INSTALLATION GUIDE

HYDROVANE
STEERING THE DREAM

HYDROVANE INTERNATIONAL MARINE
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HYDROVANE INSTALLATION GUIDE

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We are so pleased that Hydrovane will be part of your sailing adventure.

Should you have any questions during the installation, do not hesitate to ask.

A 3 Part Series of INSTALLATION VIDEOS are found on our website: www.hydrovane.com/instructions.

CONTENTS

A. CONSIDERATIONS AND PREPARATIONS

Installation Checklist

- [ ] Mounting Pads (not necessary for perfectly flat mounting surfaces)
- [ ] Backing Plates
- [ ] Mounting Bolts
- [ ] Sealant (Sikaflex 291, 3M 5200, or equivalent)
- [ ] 2" (50.8 mm) outer diameter PVC Tube (not required, but helpful if available)
- [ ] Tools:
    - 17mm Socket Wrench
    - 19mm Socket Wrench – for A Bracket
    - Sander and/or Grinder – for shaping Mounting Pads
    - Electric Drill – for drilling holes
    - Fine toothed hacksaw – for cutting E and A Stay Tube Struts to length.

Installation Materials

MOUNTING PADS

Warning: Please bear in mind that it is critical the Brackets cannot 'work' – THEY MUST BE ABSOLUTELY RIGID. Therefore, properly shaping the inside of the Mounting Pads, if needed, is an important step, and many admit it is the most time-consuming part of the installation.

Warning: The Hydrovane Bracket Flanges must be flush with the contact surface, or the aluminum castings will fracture.

Tip: Templates for Pad outer shape are found at hydrovane.com/specifications

Mounting Pads are pieces of teak or suitable synthetic that are very hard but can be shaped to pick up the contour differences between the transom and the flat inside faces of the Bracket Flanges. Even if the fiberglass transom appears to be flat at that point it is wise to make a Mounting Pad to be sure the load is equally distributed. That being said, true flat areas on the transom will not required a Mounting Pad.

Ready-to-shape Mounting Pads can be ordered from Hydrovane, or custom fabricated.

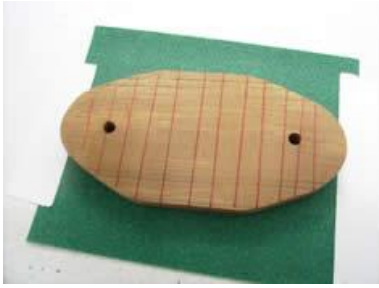
Suggestions on Mounting Pad material:

- The Teak Mounting Pads we offer are made of Oroko teak. it looks good and easy to work with. We also offer Spacer Pads (sold with unfinished edges) if needed for the H Bracket.
- The Plastic Mounting Pads we offer are made of HDPE (high-density polyethylene) – easy to work with, light, and long lasting. H Spacer Pads are also available if needed.
- UHMWPE (has lots of brand names… for example, Starboard)
- Phenolic plastic or Tufnol – looks like wood, but very expensive.
- Delrin/Acetol

Pad Thickness: Our old recommendation for a maximum thickness was 4" or 10 cm, but that can be increased somewhat if the much harder phenolic plastics are used. The challenge is to find bolts of sufficient length. For greater distances/thicknesses a stainless steel extension must be fabricated. This will have been discussed with out technical team.



CONTOURING THE TEAK FOR CURVED SURFACES – Provided by Folkes 39 owner: *"I taped a sheet of 3M 'Sandblaster' 60 grit (this paper cuts amazingly fast and doesn't load up) to my curved deck and transom where the pads would be mounted. I then drew indicating lines on each teak pad then began to "Holystone" in reverse! I would check the indicating lines to adjust the cutting evenly and to know when I was finished."*



BACKING PLATES

Warning: Washers alone are absolutely not enough support. The use of substantial Backing Plates is applicable to every installation.

Warning: Bolt nuts or heads must be flush to Backing Plates. If there are substantial gaps between the Backing Plates and the hull, they must be filled. Mix a suitable quantity of thickened epoxy and put it into a plastic pouch – fitted between the plate and hull. Tighten bolts and before the epoxy or resin hardens, cut or mould the material to the desired shape by carving away any surplus.

Backing Plates can be made of any substantial marine material: 316 stainless steel, aluminum plate, or any of the hard plastics that are listed above.

The Backing Plate Kit we offer includes one 8mm thick aluminum plate and two M10 x 150mm Bolt Sets, fully threaded.

If there are obstructions on the inside of the hull (for example, the chainplate), two separate Backing Plates could be used.

Backing Plate Examples

TRANSOM MOUNTING BOLTS

Unless Backing Plate Kits are ordered from us, you will need to source your own Mounting Bolts. The length required depends on the thickness of your Mounting Pads, thickness of the transom, and the Backing Plate. Use metric M10 or non-metric 3/8" bolts. If you have a choice. the metric M10 is stronger and preferred. The bolts must be marine grade – made of 316 or A4 stainless steel.

The Backing Plate Kit we offer includes one 8mm thick aluminum plate and two M10 x 150mm Bolt Sets, fully threaded.

Tip: If a particularly long bolt is required, but not available, one can be fashioned from threaded rod, using nyloc nuts on both ends and cutting off the excess. Such threaded rod is inferior to a proper bolt but considered adequate.

