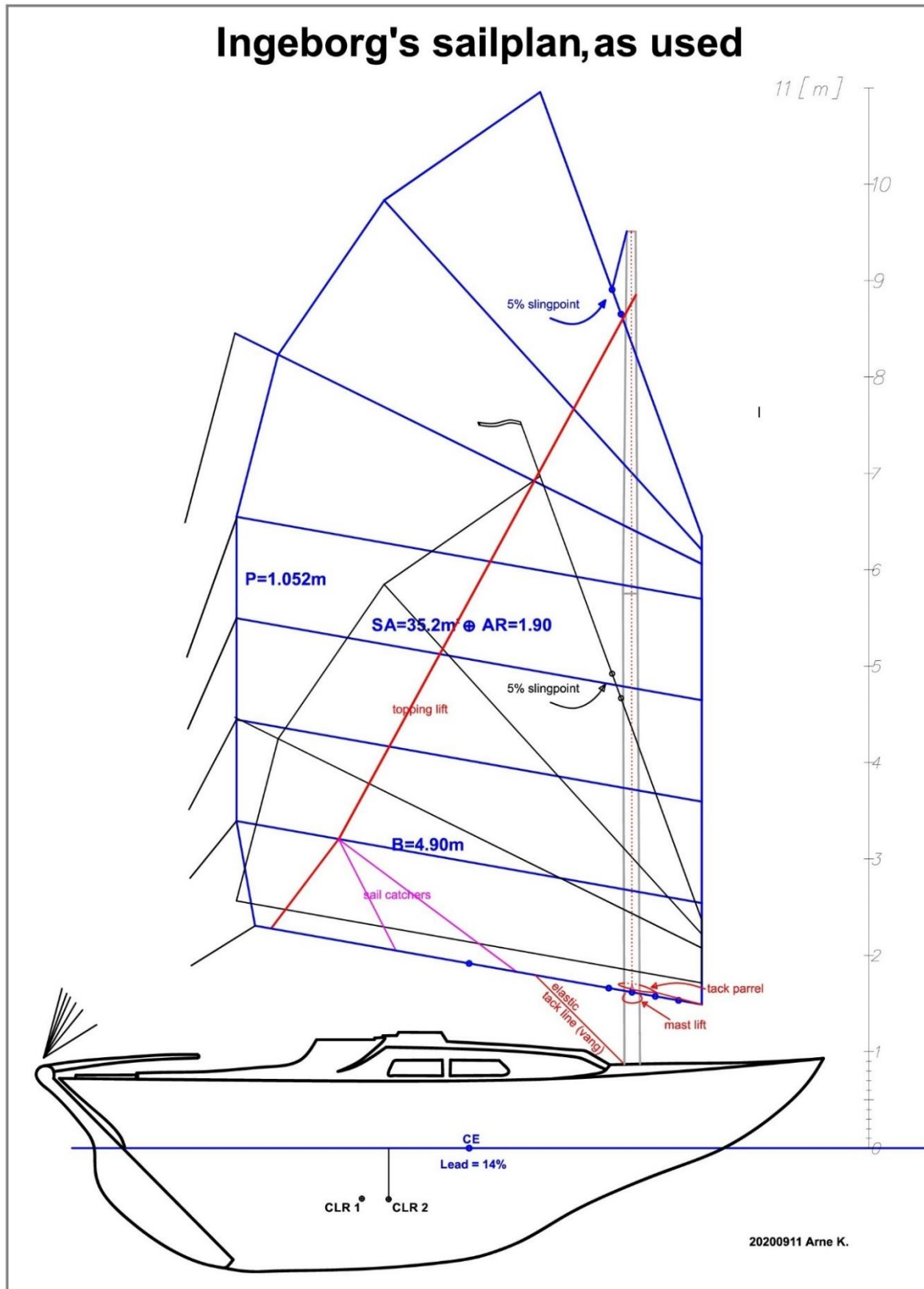
(It could even be an idea to tie the topping lifts a bit further forward on the boom, say $\frac{3}{4}$ aft from the tack.)

The final guard against this sort of trouble is the *fan-up preventer*, FUP, which prevents the yard from swinging about in a seaway (check the FUP at <https://bit.ly/2F6mzRQ>).

To the right is an old sailplan from the happy days of analogue drawing. A keen eye will discern both the original bridle type LJ, and the new topping lift and sail catcher version.

Compare with Ingeborg, overleaf...





Ingeborg's simplified sailplan

(I never bother with drawing boom, yard and sheet details in my sailplans, but still keep the extra space they need in mind.)

Read more about this type of LJ in “New Layjacks for Johanna” (<https://bit.ly/2vz5V5g>).



Frøken Sørensen in a good breeze with only three panels set.

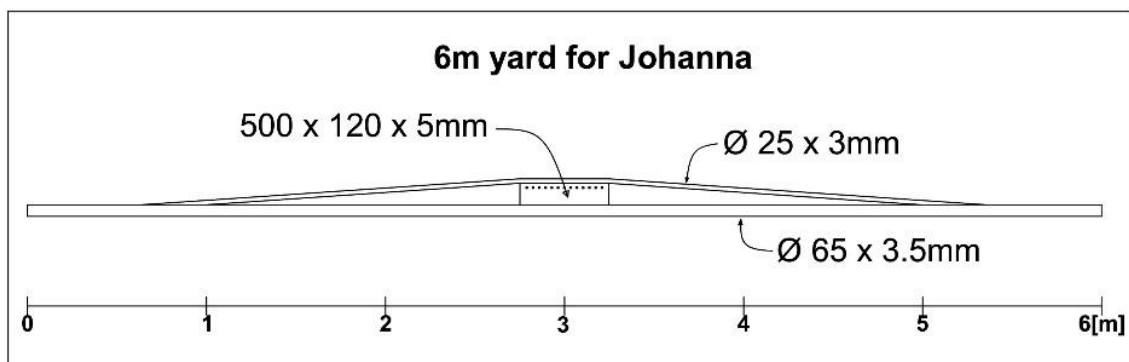
The photo above says it all: The 3-panel-up sail has tilted a good deal aft, as can be seen by looking at the position of the halyard blocks. This prevents the yard from slipping forward of the topping lift.

