Designing a Johanna-style junkrig for a Hartley trailer-sailer 16.

Making use of the shortcuts provided by chapter 3 and chapter 4 of “The Cambered Panel Junk Rig” (TCPJR).

by Arne Kverneland

When a JRA member said he could use some help in designing a cambered Hasler-McLeod style sail for his Hartley TS 16, I found I would try my hands on it. Since I have the Chapter 3 and 4 around, I find it to be a fairly quick exercise.

On next page is the original specs of the TS 16, found in an old Hartley catalogue. Step one is to make a digital cut-out of the sail plan and print it to a scale I can use, that is 1:50 in this case.

Then I sketch up a possible mast or two, and use the chapter 3 procedure to position the boom. In this case I found I had to push the sail quite far aft to get the CE of the JR at the same place as that of the BM rig (The CE of the Bm rig was found by balancing the sail area on a ruler - see the photo on page 4).

The quick sketching method in Chapter 3 lets us make use of two formulas.

1. **Sail Area**, \( SA = \text{boom} \times h \times "\text{The Johanna Sail Area Factor"} = \text{boom} \times h \times 0.79 \)

2. **Aspect Ratio**, \( AR = h \div \text{chord} \) \( [ = h \div (\text{boom} \times \cos10°) = h \div (\text{boom} \times 0.985) ] \)

These two formulas can be merged into another one (.or three, actually...):

3a. **Sail Area**, \( SA = 0.78 \times AR \times B^2 \) ...and this can of course be twisted into...

\[ 3b: \quad AR = \frac{SA}{0.78 B^2} \]

3c. **B**, \( B = \sqrt{\frac{SA}{0.78 \ AR}} \)

These new formula, 3a, b and c lets me get away without sketching more than the boom. After trying a bit back and forth, the formula 3b indicated that an AR=1.85 might be good:

\[ AR = \frac{SA}{0.78 B^2} = \frac{17sqm}{0.78 \times (3.45m)^2} = 1.83 \]

Time to move over to Chapter 4 and try one of the master sails:

I go for the master sail with AR = 1.85 has a SA=36.55m²

By scaling it down to B=3.45 the linear scaling factor, \( F_L = 3.45/5.077m = 0.679534 \) the sail area \( SA_{AR=1.85} = 36.55m^2 \times F_L^2 = 16.88m^2 \). That is close enough, as the original Bermuda \( SA = 180sqft = 16.72m^2 \).

All I then have to do is to print out the sail in this size on a transparent and lay it over the original sail plan. See page 3.
Unfortunately, the underwater body is not shown here, but I know it has a big rudder plus a centreboard. I decided to find the approx. position of the CE and use that on the JR.
The Hartley TS 16 with the suggested JR.
**A lower and broader sail?**

I find that I can just get away with the shown sail of AR=1.85 and B=3.45. However, if the owner prefers an even lower AR rig for the same sail area, I would suggest to start with the same master sail with AR=1.85 and just drop one panel, to 6 panels.

The master sail’s SA would then crimp to $SA_{\text{master}}=31.25 \text{m}^2$ and the AR would be $AR=1.64$

The maths to find the length of the battens would be about like this:

The linear scale factor to get a 6-panel sail with $SA=16.88 \text{m}^2$ can be found as

$$F_L = \sqrt{\frac{TS \ 16\text{’s} \ SA}{Master \ sail\’s \ SA}} = 0.7350$$

Then the new batten length could be found as:

$$B_{(6\text{-panel sail})} = 5.077 \text{m} \times 0.7350 = 3.73 \text{m}$$

**Camber**

The needed round to get the wanted camber/chord ratio can just be picked from Fig 4.4 in Chapter 4 and then scaled down, using the linear scaling factor, $F_L$.

**Good luck!**

Stavanger, 20160124,

*Arne Kverneland*

A glimpse of my little drawing board, revealing my semi-manual method of drawing. Note the cut out Bermuda sail area, up to the left, used for finding the CE.
This photo shows my 6.5m *Frøken Sørensen*. The sail is 20sqm, with an AR=1.95, so is quite similar to the one I suggest for the Hartley TS 16.

*Frøken Sørensen* is a fine daysailer, and I am sure the TS16 will be good as well...
Appendix, 20160125

Today, just for fun, I tried another version. I first drew up a new boom on the boom line which let me have a full 10% balance in the sail (using the plumb mast). This gives better freedom later to move the sail further aft or forward on the mast. The resulting boom/batten length was thus increased from B=3.45m to B=3.60m. This is so much that even a crimped master sail with AR=1.80 became too big. However, I found that if I took the master sail with AR=1.95, and removed the lowest panel, a crimped version of that, with B=3.60m (versus the master sail, B=5.077m) would end up with

\[ \text{SA}=16.81\text{m}^2 \text{ and the AR}=1.73 \]

The Linear Scale Factor, \( F_L = \frac{3.60}{5.077} = 0.709080 \)

To find all the lengths on this 6-panel sail one just multiply the all dimensions on the AR=1.95 master sail with \( F_L \) (0.709080).

I printed it out and put it on the original sail plan. See next page (7).

Actually, this sail would be very close to the sail you see on my Frøken Sørensen, with one panel reefed away, here:

![Image of sail](image_url)

Finally, I scanned a combined version - with both junkrigs on top of each other (p.7). Personally I am uncertain which I like most.

A.K.
6-panel junk sail for Hartley 16 TS, based on master sail with AR=1.95

AR=1.73
SA=16.81m²

To scale dimensions down from the AR=1.95 master sail:

Linear scale factor,

\[ F = 0.709080 \]
6-panel junk sail for Hartley 16 TS, based on master sail with AR=1.95

JUNKDIG FOR A
HARTLEY TS16
20160124 Anne K.