Rigging Guide Viola 14 Lug Rig

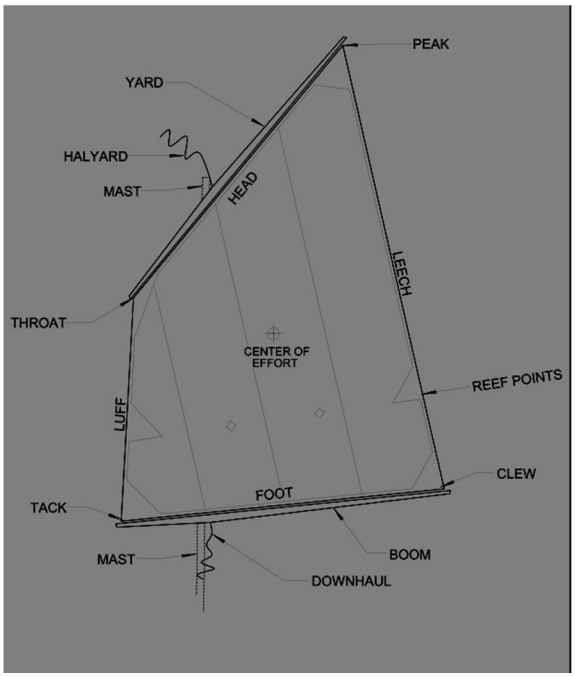
The Balanced Lug Rig

The balanced lug rig is often chosen by small boat designers for having the following favourable characteristics:

- Traditional in appearance
- Cheap to rig
- Easy home construction of the spars involved
- Relatively short spars for a given sail area
- Powerful sail that is easy to control for the sail being self-vanging
- Very quickly to raise and to strike the sail (important for sail & oar use as well as emergencies).
- Good sail shape, also when reefed

The lug rig is a very good choice for the Viola canoe if looking for a versatile rig that can easily be reefed, also on the water. It is excellent for touring or camp-sailing.

The picture below shows the definitions used throughout this document for the various parts of a balanced lug rig.



Making the Mast

Mast sections are to be made of 6000 series T6 series aluminium tubes. The instructions for making the shoulder and bearings on the top mast section by using glass tape epoxied to the mast and a short section of aluminium tube of the same diameter as the bottom mast section for the shoulder (to ensure that the top mast section sits well in the bottom section) can be found in the Viola 14 plans.

Dimensions/details bottom mast section:

- Length 2450mm
- Outside diameter 60mm
- Inside diameter 56mm (2mm wall thickness)
- Centre halyard cleat 550mm from the bottom of the mast. Bolt or rivet the halyard cleat to the mast.
- Optional saddle just above mast partner level for the dagger board elastic.

Dimensions/details top mast section:

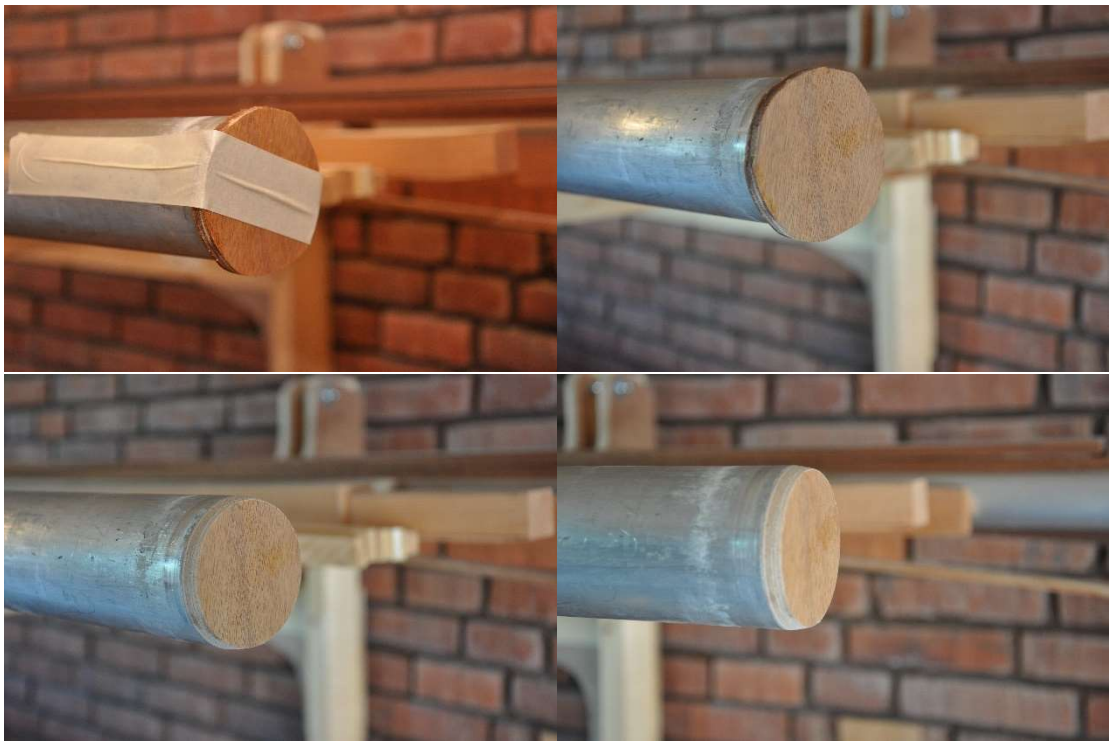
- Length 2200mm
- Outside diameter 55mm
- Inside diameter 51-50mm (2mm wall thickness preferable, 2.5mm wall thickness acceptable)
- Burry 300mm
- Height aluminium shoulder 50mm. The shoulder is riveted to the mast with 2 rivets as well as glued to the tube. If there is much space to fill, first make some glass tape wraps around the mast before gluing the shoulder in place.
- Bearings are 50mm wide made from glass tape wraps glued in place with epoxy to make bearings ensuring a proper fit in the bottom mast section.
- A large saddle/dead eye with a stainless steel insert is to be bolted/riveted to the top mast.