Fit the sail catchers (rope or canvas) only after the topping lifts have found their position and length by trial sailing. These can take many shapes. Generally, the bigger the sail, the more elaborate the sail catchers. Note on the photo above how they have been passed through loops tied to the topping lift. This ensures that they will never rub on the topping lift itself. *The sail catchers may fail, but the topping lift must never fail.*

Note: I don't try to say that the bridle-type LJ are useless. They are not. If you prefer them, then use them.

Choice of yard

These days I make both battens and yards out of aluminium tube (ordinary 6060-T6). The exception may be dinghy-size sails of less than 15sqm. There, it may be simplest to make both mast and yard of wood. Malena's yard was a straight copy of PJR's wooden yards, and never failed, even when the load increased because of adding camber in the sail. However, when trying to copy the success on the much bigger sail of Johanna, the weight of the wooden yard became intolerable for little me. I therefore designed a braced aluminium yard for her.



The dimensions of the braced aluminium yard for Johanna (2003)

The Johanna-style sails call for full-length yards, which call for more serious engineering. When the sails with cambered panels were introduced, the weight of the sail was suddenly transferred to the ends of the yard, so this needed to be stiffer and stronger than before. *Johanna's braced aluminium yard* came out a lot lighter than the wooden one. I notice now that several have made use of this construction method. It is good, as long as the weld between the main tube and the bracing tube is good. The way it was designed, with that plate in the middle, made it simple to adjust the halyard's slingpoint back and forth. However, on Johanna I found that the yard struggled a bit from sideways forces, so the chosen 65mm tube appeared to be on the light side.



Johanna in 2011

In the photo above, I am in the middle of replacing the *bridle-type* lazyjacks with the *topping lift and sail catcher* version. As can be seen, no sail catchers have been fitted yet. The welded, braced aluminium yard is clearly visible.

The tube-on-tube yard.

When (in 2012) a near-copy of Johanna's sail was made for the slightly heavier Mikkel 32, *Edmond Dantes*, the yard's main tube was increased to Ø 80 x 5mm. I guessed this would be just about strong enough without any brace, but we still added another smaller tube of Ø50 x 1.5mm on top of it to increase stiffness in the vertical plane. The tubes were first bolted together at the ends, and then tied together with steel wire (see next page). Finally, epoxy was added to fill the groove between the tubes.

This simple way of making a yard turned out to work so well that I have since fitted it to two of my boats: Frøken Sørensen in 2013 and Ingeborg in 2016.

Changes made: The epoxy soon failed on ED's yard, but I guess the steel wires still hold it. For my present Ingeborg, I have now replaced most of the epoxy with putty or glue, similar to Sikaflex. This has let me do without the steel wire ties. It is the bolts in the ends, which do the most important job with taking up the shear forces.



The first tube-on-tube yard for ED, in 2012: Main tube, Ø80 x 5mm and upper tube Ø50 x 1.5mm

Unfortunately, I have not yet been able to work out a formula for the dimensions necessary for these yards, so I just let you have the ones I have used on my boats:

	<i>Frøken Sørensen</i>	<i>Ingeborg</i>
Upper tube	Ø 22 x 2mm	Ø 35 x 2mm
Main tube	Ø 50 x 1.5mm	Ø 65 x 3.5mm

I like this simple way of making the yards, with no welding needed, as they appear to be stiff and strong enough. I guess I recommend this method.

Dressing and padding the yard, boom and battens.

Aluminium rubbing directly on aluminium is no good. For the last couple of boats, I have stitched some thick PVC cloth onto the yard and boom where they get in contact with the mast. The sails have batten pockets at the mast made of the same material. This keeps the rig quiet enough for my inshore sailing. However, for more serious voyaging, I recommend fitting some padding material to the yard and boom, scraps of old rag, for instance, and then stitching PVC cloth onto the outside of that. A similar method could be used on the battens. Just remember during the construction of the sail, to make the batten pockets sufficiently oversize to take the padding material.

(..A second argument for padding the battens could be that it will increase the contact surface and thus reduce the contact pressure. This would reduce the likelihood of chafing holes in the sail in the area of the mast...)

As for how to tie the sail to the end of the yard, boom and battens, I would say that any method will work. The sail is tied to the yard and boom via loops sewn into the sail. This

simple tying method gives freedom to shift and adjust the position of the topping lifts, sail catchers and TL on the boom, and the position of the halyard and YHP on the yard (which is not possible if the head and foot run through sail tracks).



The PVC-cloth is stitched onto the yard and boom using 'Sailmakers's Herringbone Stitch'



The sheet end of the battens on Ingeborg.

The way I have terminated the battens above, surely is crude, but also strong, and simple to make. By tying the sheetlets to the chains, there is no way they can be chafed off. I have also done the same by banging flat some battens ends (Malena and Broremann) and then drilling a hole and fitting a shackle - any method works - sort of.