SEALANT

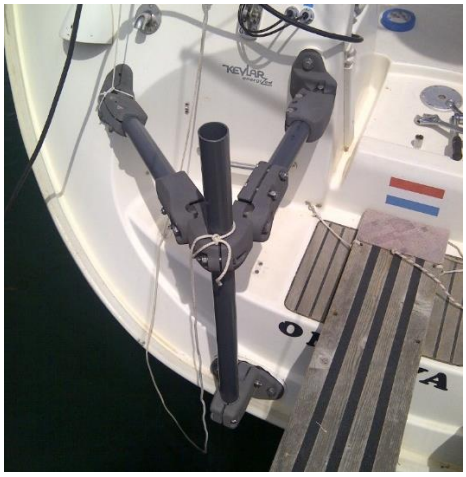
On the outside on the hull, where the fit should be flush, any marine exterior sealant/adhesive such as Sikaflex 291 to 3M 4200/5200 or an equivalent product is fine. The purpose is to make it watertight.

Sealant should also be used to coat Mounting Bolts as well as between the Backing Plate and the inside of the transom.

2'' OD PVC TUBING

Warning: DO NOT attempt to tighten any casting on a tube smaller than 2" (50.8mm), or a flexible tube. This will crack the casting. 50mm OD plastic tube is not suitable.

Not required, but useful if 2" (50.8mm) outer diameter (OD) tube is available in your area. The purpose is to use the plastic tubes as lightweight dummies for positioning and determining strut lengths. The Shaft Assembly Tube and Bracket Stay Tube Struts are sized as 'imperial' (non-metric) 2**"** outside diameter (OD). The actual Shaft Assembly is heavy to be playing around with. In North America there is a 2**"** OD plastic tube that is cheap and usually available at large hardware stores.



PVC Tube Examples

Installation Warnings

'OVER ENGINEER' TO MAKE A ROCK-SOLID INSTALLATION

Warning: The loads on the Hydrovane Brackets will be enormous at critical times. The weakest link need not be the Mounting Pads, Backing Plates, or Mounting Bolts – but that is what happens with poor installations. Use materials that are good quality and plenty strong.

BE AWARE OF THREAD GALLING

Warning: Thread galling occurs when pressure and friction cause bolt threads to seize to the threads of a nut or tapped hole. Heat caused by tightening too quickly or too hard is usually the trigger. Once

seized, the only solution is to cut the bolt or snap the bolt by adding extreme force to the wrench. This problem is exacerbated by bits of stray stainless steel or other grit.

To help prevent galling, you will notice on your new unit that all the M10 and M12 bolts are supplied with lithium grease, as well as TEST NUTS to use at the positioning stage. Be sure to use the stainless steel nyloc nuts when you do the final bolt tighten.

Tip: Follow best practices to help prevent galling of all stainless steel bolts and nyloc nuts:

1. Always clean the thread of any residual bits – wire brush, wipe or blow.
2. Do not use WD40 on the bolt – WD40 encourages galling.
3. If there are any burrs left from manufacturing, clip them off and file smooth the rough edge.
4. Use a lubricant before tightening. The suggested lubricants should contain substantial amounts of molybdenum disulfide (moly), graphite, mica, or talc. We use a 'high pressure bearing grease' – Morris K43EP Lithium Multipurpose Grease (KEP).
5. We recommend using non-stainless steel TEST NUTS (plain steel, plastic etc.) during positioning as 'dummies' and only use the stainless nuts for the final assembly.
6. Never use an electric drill to tighten bolts or nuts – the speed and pressure causes heat which makes matters worse. You must tighten by hand.
7. If for some reason you intend to remove the Hydrovane from the boat on a regular basis, consider replacing the stainless steel nyloc nuts with bronze (or NAB – Nickel, Aluminum, Bronze) and locking washers – to eliminate the potential for galling. We have bronze bolts available for such situations – please ask.

DO NOT OVER-TORQUE BOLTS

Warning: Please be very careful not to over-torque any of the bolts. The result would be a cracked casting. If you have a torque wrench, please refer to the recommended torque settings within. Tighten bolts to your usual snug tightness with a socket wrench. Please be very conscious not to crank too hard.

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ADDRESS TRANSOM FLEX

Warning: Generally not necessary for offshore capable boats. However, if there is any transom flex or potential for flex under load, the likelihood for failure is high, especially in the worst of conditions. Beef up the section of the transom with more fiberglass or use large, single piece, heavy gauge metal Backing Plate.

INSTALLATION 'IN THE WATER' OR 'ON THE HARD'?

Both options are fine. Our preference is for the 'in the water' installation, primarily because it provides certainty as to where the waterline is.

Warning: If done in the water, keep lines on everything – the pieces are slippery, heavy, and valuable. Use strong tape and good knots.
Tip: Rig a tarp under the aft end of the boat… just in case!

Receiving Your Hydrovane

A new Hydrovane is shipped in 4 or 5 Boxes, each segment fully assembled:

Box Number	Contents
1	Drive Unit, Tiller/Fork Arm Assembly, lead Counterweights, H Bracket
2	Rudder and Standard Vane Assembly
3	Shaft Assembly
4	Second Bracket: A, E, or H
(5)	Stubby Vane or XT' Extendable' Vane

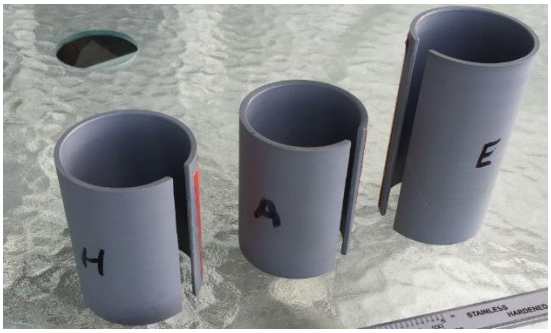
Warning: Tiller/Fork Arm Assembly and Counterweights are under separate flaps. Be sure not to throw these out with the box! Look for them carefully… they will be there.

- CHECK FOR DAMAGE – If there are any signs of damage from shipping, notify us immediately and send photos. UPS, our preferred shipper, will only process claims within 10 days of delivery.