Tip:

To make the top section water tight, you can either use commercially available plastic caps or inserts, if you can find them in the right size, or simply make some yourself using plywood/timber offcuts. Use the same on the bottom of the lower mast section. Since you are wrapping electrical tape around the joint, you do not need a plug in the bottom of the top mast section. I you would like to build in some additional security however, fit them on both ends.

If making the plugs yourself, cut one round of timber the size of the inner diameter of the tub (a hole saw is great for this job) and one other round of plywood slightly oversized in comparison to the outer diameter of the top of the top mast section/bearing at the bottom end of the top mast section. Glue the smaller round and the larger round together making sure that they are nicely centred.

Next glue the plug that you just created in place. When the glue has hardened, trim the outside of the round that overlaps the tube's sidewalls to size.



Lastly apply varnish or paint (epoxy optional) to protect the plywood.

Making the Yard and Boom

The yard and boom are to be made from a 490cm Standard Diameter Mast (SDM) constant curve carbon windsurfer mast. The stiffness of a windsurfer mast is determined using the IMCS (Index Mast Check System). The industry has to a large degree standardized the approach towards windsurf masts meaning that masts of the same diameter (SDM is what you want rather than RMD – Reduced Mast Diameter used for wave riding windsurfer rigs) and the same length (in our case 490 cm) of constant curve design (opposed to hard top or flex top windsurfer masts) have, more or less, the same stiffness (IMCS value) along the length of the mast. For masts having a length of 490cm this is around ICMS 29.

Carbon windsurfer masts up to a length of 490cm are commonly available. Longer masts are typically much more expensive since they require a higher carbon content to have an acceptable weight. The carbon content is not important in respect of the mast bend (they will be approximately the same). The higher the carbon content, the lower the weight of the yard and boom however the higher the costs.

The yard and boom you see in this rigging guide are made from a 490 cm SDM constant curve windsurfer mast having a 50% carbon content and an IMCS of 29.

A Really Simple Sails (RSS) sail is recommended to be used for the Viola 14 canoe (you can find the link to the sail maker's website at the bottom of this document). The round of the head of the RSS lug sail has been carefully determined to work in perfect harmony with the stiffness of the carbon yard you make from the windsurfer mast.

Dimensions/details yard:

- Yard length 2600mm (to be made from the top part of the windsurfer mast)
- There are two holes at the front end of the yard, the most front one is for the halyard attachment and the other one to attach the throat of the sail to the yard.
- There is one hole at the front of the yard to attach the peak of the sail to the yard.

Dimensions/details boom:

- Boom length 2300mm (to be made from the bottom part of the windsurfer mast).
- The centre of outhaul cleat is 1475mm from the front of the boom.
- A saddle is bolted to the front part of the boom. For the boom visible in the photos, 40mm bolts were used epoxied in place in the wooden plug glued in the front end of the boom.
- It depends on whether you want an adjustable outhaul or not. If so, it is easiest to bolt a saddle to the top of the boom and a cheek block to one side of the boom. Otherwise just drill a hole to take a lashing to tie the clew in place.

Plugs are glued in the end of the yard and boom (as described for the mast above) using a round piece of timber and a plywood round patch on the end covering the spar's edges (similar to the plugs described further above). The plugs inside the spars need to be long enough as to allow the necessary holes to be drilled in the mast. In case the fit is loose, wrap some glass tape with liquid epoxy around the wooden plug before gluing it in place with epoxy glue. Round the outside edge of the plywood patch well as to avoid any sharp ends.

All holes should be drilled / fittings attached as much as reasonably possible towards the ends of the spars.

It is recommended to leather the yard and boom where they come into contact with the mast (there are some excellent tutorials on the web for this) to protect the boom and yard against damage caused by chafing.

Tip:

Attaching fittings to carbon tubes requires more attention since you cannot simple rivet Monel rivets in the carbon section. A carbon plate is cut from a carbon off cut to which the saddle is bolted using stainless steel bolts, rings and locking nuts on the inside of the carbon plate. Cut off any part of the bolts sticking out of the nuts. Next some oversize holes are

drilled in the carbon tube in which the nuts just fit. Lastly the plate with the saddle bolted in place is glued on the boom with epoxy glue. The same method is used for attaching the clam cleat to the boom.

Bending on the Sail to the Yard

With the balance lug rig, one needs to bend on the sail to the yard and the boom before hosting it. The lug sail is best laced to the yard and loose footed on the boom (this allows more draft in the bottom of the sail, the depth of which is easily controlled by the outhaul.

Let's first have a look at the yard. The key thing to consider here is that the tension put on the luff of the sail by the downhaul should stop at the throat of the sail so that the tension on the head of the sail can be set independently from the luff tension. One needs to avoid the tension on the luff having an impact on the tension in the head of the sail.