Tying on the sail.

This can be done in basically two ways:

1. Either tie the sail to the battens indoors, and then bring the bundle to the boat. I prefer that method, as much of the job can be done without depending on calm weather.
2. Or bring the sail on board, fit the yard, hoist a little, then fit a batten, and so on...

Even when using my preferred alternative #1, I set up the boom first, with the topping lifts, mast lift and tack parrel, plus a temporary sheet. With this in place, I can bring aboard the sail bundle and insert it between the topping lifts, aft and between the mast and the mastlift, at the forward end. Then, on top of this comes the yard (see photo overleaf).

Fitting the halyard to the yard. On the last three junks I have rigged, I have only lashed the halyard blocks to the yard, with no nuts and bolts involved. This has some advantages:

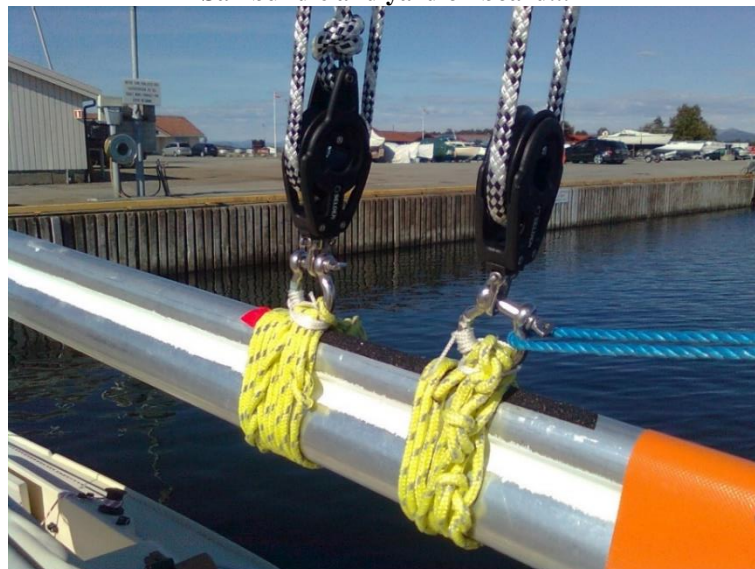
- No holes need to be drilled at the most stressed point of the yard.
- No special slingpoint hardware need be constructed.

- One is free to move the halyard's slingpoint back and forth, until it feels right.

For my Johanna-style sails, I have found it better to tie the halyard to a point a little aft of the mid-point, around 5%. This has proven to offload the *yard hauling parrel*, YHP, and the *throat hauling parrel*, THP. These days I am pondering on moving the halyard to 7 or even 10% aft of the mid-point. What must be avoided, is to fit the halyard *forward* of the middle of the yard, because that has proved to make the sail tail-heavy when raising and lowering it.



Sail bundle and yard on board...

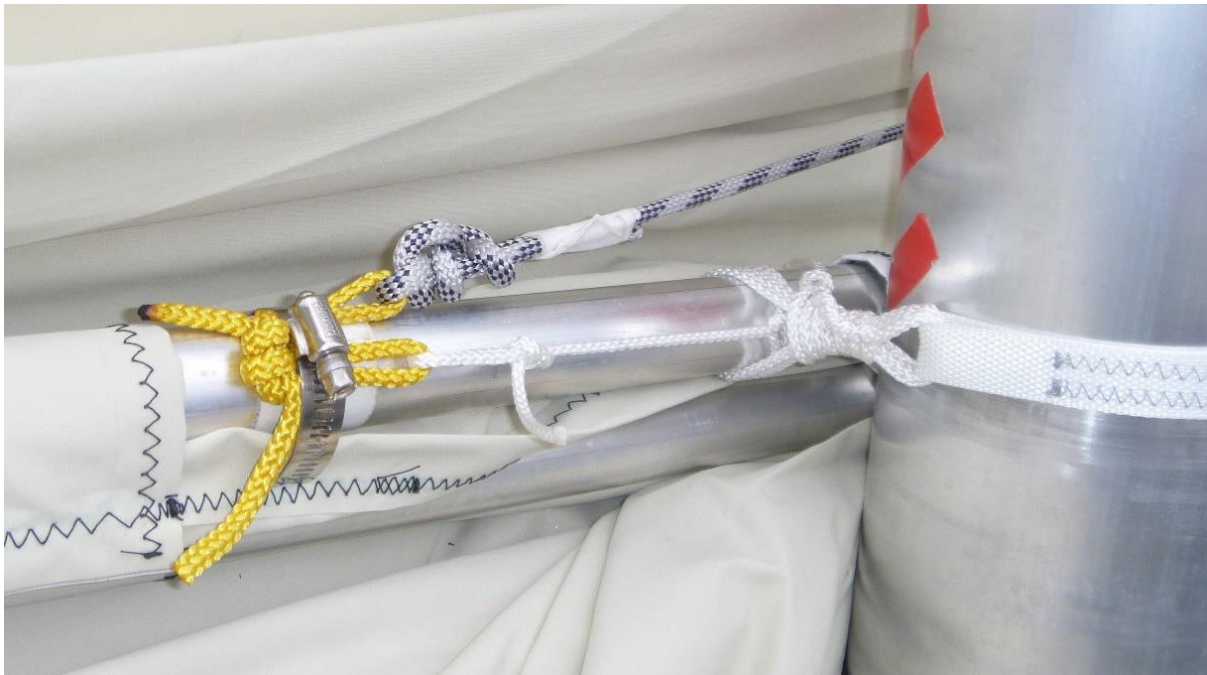


the 5-part halyard, same as on the diagram on p. 3

This photo shows how I have lashed on the halyard blocks. The use of that dummy yard pays back here, as the halyard goes on without any problems or head-scratching. Here I have hedged my bet by fitting strips of friction tape onto the yard. No problems with slingpoints moving.