- CHECK THAT THE SHAFT SPINS FREELY – Holding the Shaft Assembly in the air by the outer Tube, spin the Shaft inside. It should rotate freely. Once the Shaft Assembly is installed, you will do this test again to ensure the Shaft is not binding. Check that the black Shaft Top Bearing and white Shaft Bottom

Bearing are flush with the stainless tube. Check that stainless steel Bottom Collar is not touching the Shaft Bottom Bearing.

Warning: Shaft Bearings can be knocked out of place during shipping. Tap or bang each end of the Shaft on a hard floor to push Top and Bottom Bearings back in place (friction fit). The stainless steel Bottom Collar #26 might also need re-setting. Ensure a space between the top of the Bottom Collar and the Bottom Bearing of at least business card size.



- SHAFT SLEEVES – Take note of the Shaft Sleeves (grey plastic) that are included with both Brackets, where the Shaft Assembly slides in. These are common to lose overboard during the installation, so we recommend taping them to the Bracket. The Shaft Sleeves are machined to specific widths and are NOT interchangeable.

  Warning: Tightening Brackets onto the Shaft Assembly with an incorrect Shaft Sleeve will result in cracked castings. Be mindful not to mix them up.

Planning Your Installation

Warning: In planning the installation, pay attention to nearby aerial obstructions, as well as the recommended maximum and minimum distances for Bracket Clamps on the Shaft Assembly.

- We will have helped determine the correct Shaft Assembly length and Bracket configuration for your boat. You will probably have a good idea of where and how you want to mount the unit.
- AERIAL OBSTRUCTIONS – Too often and too late certain aerial obstructions like a new arch, solar panels, or radar pole are discovered. Review vane clearance at www.hydrovane.com/specifications.
- FLEXIBILITY IN PLACEMENT – As the Brackets do not require critical positioning, you may move the placement higher or lower subject to the little surprises found on the inside of the transom and the following maximums and minimums:

- SHAFT VERTICAL – The object is to install the Shaft Assembly in a vertical position, somewhere on the transom. To establish what is vertical, start with a measuring tape on the transom's mid point at the top to the point at the bottom (if there is one). For eyeballing, compare to the mast (or better yet, the keel, if on the hard).
- BOTTOM OF THE SHAFT SITS ABOVE THE WATER –The Shaft is intended to sit with its bottom tip 1" (2.5 cm) above the water… for the practical reason: to avoid growth. That position is very suitable for normal operation. If, for other reasons, it is desirable to lower or raise the Shaft, that is fine.
- UPPER BRACKET – Preferably the upper Bracket is close to the Drive Unit. The higher, the better, but you **must leave at least 7" (18 cm) of Shaft Assembly for the Drive Unit to slide over**. The upper Bracket should be, preferably, no lower than 18in (46 cm) from the Drive Unit. This maximum has been stretched without consequence, but the concern is the amount of unsupported weight and structure.
- LOWER BRACKET – The lower bracket should clamp on to the Shaft Assembly at somewhere between 10 in (25 cm) and 20 in (50 cm) above the waterline. Ideally the lower Bracket is as low as possible but not too close to the Shaft Bottom Bearing tol cause binding – prefer a minimum of 2" (5 cm) of stainless visible below the clamp. If need be, the Bracket can clamp a bit lower on the Shaft Tube, but ensure the Shaft can spin freely and the Shaft Bottom Bearing is not crimped.

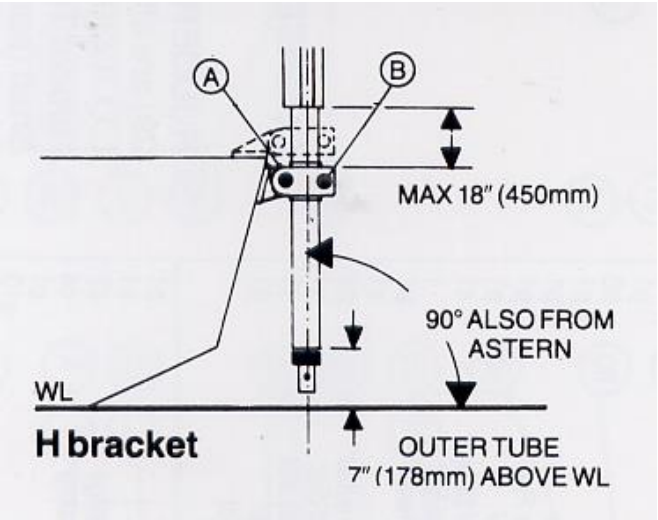
B. FITTING THE BRACKETS AND SHAFT

Always install the H (Hinged) Bracket first. Your second Bracket will be another H, an E, or an A.

First Bracket: Hinged 'H' Bracket

Every installation will have at least one H bracket.

For some installations extra consideration may need to be made as to which way around it should be mounted – hinging up (more common) or hinging down (allows more space between the H Shaft Clamp and the bottom of the Shaft).



Bolt Tightening Sequence: A – B

H Bracket lower position with plastic Pad

1. Mark out the centerline of the transom or a line parallel to the centerline for off center installation.
2. Hold the H Bracket on the transom and use a dummy PVC tube to find correct positioning where the shaft will be vertical side to side (fore and aft is not an issue at this point as the H Bracket is hinged).
    - Traditional: if the transom is vertical or slopes forward from the deck, the H Bracket is fitted close to the deck line or on the deck.
    - Reverse and sugar scoop/platform: if the transom slopes aft from the deck, the H Bracket is fitted as low as possible on the transom or on the counter underneath, but within the limits as explained in 'Planning Your Installation'.
3. DRILL HOLES – Use the Bracket Flange as a template to mark the position of the two 3/8" or 10 mm clearance holes for the Mounting Bolts.
4. MOUNTING PAD – If required, have ready the Mounting Pad (and Spacer Pads, if required) for between the Bracket Flange and the hull. See 'Mounting Pad' in Section A.
5. BACKING PLATE – Ensure use of a Backing Plate. See 'Backing Plate' in Section A.
6. CHECK POSITIONING – Before tightening the Mounting Bolts, fit the Shaft Assembly into the Bracket with bolts (A) and (B) tightened only sufficiently to hold the Shaft Assembly vertical to ensure the correct location of the Bracket Flange. Also be sure to check positioning of the grey Shaft Sleeve between the casting and the Shaft Tube.