It takes a bit of trial and error, but quickly you will find the correct peak tension that will not result in the tension on the luff progressing in the head of the sail, but giving the right tension on the head getting rid of wrinkles and such. If there is too much tension on the head of the

sail, this will result in the yard bending too much and thus flattening the sail early (the yard bend will take the shape of the round in the head of the sail). Flattening of the sail should be induced by wind strength and downhaul tension, not by too much tension on the outhaul in the peak!

When tying on the sail, what you are a looking for is a slight crease in the sail along the length of the yard. It follows from the above that this crease should be there when the sail set, not when the sail is down since the throat being pulled down by the tension on the luff is the starting point. The crease disappears when the wind fills the sail.

Between the lashings on either end, the sail is to be laced to the yard either using individual lashings around the boom for each eyelet, spiral lancing or half hitches (as shown in the photo below). Half hitches will be a bit more aerodynamic than a spiral lashing as far as the wind is concerned as most of the lashing hides along the edge of the sail inside the wake of the spars.

Bending on the Sail to the Boom

The tack of the sail is best fixed to the boom using a small D-shackle. The larger halyard shackle visible in the picture below is used for reefing the sail (please refer to the section dealing with reefing further below).

The clew of the sail is attached as shown below in the section dealing with the outhaul. A rope loop (in this case 4mm Dyneema) keeps the clew near the clew.

The outhaul fitted allows quick and precise adjustments to the depth in the bottom part of the sail. The maximum depth (1:7) is pre-set by having a roper stopper in the control line.

The outlook consists of a 3mm Dyneema pre-lead line (light grey in the photos) and a 4mm Dyneema control line (red in the photos). The pre-lead line runs from a saddle fitted on the end of the boom to a single block fitted in the clew of the sail to a cheek block on the end of the boom ending in a single block. The control line consequently runs from a becket in the clam cleat to the single block attached to the end of the pre-lead line mentioned above, through the clam cleat to a single block mounted at the front of the boom.

This means a 1:2 cascade running into a 1:2 cascade so a total purchase of 1:4.

Tips:

1. *The outhaul can be simplified by leaving the second cascade in the system out, so no primary line in the system followed by the control line but just the control line that runs from the saddle on the aft end of the boom to the clew to a cheek block on the aft end of the boom through the cleat mounted on the bottom of the boom just in front of the mainsheet attachment to a block tied to the front end of the boom.*

More than enough purchase really; the advantage of having a second cascade in the system is that it is easier to precisely set it.

Even simper would be to have the control line run from the saddle on the aft end of the boom to the clew to a block tied to the saddle on the aft end of the boom through a cleat mounted on the top of the boom.

2. *Obviously you can also tie the tack and clew to drilled holes in the boom. Clearly this means that you cannot control the draft (belly) of the sail whilst sailing and you would have to strike it first.*

Rigging the Mast

If the fit of the burry of the top mast section in the bottom mast section is not tight, start by wrapping tape around both bearings on the mast top section until you will have a tight fit when the top and bottom sections are slotted together.

Next slide the top mast section in the bottom mast section. Wrap some electrical tape around the joint to make the mast watertight and to avoid the joint being able to pinch the fabric of the sail and to keep the deadeye in the top of the mast at a 90 degree angle to the horn cleat at the bottom of the mast.

Thread the halyard (the rope used to pull the sail to the top of the mast) through the deadeye in the top of the mast and step the mast in the mast partner and mast step.

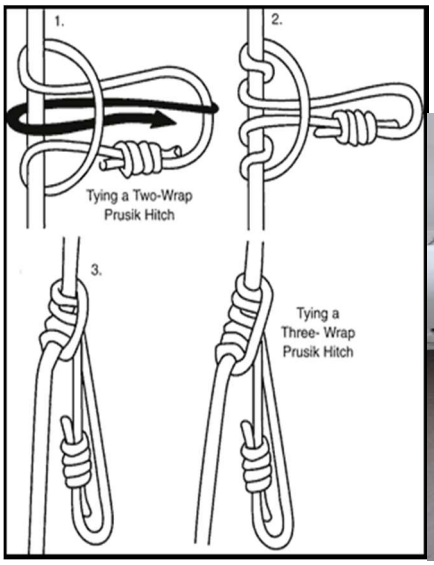
It is best to use line with a Dyneema core for the halyard since you do not want any stretch in it. Polyester halyards stretch under load and consequently you will need to compensate for this by constantly adjusting the downhaul. A secondary negative effect is that your boom will sit lower and lower!

4mm Dyneema (Dyneema core and polyester sheath for easy handling) will be fine to handle since the sail is relatively small. Typical break loads vary between 600 – 1000 kg, more than sufficient for the Viola canoe. Buy 10-11 meters for comfortable rigging.