Tying on the batten parrels and HK parrels.

Even though assembling the sail bundle indoors made the rigging process on board easier, there are still some jobs to do which require fairly calm weather. The *batten parrels*, made of 10-20mm webbing, are best pre-made at home by making a loop at each end with the sewing machine. Then they go on, one by one as the sail is raised. The photo on next page shows how a termination for both batten parrels and HK-parrels can be made. Another method could be to use some sort of rolling hitch.



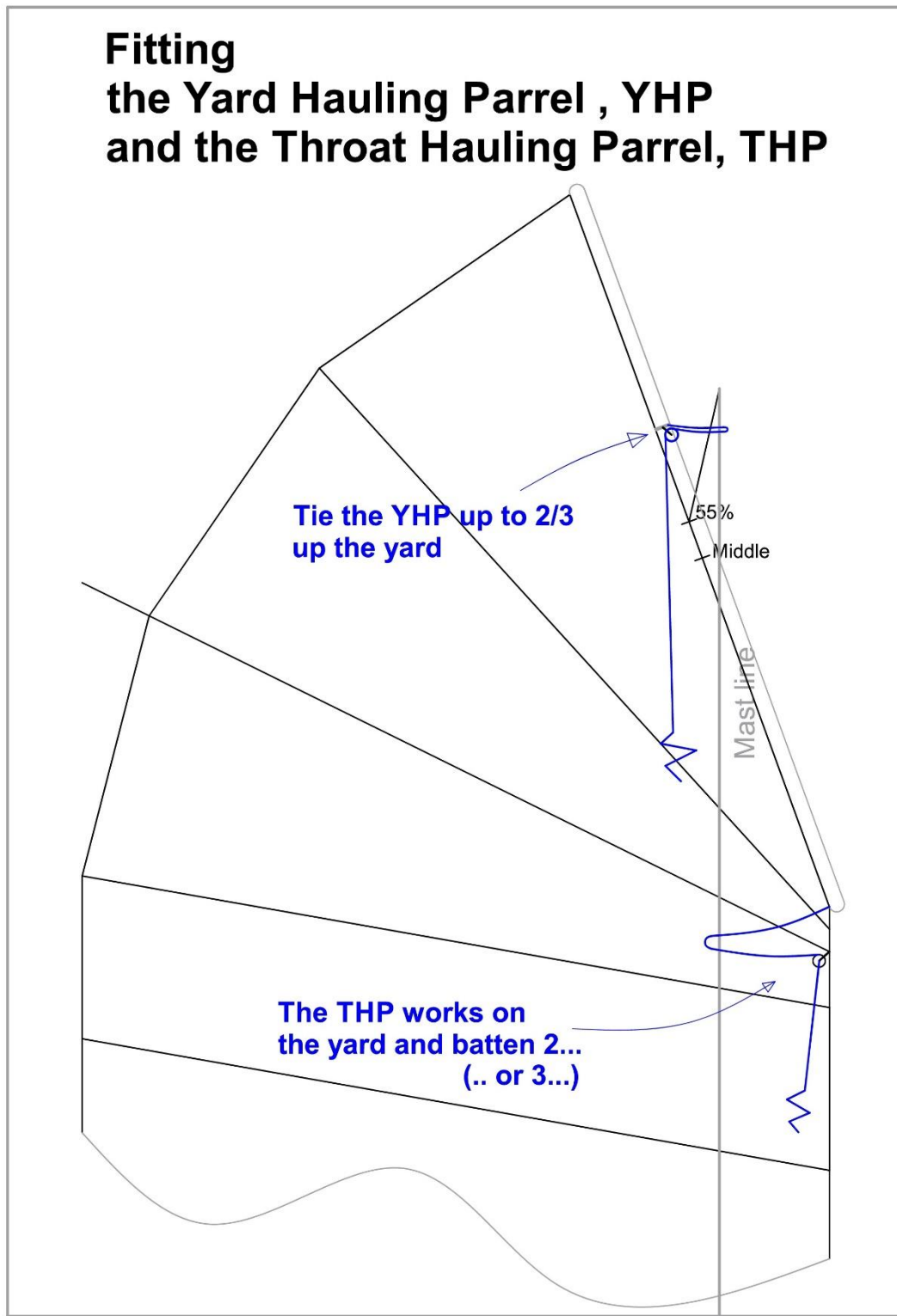
Ingeborg, 2016: Attaching HK parrels and batten parrels (webbing)

The photo above shows how two loops have been secured to the battens with a hose-clamp. This lets me tie on the HK- and batten-parrels. They still work fine - except that the 'stainless' hose-clamps have now started to rust!



Progress...

Tying the YHP and THP on.