7. BOLT FLANGE TO TRANSOM – Bolt the H Bracket securely on its Mounting Pad to the hull using a sealing compound and Mounting Bolts, and a Backing Plate on the inside.
8. SHAFT CLAMP BOLTS – You may choose to fit the real Shaft Assembly at this point. Or, you may continue to use a PVC dummy shaft for positioning the second Bracket.

   Follow the BOLT TIGHTENING SEQUENCE as shown in drawing above.

   - Support the unit so that bolt B may be slackened off and the forward bolt A tightened first. Finally, tighten bolt B.

   Bracket bolts should be tightened snugly. If using a torque wrench, 30 LBT.FT (40.67 N m) is sufficient for all M10 Bracket bolt sets.

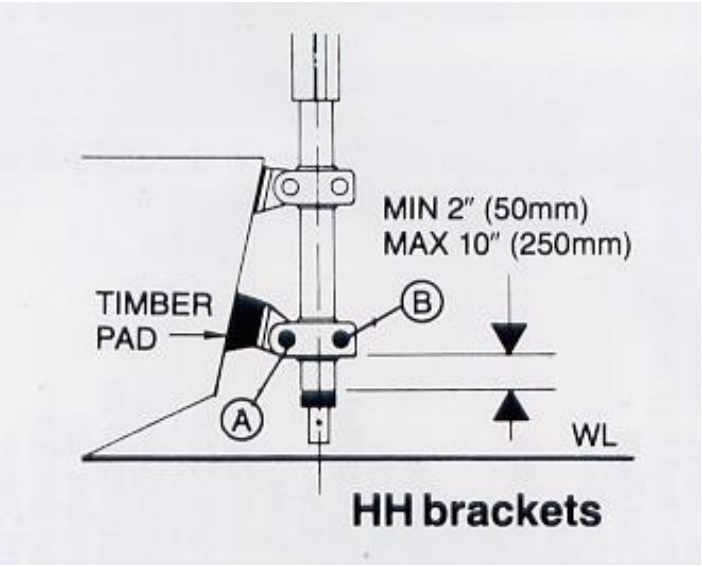
   Warning: Tighten bolts to your usual snug tightness with a socket wrench. Please be very conscious not to crank too hard as the result can be a cracked casting.

   Warning: The most common mistake, typically made by skilled tradesmen that do not look at these instructions, is to not properly tighten the bolts that clamp the castings on the Tube. Be sure to follow the Bolt Tightening Sequence!
9. When the H Bracket installation is complete, recheck the tightness of all bolts.

Second Bracket: Hinged 'H' Bracket

On H/H installations the second H bracket is fitted as detailed above to give maximum Bracket spacing within the limits shown.

If the transom is slightly raked, the second H Bracket will require a thicker Mounting Pad to keep the Shaft Assembly vertical. When the installation is complete, recheck the tightness of all bolts.



Bolt Tightening Sequence: A – B

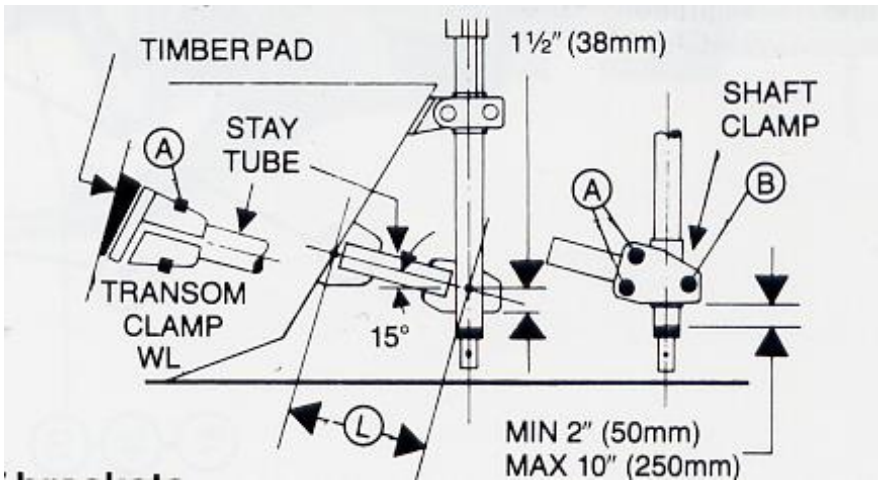
Second Bracket: Single Strut 'E' Bracket

The E Bracket is the only bracket without a hinge, meaning the angles are fixed and MUST be accommodated by using a Mounting Pad to accommodate the contour of the hull AND the difference in angles.

- FIXED ANGLES – Each of the castings at either end of the Stay Tube Strut hold the tube at an angle of 15˚. The result, depending on the direction the castings are positioned, it to create aggregate angles of either 30˚ (15˚ + 15˚) or 0˚ (15˚ – 15˚).

The E Flange should always be mounted horizontally on the transom for maximum lateral support.

Warning: The Bracket must be well aligned. Misaligning the castings and strut cannot be solved by cranking into place when bolting together. The Bracket must fit perfectly before bolt tightening. If bolted in place in other than its natural position (ie, forced into place) then there will be constant stress on the casting(s) which inevitably ends in a 'stress fracture' – a broken casting. The aluminum metal used can tolerate considerable flex for short periods and withstand enormous working loads BUT it cannot handle constant stress.