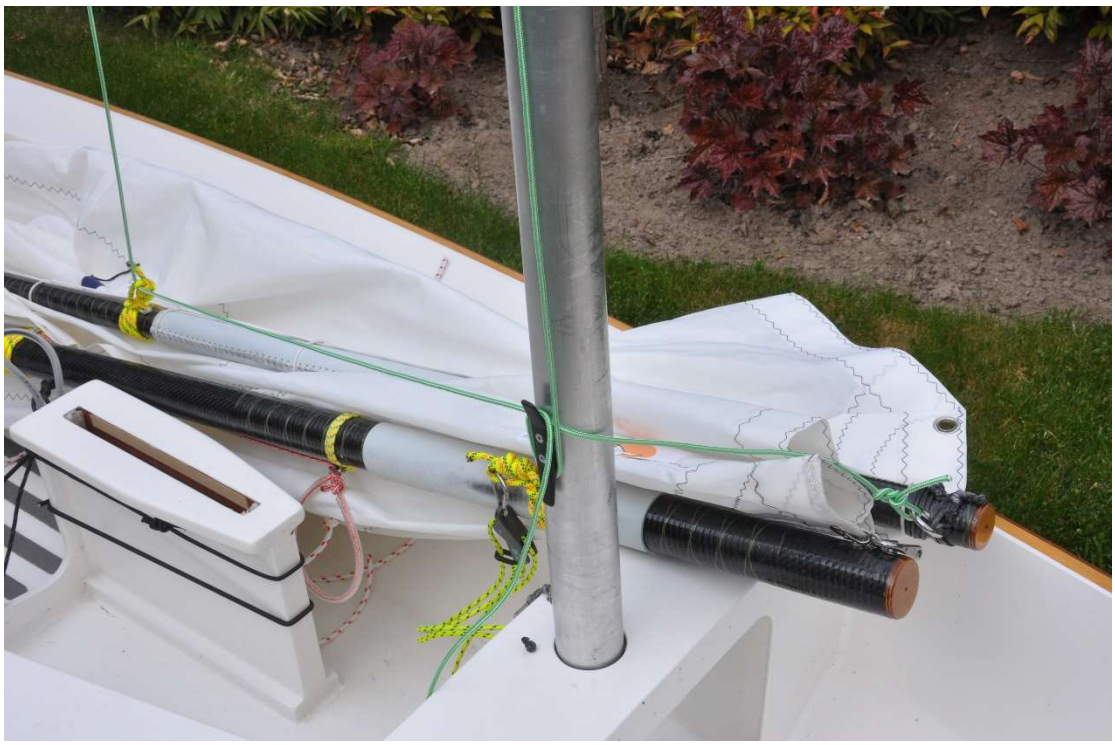
Step the mast. It may be good to secure the hauling part of the halyard to the boat to avoid it blowing away from you when striking the rig.

Some designers use a two part system where there is a loop of rope to hold the yard against the boom and a separate halyard to pull the yard up to the top of the mast. An alternative method draws from the canoeing chapter of "The Dixon Kemp Manual of Seamanship" from about 1870. It is a brilliant system which uses one rope to do both jobs as well as keeping the yard raised during hoisting and dropping (only at the last part of lowering the sail, you will need to control the yard to avoid the aft end dropping in your boat in an uncontrolled manner). This the method described in this rigging guide.

First fit to the yard a Dyneema rope loop tied around the yard using a prusik knot. The prusik knot will not slide unless you loosen the knot (which is easy to do). The correct position is appr. 40% of the yard length from the front of the yard. The halyard will pass through this rope loop as described further below.



The way to rig the halyard is to pass the end of the halyard that is to be attached to the yard first through the Dyneema rope loop on the yard (from the back to the front) described above. Next pass the end of the halyard between the mast and the hauling part of the halyard and tie it to the end of the front of the yard with a bowline knot. Dyneema easily survives the friction (which is very limited anyway) for many years and it is easy to inspect it for wear and tear. The rope loop being soft, it has the additional advantage that it cannot damage your mast.



In the photo’s you see a stainless steel ring tied to the front of the halyard with some Dyneema rope - the stainless steel ring is easier to work with in challenging (wet and/or cold) conditions when having to attach the halyard to the yard.

Downhaul

A 1:3 downhaul is sufficient for this boat. Anything more than 1:4 is overkill. In the photo below you see a system using a clamcleat CL 253 (trapeze clamcleat) that integrates a block and a cleat in the same unit. Coupled with some 3 small single blocks, this makes for a simple easy adjustable system that is relatively cheap. I use small carabiners on either end for ease of rigging.

Alternatively, you could use a system using a fiddle block with a camcleat.

The downhaul is easily fitted in place by having a carabiner on each end. One end clips in a rope loop fitted next to the mast and the other end in the rope loop attached with a prusik knot around the boom. Rope loops on the boat (and your spars) are cheap, very strong and soft to the body.

When the downhaul is properly tensioned, you should have a crease running from the tack to the peak of the sail (as can clearly be seen in the photo below). This crease will disappear when the wind fills the sail. If you have a crease running from the clew of the sail to the throat, you will need to increase the tension on the downhaul.

A square lashing to keep the boom near the mast is not necessary when using Dyneema in the halyard and downhaul (the boom will not really move away from the mast). Some people like to fit more sail controls like a vang or a bleater allowing one to move the downhaul back a bit on the boom creating a vanghaul (more information can be found on www.storerboatplans.com).

Mainsheet

A 7-8mm diameter sheet works well for the boat. A standard Laser sheet is used on the boat shown in the photos (appr. 14 meters in length).

There are multiple ways of rigging a mainsheet to your Viola 14 canoe. Shown in the photos below are three alternatives.

The standard method (first photo below) uses a fiddle block where the larger lower block is a ratchet block. This fiddle block is however relatively expensive, and it is possible to rig a second bridle on the boat with a single block and use a normal single ratchet block on the aft bridle (second photo).