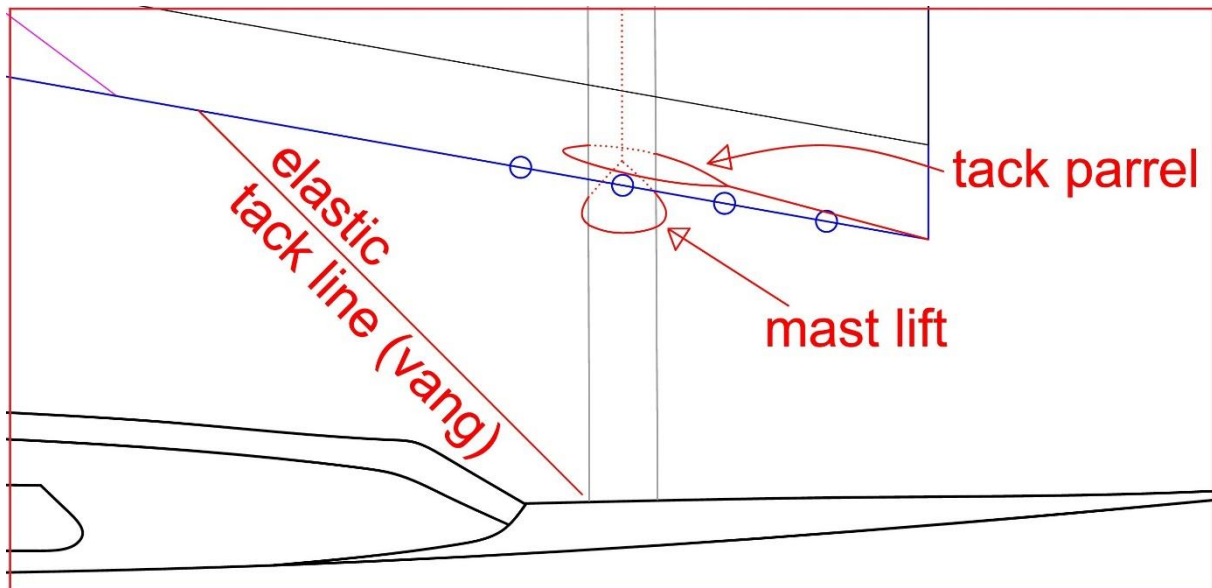


The fitting of this pair of parrels is fairly straightforward. Nowadays I attach the *yard hauling parrel*, YHP, 2/3 up the yard, as this gives the best peak-up moment. Then one must fit the turning block (on deck) for the halyard, YHP and THP, and even the FUP, if used. All this means that one must plan ahead to get it as tidy as possible, and above all, without adding too much friction. On *Ingeborg*, I decided to lead the running lines from the mast via the side

decks, to let me sail with the sprayhood up. More about the *hows* and *whys* on the THP and YHP on next page.

With the halyard ending on the starboard genoa winch and the sheet on the port winch, the setup has become quite tidy and user-friendly.

More standing lines.



Tack parrel, TP, mast lift and tack line, TL (AKA kicking strap or vang)

The *mast lift*, a single line from the mast top, runs down the mast, under the boom, around the mast and back up again, to support the boom and to act as a fore lazyjack. Nowadays I make its low end as a quite large loop around the mast, from 50mm webbing. This is kinder to the furled sail than just a line.

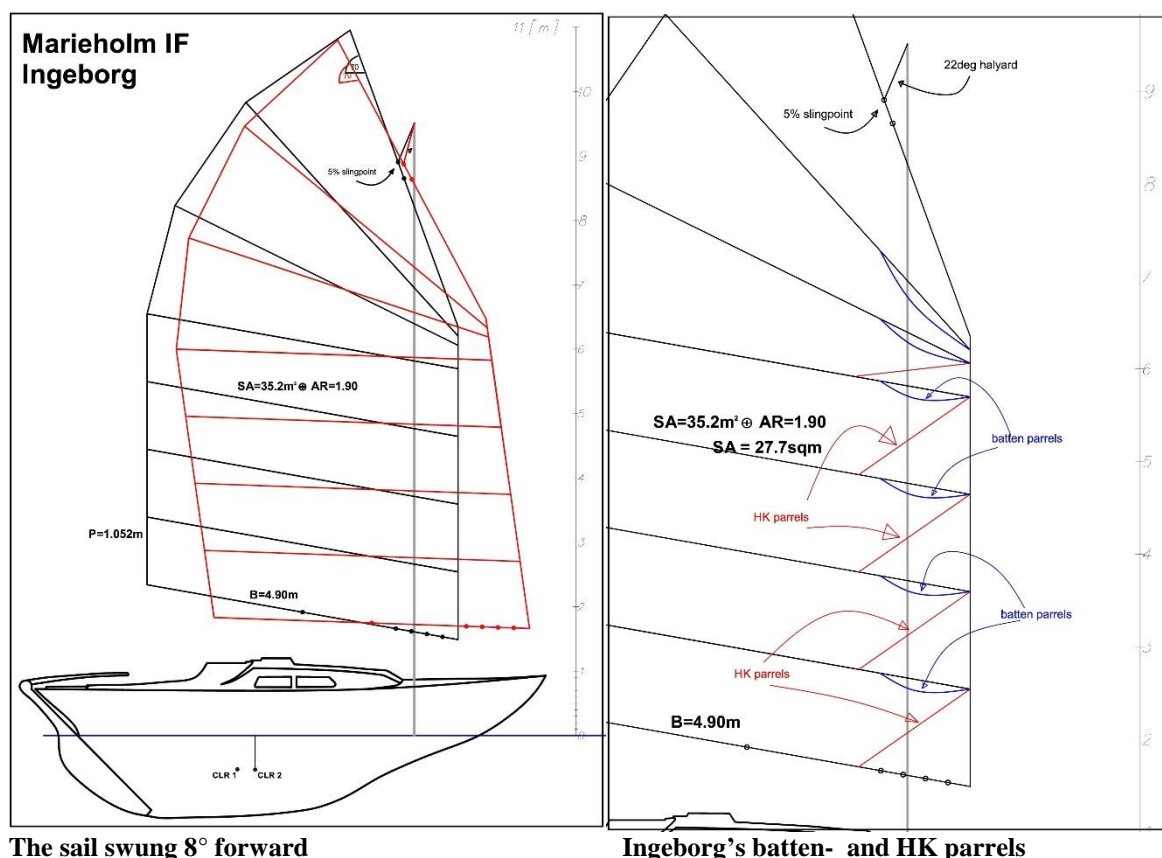
Even the loop of the *tack parrel* (TP) could well be made of webbing. Its wide contact surface reduces any likelihood of chafing on the mast. Remember to pass the TP above and inside the mast lift.