Bolt Tightening Sequence: all A's – then B

E bracket in lower position

E bracket in upper position

1. FLANGE FLAT ON TRANSOM – With the Shaft Clamp at your desired orientation, flip the Transom Flange so that it most closely matches the slope of the transom. Any remaining angle difference should be filled by a shaped Mounting Pad. On the interior of the hull, a similar Pad or epoxy filler may be needed to ensure the nuts and bolt head sit flush against the Backing Plate.
2. CONFIRM POSITION – FAR FROM THE 'H' – Try to maximize the distance from the 'H' Bracket … but:
    - CLEAR OF SHAFT BOTTOM BEARING – If it is the lower bracket, keep clear of the Shaft Bottom Bearing - recommend 2" (5 cm) of stainless steel Tube showing above the bearing.
    - LEAVE ROOM FOR DRIVE UNIT – If it is the upper bracket, leave 7" (18 cm) of Shaft Assembly for the Drive Unit to sit on.

3. DRILL HOLES – Use the Bracket Flange as a template to mark the position of the two 3/8" or 10 mm clearance holes for the Mounting Bolts.
4. MOUNTING PAD – Have ready the Mounting Pad for between the Bracket Flange and the hull. See 'Mounting Pad' in Section A.
5. BACKING PLATE – Ensure use of a Backing Plate. See 'Backing Plate' in Section A.
6. ESTIMATE AND CUT TUBE – Establish distance 'L' from the transom to the Shaft Assembly.
    - The Strut length: L less 2" (5 cm), less an allowance for the thickness of a Mounting Pad.
    - The stainless steel E Stay Tube Strut is provided at a length of 18" (46 cm) – never longer. Once appropriate length for your installation is determined, cut the stainless tube with fine toothed hacksaw.

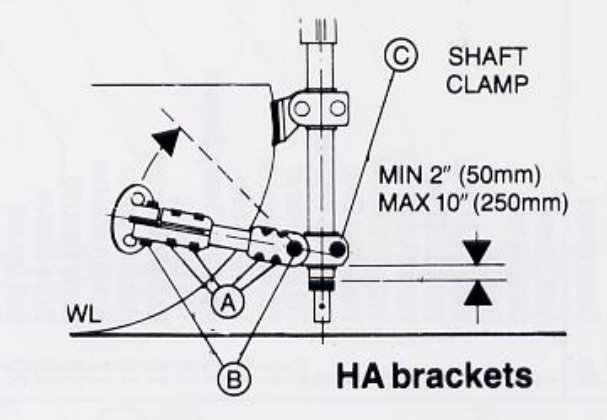
    Tip: First use PVC tube to play around with estimated E Stay Tube Strut length.
7. BOLT FLANGE TO TRANSOM – Bolt the E Bracket Flange on its Mounting Pad securely to the hull with the Backing Plate inside.
8. ASSEMBLE THE END FITTINGS ONTO THE STRUT (STAY TUBE) AND BOLT
    - SHAFT CLAMP: Assemble the Shaft Clamp around the Stay Tube Strut and the Shaft Tube. As this point, you will be using the real Shaft Assembly. Ensure that the plastic Shaft Sleeve is in place (best if taped to the clamp). Tighten the bolts only sufficiently to hold the Shaft Clamp in its planned position. The E Stay Tube should be touching the plastic Shaft Sleeve.
    - TRANSOM CLAMP: Assemble the Transom Clamp around the E Stay Tube Strut with the Strut fully inserted into the clamp.
    - Bracket bolts should be tightened snugly. If using a torque wrench, 30 LBT.FT (40.67 N m) is sufficient for all M10 Bracket bolt sets.
    - Warning: Tighten bolts to your usual snug tightness with a socket wrench. Please be very conscious not to crank too hard as the result can be a cracked casting.
    - WARNING: Follow the Bolt Tightening Sequence!
    - TIGHTEN BOLTS ACCORDING TO BOLT TIGHTENING SEQUENCE, shown in drawing above: All 4 (2 on each) A bolts must be tightened first. Check that the tightening is even – the gaps in the castings should be even. Only when all A bolts are tightened should the B bolt then be tightened.
9. When the E bracket installation is complete, recheck the tightness of all bolts.

Second Bracket: Double Strut 'A' Bracket

The A Bracket is our biggest, strongest, and most versatile bracket. The A Bracket solves most difficult installation issues thanks to:

- Its flexibility:
  - Arms swing up or down vertically
  - Arms open in or out from 40 to 80 degrees separation (Brackets 2013 or older have arms fixed at 40 degrees)
  - Transom Flanges fully rotate to become flush with any surface.
  - A Stay Tube Struts can be cut to any length.
- Strength - Engineers love triangles

Warning: The Bracket must be well aligned. Misaligning the castings and struts cannot be solved by cranking into place when bolting together. The Bracket must fit perfectly before bolt tightening. If bolted in place in other than its natural position (ie, forced into place) then there will be constant stress on the casting(s) which inevitably ends in a 'stress fracture' – a broken casting. The aluminum metal used can tolerate considerable flex for short periods and withstand enormous working loads BUT it cannot handle constant stress.



Bolt Tightening Sequence: A – B – C

1. Fix the real or dummy Shaft Tube into the H Bracket – so shaft is in place.
2. Slide the A Shaft Clamp casting onto the Shaft Assembly

- If necessary, use the 'Opener' – If the Shaft Clamp does not slide easily over the Shaft Assembly, remove bolt C and screw it into the adjacent threaded hole – see more discussion about the OPENER in the section on assembly of the Drive Unit. Note there are total of 5 of such 'Opener' holes on the A Bracket - each to open the casting to get it onto the Shaft Tube or Strut Tubes.

  Warning: Be careful with the Opener – excessive force can crack the casting. Open one quarter turn at a time only.