For cruising a block with camcleat may come in handy if having to paddle sail. If using a block with camcleat, make sure that the camcleat points up so you cannot accidently cleat your mainsheet and it is easy to pull the sheet out of the cleat if so required.

All of these systems use only 3 blocks allowing quick adjustments since you do not have to pay out/take in much sheet, which is in line with this type of boat that requires active sailing. Use a ratchet block to keep the loads manageable.

Option 1: mainsheet, 1 single block with becket attached to the boom with a carabiner, 1 swivelling fiddle ratchet block

Option 2: mainsheet, second bridle, 1 single block with becket attached to the boom with a carabiner, 1 swivel single block, 1 swivelling ratchet block

Option 3: mainsheet, second bridle, 1 single block with becket, 1 swivelling ratchet block, 1 swivel single block with camcleat

The bridle/bridles) is/are easily be rigged using the drain holes in the mid frame, please refer to the photo below and elsewhere in this rigging guide. The advantages of using ropes rather than metal fittings is that they are cheaper and are less prone to damage to do doing damage (they are soft).

The top block of the mainsheet is attached with a carabiner to a rope loop attached with a prusik knot to the boom. Tie the aft end of the main sheet to the boat or put a figure of eight in or both (the knot prevents the boom to go out more than 90 degrees and because the sheet is also tied to the boat, you can easily find it).

Tips:

1. The bottom fiddle mainsheet block shown in the photo has a ratchet bottom sheave and ball bearing top sheave. You can build one of these from 2 separate blocks to save some money: the bottom part of the block would consist of a ratchet block with becket, the top part would consist of a smaller sized single block that is tied/shackled to the becket on the ratchet block. Use some wounds of electrical tape to make for a stiff assembly.

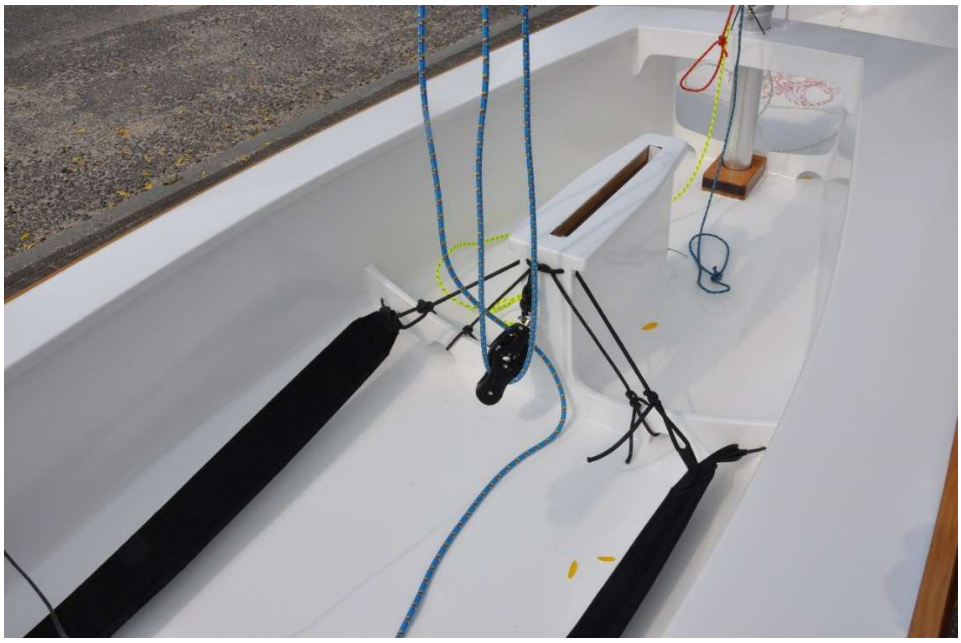
2. The blocks in the photos are ball bearing blocks. One could also use simpler cheaper non-ball bearing blocks of a larger diameter than required for the diameter of the rope to still get

some decent action (i.e. low friction), so for example blocks suitable for 10mm rope using 8mm rope only.