Finally, the *tack line* (TL). This was initially tied to the boom right aft of the mast. Now I prefer to lead it further aft so it makes about a 45° angle, to give it a light kicking strap (or vang) effect. A thick rubber snubber on it must be used to handle the asymmetries with the boom on one side of the mast.

Together these three lines act as a string version of a boom's gooseneck.

Standing, versus running Tack parrel.

A running TP is used by some people who have big, broad sloop rigs. This is to allow the sail to be moved forward a little, so that it is more centralised when on a reach or a run, and thus reduces weather helm. I have never used one so have no advice to give on this. Still, since the Johanna-style sail has a boom-rise of 10°, it should be possible to swing it forward if long enough batten parrels have been fitted. On the diagram overleaf, the sail has been swung 8° forward. However, I prefer boats with good rudders, so I don't have to bother with moving the sail around.



The sail swung 8° forward

Ingeborg's batten- and HK parrels

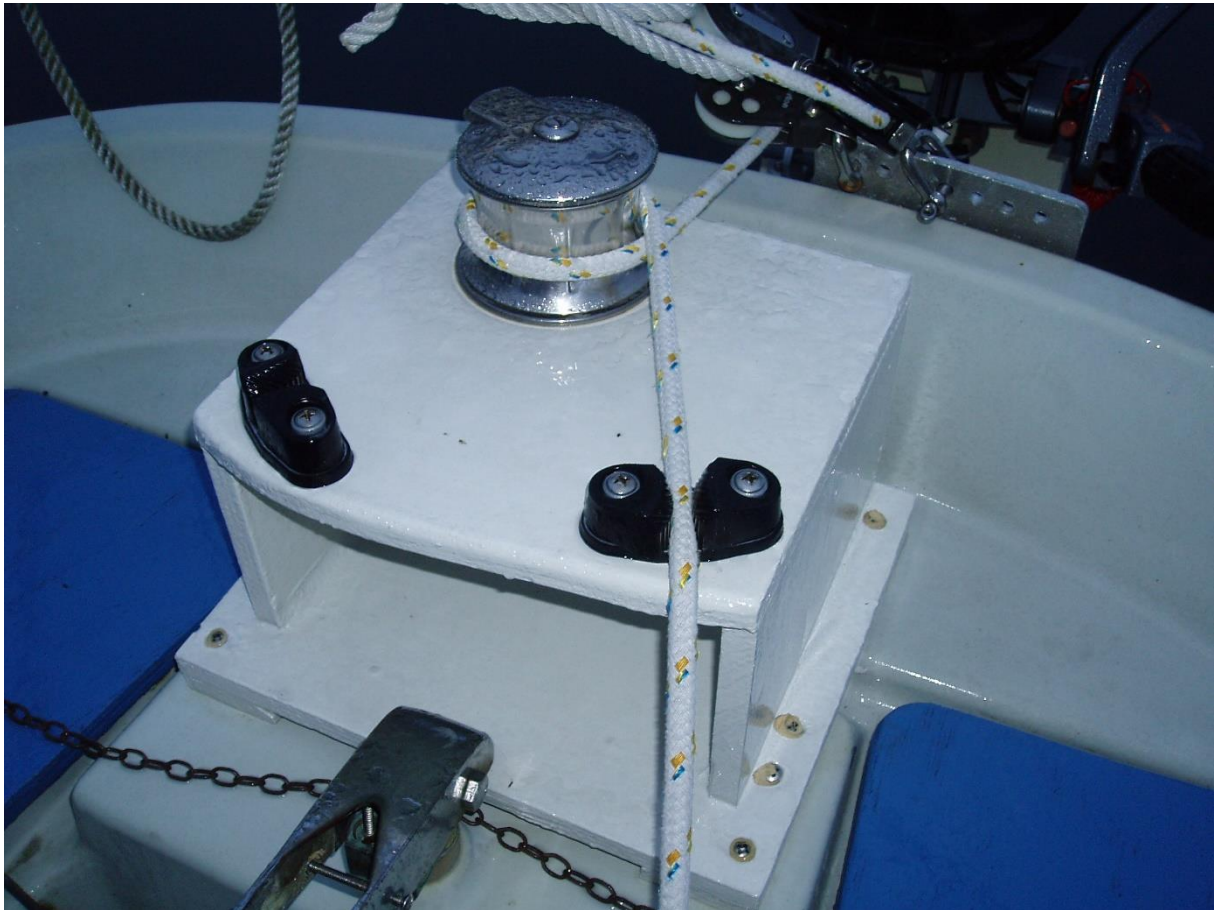
The Hong Kong (HK) parrels.