3. DETERMINE POSITION – FAR FROM THE 'H' – Try to maximize the distance from the H Bracket … but:
   - CLEAR OF SHAFT BOTTOM BEARING – If it is the lower bracket, keep clear of the Shaft Bottom Bearing– recommend 2" (5 cm) of stainless showing above the bearing.
   - LEAVE ROOM FOR DRIVE UNIT – If it is the upper bracket, leave 7" (18 cm) of shaft for the Drive Unit to sit on.
   - FOR VERY LONG SHAFT ASSEMBLY – If the Drive Unit will be particularly high, the bracket should clamp onto the Shaft Assembly within 25" (65 cm) of the top but preferably closer if possible.
4. TIGHTEN ONTO SHAFT – Tighten bolt C lightly to hold it temporarily in place.
5. ESTMATE STAY TUBE STRUT LENGTHS BASED ON WHERE YOU WISH TO POSITION FLANGES – Estimate the required length of the struts, taking the Mounting Pad thickness into account.
   - Note that each of the 4 castings that fit onto the Stay Tubes has a threaded hole for use as an 'Opener', if needed. Remember – a quarter turn at a time.

   Tip: First use PVC tube to play around with A Stay Tube Strut position and lengths.

   IDEA! If you have an upper A Bracket and can configure it with both Struts horizontal, then it's possible to construct a little platform to rest on top. Great for cleaning fish.
6. CUT TUBE LENGTH – Cut stainless steel A Stay Tubes to the estimated length using a fine-toothed hacksaw and assemble the complete bracket by bolting it lightly together.
7. POSITION ARMS – Swing the two arms up and rotate the Mounting Flanges to lay flush with the hull.
8. DRILL HOLES – Using the A Bracket Flanges as templates, drill the 3/8" or 10mm clearance holes through the hull.
9. MOUNTING PADS – If required, have ready the Mounting Pads for between the Bracket Flanges and the hull. See 'Mounting Pad' in Section A.

10. BACKING PLATE – Ensure use of Backing Plates. See 'Backing Plate' in Section A.
11. CHECK ALIGNMENT – Check the overall alignment and location of the A Bracket and the overall position of the unit.
12. ASSEMBLE THE END FITTINGS ONTO THE STAY TUBE STRUTS AND BOLT
    - SHAFT CLAMP: Assemble the Shaft Clamp around the Shaft Assembly and Tube Clamps. As this point, you will be using the real Shaft Assembly. Be sure that the plastic Shaft Sleeve is in place. Tighten the bolts only sufficiently to hold the Shaft Clamp in its planned position on the Shaft Tube. The A Stay Tubes should be touching the plastic Shaft Sleeve inside.
    - TRANSOM CLAMP: Assemble the Transom Clamps around the A Stay Tube Struts with the struts fully into the Clamp.
    - Bracket bolts should be tightened snugly. If using a torque wrench, 30 LBT.FT (40.67 N m) is sufficient for all M10 bolt sets. The maximum recommended torque for the two M12 bolt sets on the A Bracket Shaft Clamp is 35 LBT.FT (47.45 N m).
    - Warning: Tighten bolts to your usual snug tightness with a socket wrench. Please be very conscious not to crank too hard as the result can be a cracked casting.
    - WARNING: Follow the Bolt Tightening Sequence!
    - TIGHTEN BOLTS ACCORDING TO BOLT TIGHTENING SEQUENCE, shown in drawing above: All 4 (2 on each) A bolts must be tightened first. Check that the tightening is even – the gaps in the castings are even. Only when all A bolts are tightened should the B bolt then be tightened.
13. BOLT FLANGE TO TRANSOM – Bolt the A Bracket Flanges on their Mounting Pads (if required) securely to the hull with the Backing Plate inside.
14. When the A Bracket installation is complete, recheck the tightness of all bolts.

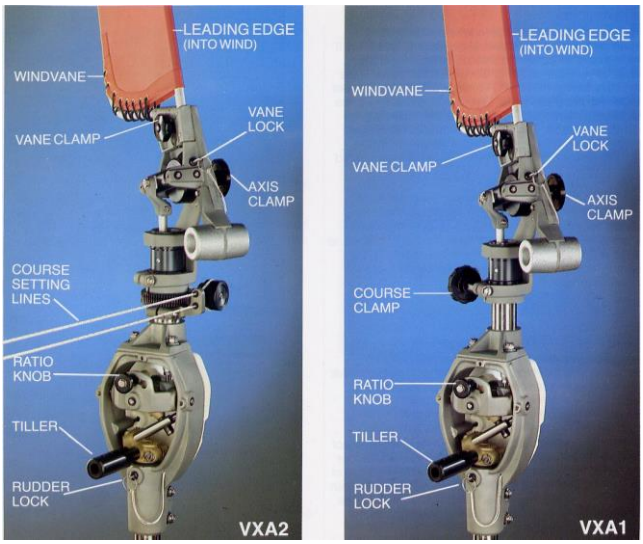
Shaft Assembly Check

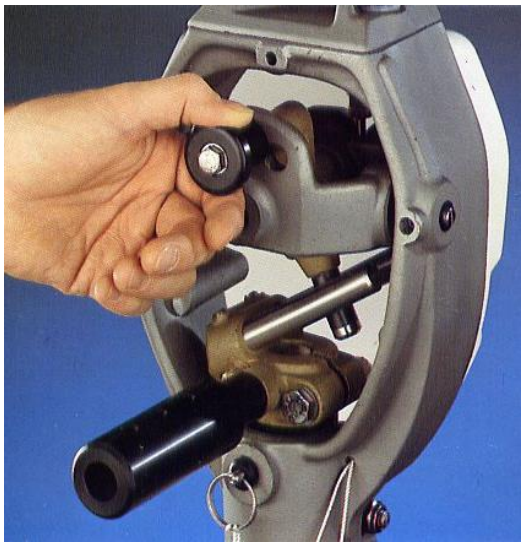
The Shaft Assembly should be bolted firmly in place prior to attaching the Drive Unit.