Hiking Straps

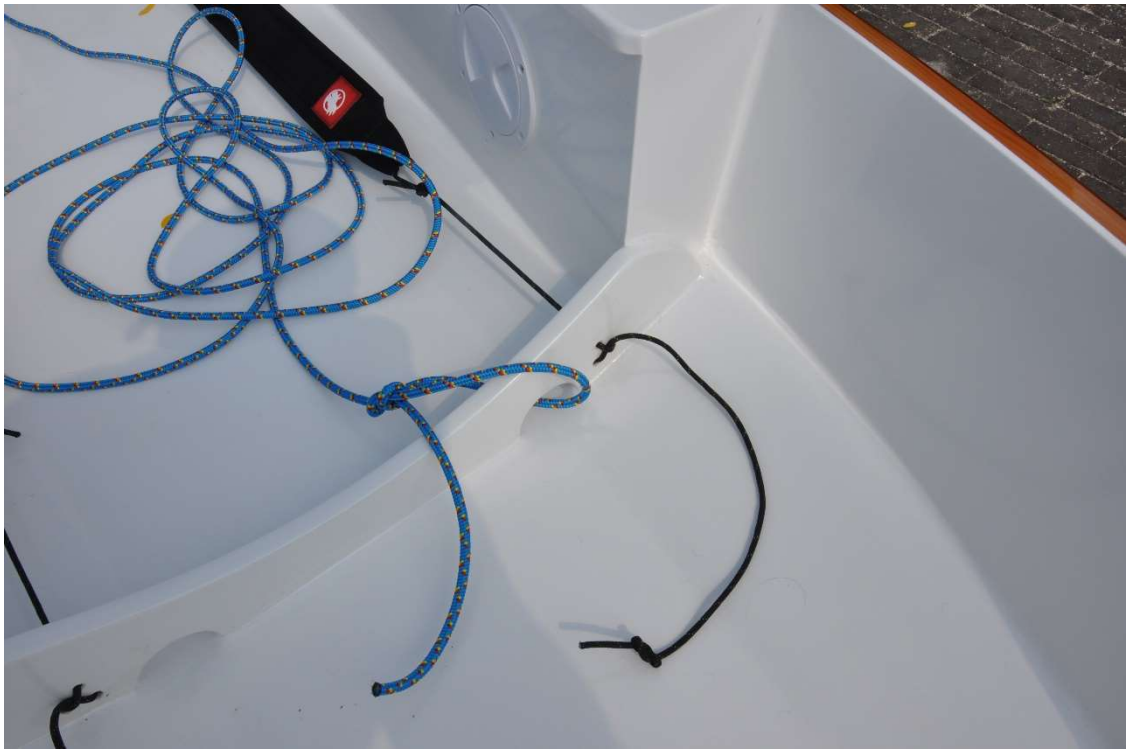
Two hiking straps running along the side buoyancy tank are used rather than one in the centre. Since the boat is so narrow a single hiking strap would not be correctly positioned as to allow a proper hiking position (an exception would be for juniors). You will be sticking your feet under the hiking strap on the opposite side as to where you are sitting.

The front end of the hiking straps are attached to a rope lope fed through 2 holes drilled in the mid frame. Further down there is another more detailed photo.



The front end of the hiking straps are lifted of the sole by 6mm elastic that is fed through 2 holes in the mid frame next to the dagger board case. The elastic also keeps in place the top end of the rope bridle that is knotted to the limber holes in the mid frame. All soft attachment points, cheap and easy.

Three holes are drilled in the aft link frame through which the tails attached to the leaning straps is fed as visible in the below photo. This allows easy adjustment of the leaning straps (much easier, faster and precise in comparison to using saddles and knots bolted to the aft frame and further they are lightweight, strong and soft).

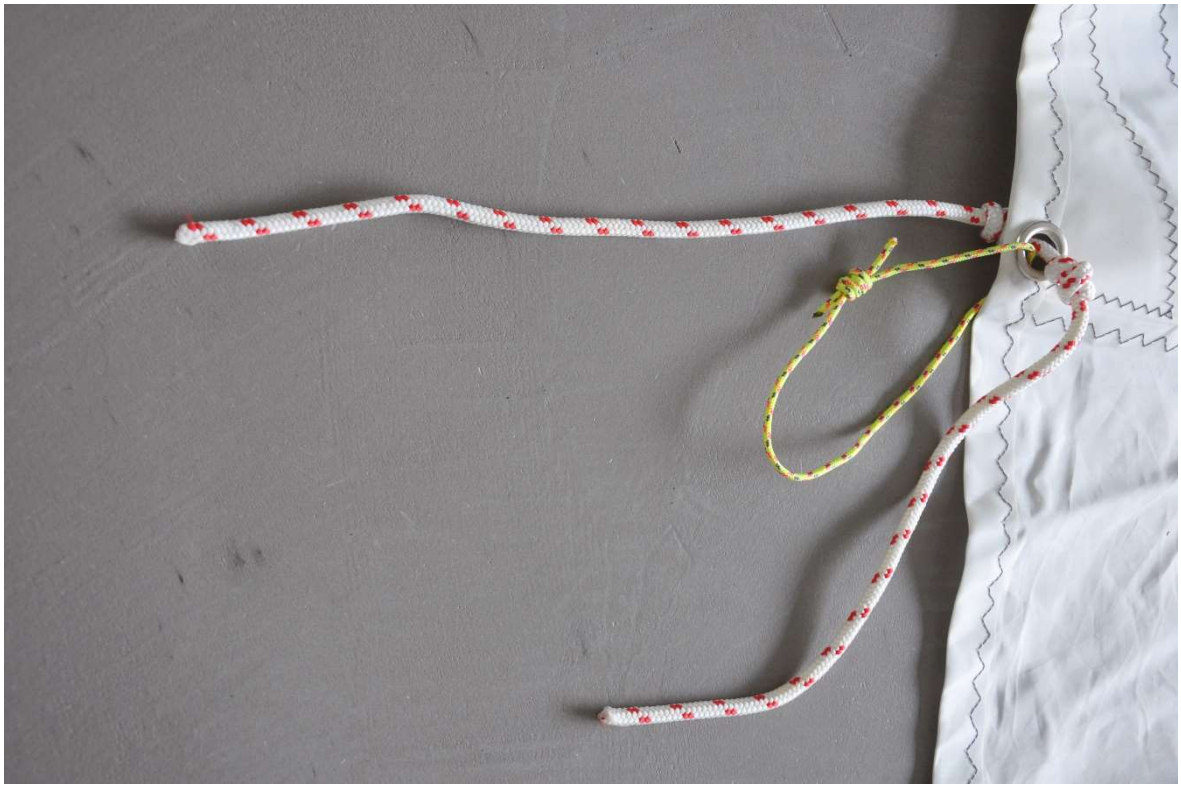


Reefing

With a bit of preparation, tying in a reef can be quick on a lug rig:

- Put in reef ties in all reef ties eyelets and also in the reef clews.
- Tie in a rope loops (the yellow rope in the below photo – reef rope loops) in each reef clew. When the reef tack is clipped into the shackle at the front of the boom, the length of the foot of the sail between reef tack and reef clew + yellow rope loop should be equal to the length of the foot of the full sail.