The HK parrels play a fairly secondary role on the Johanna-style sails nowadays. They appear to have seen most use on the very broad and un-balanced, fanned sails on Hong Kong schooners. As photos of these 2-3-masted vessels show, these parrels must be under huge loads. The battens, even from bundles of bamboo, clearly bend upwards. Even so, the HK parrels do their job, and there are no diagonal creases to be seen in these sails. It was only when I made the first cambered panel sail that I met this problem. Luckily, Hasler and McLeod's *Practical Junk Rig*, PJR had a note on this, which helped me out, back in 1993. Later by re-analysing the problem, I found that by moving the running luff hauling parrel (LHP) to the yard and batten 2 (from top), only, the loads on the HK parrels dropped by about 90%. Nowadays they can even be seen slack, at times. (Check 'Peaking up the JR': <http://goo.gl/r0fwCf>)

The rigging of *Edmond Dantes* in 2012

This photo, above, shows what HK parrels do. The lowest panel has yet to receive one, and this results in a big, camber-robbing crease.

Choosing and fitting sheets



March 2005: Johanna with her new pedestal for the sheet winch and carefully positioned cam cleats. (..the bigger the sail, the more care has to be taken on this matter...)

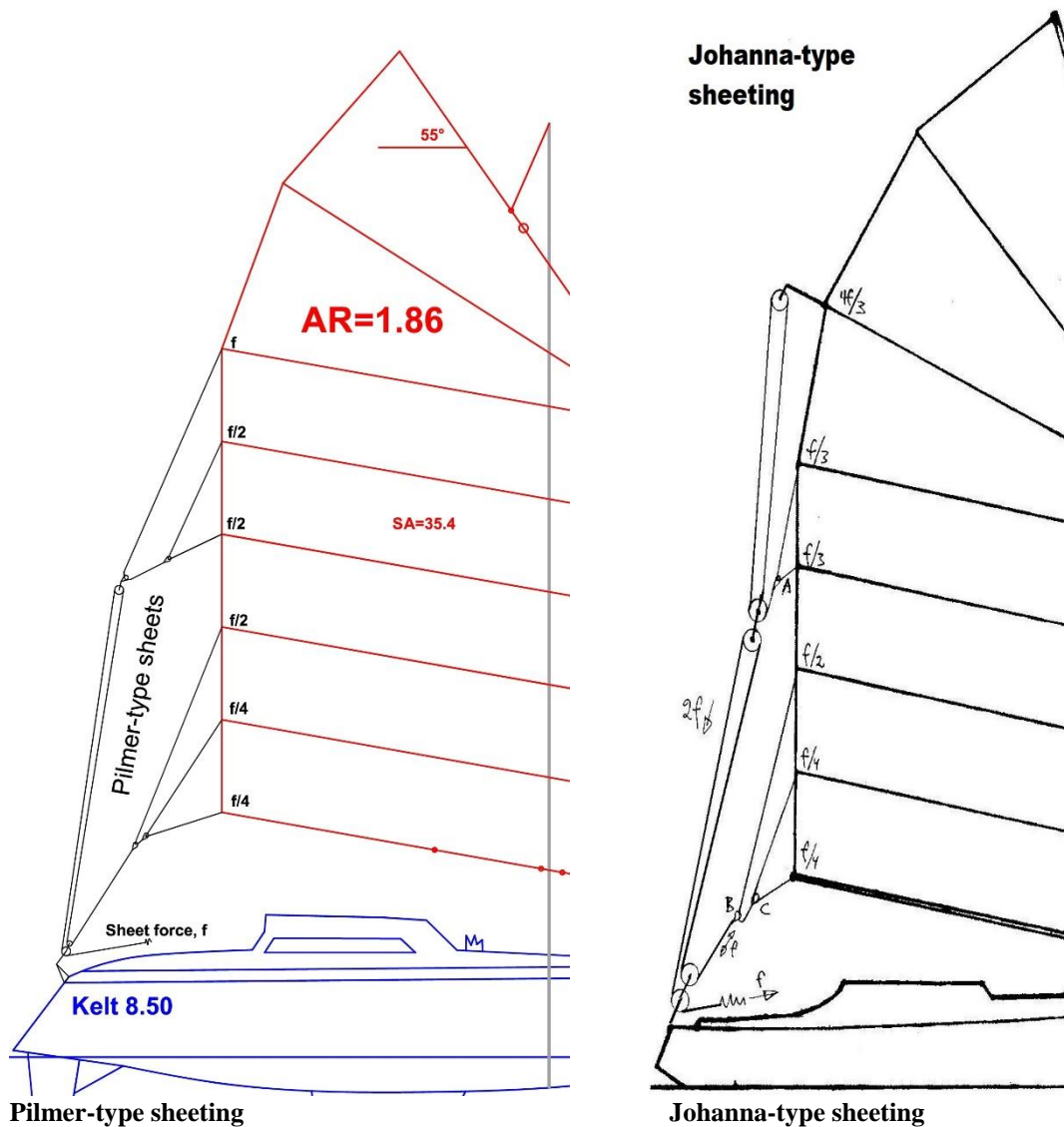
The sheets is a huge theme, so here it is easy to run astray. I'll try to contain myself.