The top of the Shaft is machined to 1". Once installed, spin the Shaft within the outer Shaft Tube; it must spin around easily and freely. If it is binding, check that the white Shaft Bottom Bearing is not being crimped by the lower bracket Shaft Clamp. If it is, you will need to lower the Shaft Assembly.

Check that the stainless steel Shaft Bottom Collar is not touching the white Shaft Bottom Bearing. If the Bottom Collar needs re-setting, put on the Rudder and insert the Rudder Locking Pin. Loosen the Bottom Collar set crew. Re-position so that the collar sits on top of the Rudder, just touching the rudder. Tighten the screw to hold it in that position. Most important is to ensure a space between the top of the Bottom Collar and the Shaft Bottom Bearing – at least business card size.

C. ATTACHING THE DRIVE UNIT





READY THE DRIVE UNIT

1. Bolt on the lead Counterweights.
2. Unscrew and remove the white plastic Frame Case Cover from the Drive Unit to avoid damage.
3. Insert the Vane Locking Pin to keep the top section rigid.
4. Remove the Shaft Locking Pin from its sleeve in the Drive Unit frame (noted as Rudder Lock on the photo above)
5. Move the Ratio Knob to the far left so that the plastic-sleeved Drive Arm points to the far right - at the 4 o'clock direction (approximately).

INSTALL RUDDER WITH KEYWAY GUIDANCE

1. If you haven't already done so, install the Rudder onto the Shaft - held in place with its Locking Pin.

   NOTE: Units from October 2020 onward have a keyway: a recess in the Rudder, and a key on the Shaft. The purpose of the new keyway is to make it easier to pull the Rudder on and secure it in place with the Rudder Locking Pin whose hole is 90 degrees to the Keyway Pin.

FIT DRIVE UNIT ONTO THE SHAFT ASSEMBLY

1. Test to see if the bore hole of the Main Frame fits onto the Shaft Assembly. Do not force it - it may or may not fit without using the 'Opener'.
2. OPENER – Find the two bolts at the base of the Drive Unit that clamp it onto the Shaft. Check that those bolts are loose. Note the empty middle hole… that is the Opener.
   - If the Opener is needed, remove one of those two bolts. Screw it into the middle Opener hole until it is hard against the far wall, then tighten this bolt only one quarter of a turn at a time until the Drive Unit Frame will slide easily into the Shaft Assembly.

     WARNING: if using the 'OPENER', be careful – excessive force can crack the casting.
3. Hold the Drive Unit in a big bear hug and slide it onto the Shaft.
4. If the Drive Unit still does not slide easily onto the Shaft Assembly, do not attempt to force it in but give the OPENER bolt another quarter turn. Keep doing so carefully until it fits.

FIT TILLER ASSEMBLY

1. You will see that the top of the Shaft Assembly emerges from the Drive Unit into the open central space.
2. Lift the Drive Unit slightly in order to slide the Tiller Casting into the frame so that the two stainless steel Drive Rods hold the plastic-sleeved Ratio Rod.
3. The bronze Fork Arm will fit onto the protruding 1" Shaft.

CORRECT POSITIONING

At this stage an extra pair of hands are helpful, but can be done solo, to achieve:

1. RUDDER @ 180 DEGREES - It is helpful to have someone hold the Rudder in the dead aft position.
2. SHAFT LOCKING PIN SHOULD FIT SNUGLY BUT FREELY - The Shaft is in the right position when the Shaft Locking Pin can move freely into its plastic sleeve on the front of the Drive Unit and passing through the hole in the plastic collar at the top of the Shaft Assembly.

   Tip: Sometimes the Shaft Pin hole fit is very, very tight. If it is too difficult to insert and remove, you can ream the plastic Shaft Pin Sleeve slightly. You want it to be a snug, but not impossible, fit.

3. TIGHTEN DRIVE UNIT SHAFT BOLTS - Loosen the 'opener', if used, and tighten the Shaft Bolts to secure the Drive Unit on. The Drive Unit should sit 90 degrees to the centerline of the boat. Of course, if the Opener was used then that bolt with its washers will be re-installed in its bolt hole and tightened.

   As with the Brackets, tighten the two Shaft Bolts snuggly. If using a torque wrench, 20 LBF.FT (27.12 N m) is the recommended torque setting. Be careful to tighten evenly.

   Warning: Please be very conscious not to crank too hard as the result can be a cracked casting.

SET FORK BOLT #58 TO LOCK TILLER ASSEMBLY ON SHAFT

1. Insert Shaft Locking Pin #61
2. Insert Vane Locking Pin #60
3. Move the Ratio Control Knob #21 to the far left - means the Ratio Rod #35 points between the 2 Drive Rods #36 at a 4 o'clock direction. This is best shown in our videos.
4. Line up the black plastic Tiller #23 so that the Ratio Rod #35 sits evenly between the 2 Drive Rods #36 without touching either one. Feel with a finger that the Drive Sleeve #19 on the Ratio Rod #35 can rotate. For post 2015 units with a thicker Drive Sleeve, the Ratio Rod is normally forced into the correct position – perfectly centered between the two Fork Rods. Makes things easier.

   For pre 2015 units with a thinner Drive Sleeve, it is helpful to put some paper (eg - business cards) on either side of the Drive Sleeve to hold equal amount of space on either side with you set the fork arm.

5. Tighten #58 Fork Bolt on the Bronze Casting. If using a torque wrench, 30 LBF.FT (40.67 N m) is sufficient.
6. Remove paper spacers, if any.