  This means that when your reef is tied in, that you still have the same control over the sail shape in the lower part of the sail as under full sail.



The reef is tied as follows:

- Drop the sail into the boat and loosen the downhaul.
- Attach the reef clew to the carabiner on the front end of the boom. For your second and third reef, attach both the reef clew of the first reef and that of the second reef to the carabiner since this nicely bundles the sail at the front end of the boom.
- Clip the carabiner in the outhaul system to the reef rope loop. If you are tying in the second or third reef, clip also the clew and the reef rope loops of the first and/or second reef in the carabiner. This bundles the sail nicely at the aft end of the boom.
- Tie in the reef ties going around the sail only (with a loose footed sail, there would be a lot of tension on the reef ties if they go around the boom and they might tear. Also this would make it difficult to control the draft in the sail using the outhaul.
- Slide up the prusik rope loop on the yard a bit with every reef. This prevents the boom from dropping since the yard is tilted more forward. Obviously you will need to slide it down again when taking out the reef(s).

- Hoist the sail again and tighten the downhaul.

Rudder

The rudder downhaul is necessary to keep the foil down. The uphaul is optional; not really necessary when just using the boat for sailing since the foil will float up nicely (after all it is all timber with some glass!), but necessary for when using the boat for cruising and having to paddle (when paddling hard the rudder will start to steer the boat which is annoying).

Insert the rudder blade in the rudder stock so that the holes in the rudder stock and the hole in the foil taking the bolt line up. Insert the bolt and put the nuts on. Use big washers on the outside of the bolt to distribute the forces over a larger surface.

Do not overtighten the nuts on the bolt, just tighten them up by hand. If using 2 nuts on each end, one can tighten these against each other using spanners and this will avoid them coming loose. Use cap nuts on the outside to avoid having any sharp bits.

The downhaul ends up in a clam cleat. One could use an auto release clam cleat if afraid for hitting something with the rudder unexpectedly (SD-002570 Auto-Release Cleat). The rudder is not very deep though, but make your choice in accordance with your specific needs.

In the photos the downhaul consists of a 3mm rope with Dyneema core pre-lead line and a regular polyester 4mm control line that stretches. Due to the stretch in the downhaul control line it is easier to tension the downhaul and to get it out of the cleat again.

To obtain the correct position for the hole in the rudder for the downhaul attachment, rotate the board in the cassette until the leading edge of the rudder passes the aft bottom corner of the rudder cassette. Mark this place and drill the hole just below this mark to ensure that the downhaul attachment point will clear the rudder cassette when the rudder rotates in its case. Obviously you will need to drill the hole 20mm or so from the leading edge.

It would be wise making an epoxy bushing for the downhaul attachment hole which is very simple to make as follows: (i) drill the hole oversize first, (ii) fill the hole with epoxy glue using packaging tape on the other side and (iii) only then (when the glue has hardened) drill the final 4mm hole necessary for the 3mm pre-lead line. This avoids any potential water ingress.

The rudder uphaul is a very simple affair on the Viola 14 canoe. A hole is drilled in the rudder head aft of the centreline of the foil and a rope is attached to this hole by a simple knot on the opposite side of the where the clam cleat for the uphaul is located (please refer to the first photo on the rudder and its controls above for the exact location of the hole in the rudder head). Obviously the same comments apply in respect of making an epoxy bushing for the uphaul attachment hole.

The rudder uphaul runs directly to the clam cleat. Very simple and it works great.

A 900mm long tiller extension is suggested mounted right at the front of the tiller.

Dagger board

The dagger board can tilt back in the dagger board case some to accommodate different rigs having different centres of efforts. To take up the play between the foil and the case, use Jap tape, carpet, felt strips etc. inside the dagger board case at the top and bottom. If the fit is just tight enough, the friction will keep the board in the desired position whilst being able to slide the foil up and down.