The four main challenges with sheets are these:

1. How to get enough sheeting force without ending up with a lot of friction in the blocks
2. How to get the twist right
3. How to avoid sheet-batten tangle
4. How to get enough deck space for the sheets when the sail is deeply reefed

The sheet force issue sounds easy to deal with, but is actually not that straightforward. I see that some people use up to 6-part sheets. The higher the purchase, the more spaghetti in the cockpit, and the more friction there is to fight when the sail is to be hoisted. In light winds, a 6-part sheet may also be reluctant to let out the sail, while a 3-part sheet never fails on this. Personally, I have always used a 3-part sheet, even on the big sail of Johanna. This means that sometimes I have to use the winch to get in the last bit - or luff up for a moment to off-load the sheet. I am also careful to position the hauling end of the sheet so that I can give it a good pull, using my whole body behind it (..as on the photo above...).

The twist issue is all about finding a combination of sheets and sheetlets, which distributes the sheet forces correctly. The point with getting the twist right is to ensure that the entire sail, from head to foot, produces good drive. A fine thing with the JR is that if you get the twist right for close-hauled sailing, it will stay just about right when reaching and running too. A sail's planform and balance at the mast play a big role here: A sheet setup that is good on one sail, may not be so good on another.



I have almost exclusively been using one of the two sheeting systems above. The Pilmer-type sheet was taken directly from the sailplan of Hasler's boat, *Pilmer*, in PJR. It has a bit anti-twist in it. As long as the sail is canted forward at the top, this works well. PJR mention that this canting was partly done to increase the balance at the top end and thus reduce the need for sheet force up there.

However, I soon found that rigging the sail upright was necessary to eliminate *sheet-batten tangle*. The result was a sail with a 70° yard angle and with a new sheeting system, called the Johanna-type. As can be seen, this has much more anti-twist in it than the Pilmer-type, and it ensures that the two top panels produce a lot of muscle.

Recently I made a little upgrade to Ingeborg's Johanna-type sheeting.

(Check this recent write-up '*Fixes, adjustment and...*' <https://bit.ly/2Zc6eCe>)

Split sheet.

Another practical alternative is to split the sheet into an *upper sheet* and a *lower sheet*. One sheet controls the upper half of the sail, and the other controls the lower half. I have seen this in use on the mainsail of the mighty *Samson* (23t, 70 + 37sqm). It makes sense for four reasons:

- One has superior control of the twist, particularly useful with the sail reefed.
- It lets you haul one sheet at a time if the wind is strong. In light winds, you can just grab both tails and haul as if it were a single sheet.
- If one sheet or sheetlet parts, the other sheet will keep the sail under some control until you can get the sail down and can make a fix. This could be *very* useful in an offshore gale...
- As a bonus, one can sheet the furled sail bundle to the centreline, even with rather short deck space.

Back to the hands-on rigging.

With the sail lashed and tied to the yard and boom, and with the batten parrels and HK parrels fitted, it makes sense to go ahead with the sheets. Whatever version you make, the sheetlets should be made over-long at first, and then gradually shortened. The point is to avoid making the spans between the battens so short that they start to pull the battens together (resulting in fluttering leech). On the other hand, they should not be too long either, or you cannot sheet in for close-hauled sailing with only 2-3 panels up. The best would be if we could haul the sheet taut at the centreline with the sail fully lowered, and without needing to have running topping lifts. However, the Johanna-style sheet is a space-thief, so I am content as long as it lets me sail close-hauled. I have my method for taming the furled bundle (below):



17. Sep. 2020: Taming the sheetlet bundle of the lowered sail...

As soon as the sail has been dropped, the sheet is hauled in almost as far as possible. Then I grab the whole sheetlet bundle, bring it to the port side where a rope loop with a hook is waiting for it. This clears the cockpit for the last leg, when approaching and entering the berth.

The sheets I have shown you, only run over three sheaves, plus maybe a turning block or two. If your budget allows it, use big blocks with ball-bearings, though this still has lower priority than the halyard blocks. Tweaking on the sheetlets takes a bit time - that's just the way it is...

To get an overview, I have given a full size photo of Ingeborg's sail, and draw your attention to a few details.

- Starting at the mast top, notice that the YHP is tied to the yard so far up and aft, that the line goes around the mast *inside* the topping lift, right at the mast top. This may look strange, but remember, with full sail set, the topping lift is completely slack.
- Talking about the topping lifts; both they and the sail catchers are quite slack. That is because I have hoisted the sail enough to tighten the tackline, TL. This, again is to keep the leech of the lowest batten panel taut and thus avoid fluttering, even if the sheetlet tries to lift the boom. Compromises...
- At the mast you may just spot the TL, thanks to the thick, black rubber-snobber attached to it.
- The luff-hauling parrel only goes through a block at batten 2 (from top), before it is tied to the yard - after a turn around the mast. It therefore deserves to be called a *throat hauling parrel*, THP. Its hauling end is passed inside the batten parrels but outside the HK-parrels.



In Ingeborg, August 2020

- Talking about the HK parrels. I find they are easy to get right: Set them up, one by one, as you hoist the sail on a calm day, then sail with them like that for a while. If you find that one or two of them are a bit slack or taut, make a note on it, and adjust them next time you raise the sail. From then on, you can forget them.
- Finally there is my toy, the *fan-up preventer*, FUP, that is the vertical thin line near the leech. Now that I have recently given it a low-friction line, it has become a joy to use. (More about the FUP here: <https://bit.ly/2F6mzRQ>)

Finally...

I hope some of this makes sense.

Stavanger, 16. Sep. 2020

Arne Kverneland

PS: Thanks a lot to Graeme for proof-reading this - it surely must have been a struggle...

PPS: The remaining errors are all mine, and I let them be. If you can produce a write-up yourself – in faultless Norwegian, I shall have another go on this...