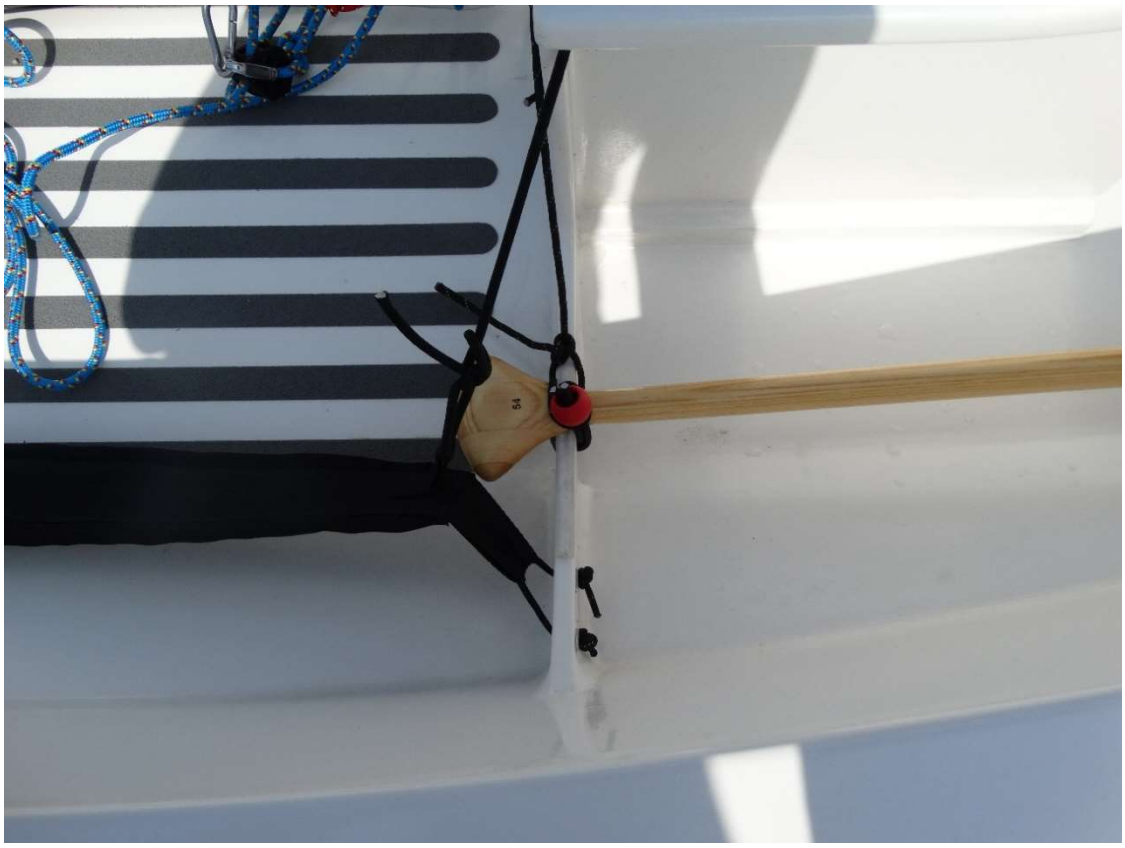
Alternatively, some elastic can be used to keep the dagger board in the correct position. The above photo shows an elastic loop going around the front of the dagger board case, then in between the elastic at the back of the dagger boar case which is lifting the leaning straps of the cockpit sole and keeping the mainsheet attachment point at the back of the case (please refer to the next photo), and finally going around the leading edge of the foil to keep the dagger board vertical against the back of the case.

A piece of plastic tube reduces friction when pulling the foil up or pushing it down.

If the dagger board is to be tilted back (like on the large fathead sail), an elastic between the handle on the dagger board and the mast will keep the foil in position.

The plastic hook allows for quick (de)rigging.

Paddling



A paddle/paddles is/are easily secured to the boat using 2 elastic loops and the limber holes in the front frame and the mid frame of the boat. Again rope stoppers are used on the elastic loops that thus quickly fasten around the limber holes and the paddle. To avoid losing them when not fastened up, the elastic loops can be kept in place on the limber holes using some Velcro.

Carried like this, the paddle is stored out of the way of the helmsman and within easy reach.

For longer distances, when cruising, a kayak style double bladed paddle is more convenient. You will need a very long one (270-280 cm long one) to clear the gunwales since the boat is relatively wide. Buy/make one with a ferule in the middle so that the paddle breaks in half for easy storage in the boat. Further you will need a raised seat as to get the paddle over the gunwales.

The seat you see in the photos has a back that folds away allowing for easy storage and was specially designed for the Viola 14 canoe (plans available on www.duckworksbbs.com). It also doubles as a comfortable seat when making camp.

Useful for paddle sailing is a thwart spanning the width of the boat (essentially a simple plank) held in place with a piece of bungee cord. The edges on the underside of the one in the photos have bevelled as to shed some weight and to give it a lighter appearance. 4 wooden dowels glued and screwed in place keep the seat in the right position and prevent it from sliding aft. These dowels have been spaced such that the seat rests on the top of the

stringers inside the buoyancy tanks and not the cleat capping the plywood side deck edges on the outside of the tanks. This thwart is also very useful when sailing in moderate conditions as it allows you to sit centred in the boat. A bungee pulling the seat aft keeps it neatly in place and secures it to the boat in case of a capsize.

Bottle Holder

A bottle holder is easily created with some elastic band around the dagger board case.

Useful links

www.storerboatplans.com – here you can find links where to purchase the Viola 14 canoe plans as well as much other useful information about building, rigging, maintaining, sailing, transporting and storing the canoe.

www.duckworksbbs.com – here you can buy the plans for the Viola 14 canoe as well as sails, epoxy, gear, hardware, etc. Plans for the kayak style seat you see in the photos can also be purchased from Duckworks. Lastly you can find the free paddle plans here from Michael Storer (the plans show a 240cm long paddle, but this is easily extended to 270-280cm).

https://reallysimplesails.com – here you can purchase the Really Simple Sails (RSS) lug sails and fathead sails for your Viola 14 canoe and other boats.

www.facebook.com – you will find the Storer Boat Plans group on Facebook with lots of information regarding the boat (including many photos of the build the boat underway).