Positioning Tests

These tests are repeated and explained further as Final Inspection Tests

1. SMOOTH THROUGH ALL RATIO POSITIONS – Pull out the Ratio Knob and move it back and forth through all positions to see that #35 Ratio Rod moves freely between the #36 Drive Rods.
2. DRIVE SLEEVE CAN BE ROTATED – Rotate the #19 Drive Sleeve with your finger. The #19 Drive Sleeve should be able to be rotated in all but the 3rd or far left Ratio Setting. At that point, it binds, but just slightly – still free enough to be moved with the touch of a finger.

   For pre-2015 units with a thinner Drive Sleeve, the Drive Sleeve MUST spin freely in all positions. If it does not, re-set the Fork Arm as above and be sure to use a business card spacer.
3. RUDDER CENTERED? – Insert Shaft Locking Pin to check that the Rudder lines up fore and aft to the boat.
4. TILLER FLIPPING - Remove the Shaft Locking Pin and swing the tiller back and forth to see that its angle from side to side is symmetrical and smooth. There should be no friction.

D. REMOTE COURSE SETTING

The Remote Course Setting Line allows you to adjust the angle of the Vane to the wind without leaving the cockpit. It's meant to be set up somewhere handy to the cockpit. It can be as long as you like – any route – and friction is not a problem.

- The remote course setting line should be led through the fairleads and around the grooved track.
- The line should be led to a position that is convenient – along the lifelines or into the cockpit.
- Double blocks can be used to lead the lines forward around any obstruction.
- The final anchoring for the line is made using the block and bungee cord provided.
- It's like a clothesline – make an endless loop with the line provided.

Heat Weld the Remote Course Setting Line

Once the blocks and positioning have been set, you want to 'close the loop'. Two sets of hands are required for the 'heat weld' – one person to hold the lines, one person to hold the lighter. Perhaps cut off a small section to experiment with first?

1. Make sure both ends are clean and not frayed. The line must be new (no contact with salt water).
2. Hold both ends to a flame (actually, rotate them above the flame so that the material can heat up slowly – do not want it bursting into flames – just slowly melting) and make both ends hot enough that they are gooey. This normally takes 5-10 seconds.
3. Once gooey, quickly mash the ends together and pat down any hump very quickly.

   Tip: helps to wet one's fingers for that 'patting down'! Person least sensitive to pain should have this job ;)
4. You're done. The weld will look like a section of solid plastic.

Tip: Which line to pull??

ADDING A RED MARKER – Provided by Dee & Pippa (Elizabethan 31): *"I sometimes found altering course with my Hydrovane's control lines difficult. It was worse at night. Sometimes I just couldn't think which of the two lines to pull. I would resort to trial and error. It worked, but I wasn't happy with it. Then the solution dawned on me. Mark the line!*

So I tied a Turks Head knot onto one control line. I used red line, so I pull the line attached to the Turks Head to turn the boat to port. Even I didn't need a marker to say the other one turns the boat to starboard. It has made life so much easier for both Pippa and I, that I thought to share it with you and other Hydrovane owners."

E. FITTING THE VANE COVER

The Vane Cover may look short or small, but yes - it will fit!

Standard or Stubby Vane

1. Use Silicon Spray. Spray the inside of the Vane Cover, covering the entire perimeter (the part that will touch the aluminum frame). Also spray the outside of the frame. Be quick, it soon dries up.

   Tip: if you don't have silicone spray, water will do. Put the Vane Cover in a bucket of water and leave it for 15 minutes.

2. Slide the Vane Cover onto the Vane Frame, smoothing down the leading and trailing edges and ensuring that the seams are exactly placed over the tubes. It takes a fair amount of yanking and pulling. You can squeeze the side of the Vane Frame inward. It helps a bit.

3. Lacing – Start near the casting. Push the laces through the eyelets from the inside outwards, diagonally hole to hole until the end of the lace is reached. Tie a knot across the bottom of the tube at this stage. There will 2 or 3 pairs of holes still not laced.

4. Sweat the laces – No it is not too short! At this stage the Vane Cover will seem to be far too short. This is not so. Once a portion of the lacing is threaded, use the line to cinch down the Vane Cover. The material is stretchy and is difficult to rip.

   TIP: Use cable ties (also known as a hose tie, zap-strap, zip tie) to help cinch and then cut away when done.

Extendable 'XT' Vane

1. Follow Steps #1 and #2 as above for Standard or Stubby Cover

2. For the XT Vane, you probably need to use cable ties. Before lacing, first cinch down the cover by with 3 or 4 long ones. Loop them through the eyelets and around the lower big, square, black Tube Frame. The purpose is to put minimal pressure on the round tube.

   Warning: cinching on the round tube may result in breaking the weld. Be sure to attach the ties to the lower black Frame Tube.

3. Once the bottom of the Vane Cover has been pulled down sufficiently so that its surface is flattened, do the lacing onto the round tube.

4. Finally, cut and remove the cable ties.

F. FINAL INSPECTION TESTS

You may have done some of these tests after installing the Drive Unit, but please perform again once the entire unit is installed.

Periodically, it is wise to get familiar with the amount of friction in the system so that you can be aware if it starts to lose its responsiveness. If there is any friction, it will need correcting.

Please also note that the Hydrovane is designed to 'rattle' – so, do not re-set joints to remove the 'rattle' or 'looseness'. The purpose of the loose joints is twofold: there must be room for a delay in the transition from a course change in one direction to a course change in the opposite direction, and secondly the joints need space to accommodate salt and dirt build-up. A tight system soon becomes too tight causing unnecessary friction and poor performance.

The degree of looseness should be just enough to feel a 'tic' – less than a millimeter – when moving parts back and forth. Cumulatively all those little spaces result in a fairly loose feeling when the tiller is jiggled.

Smooth Ratio Rod Movement

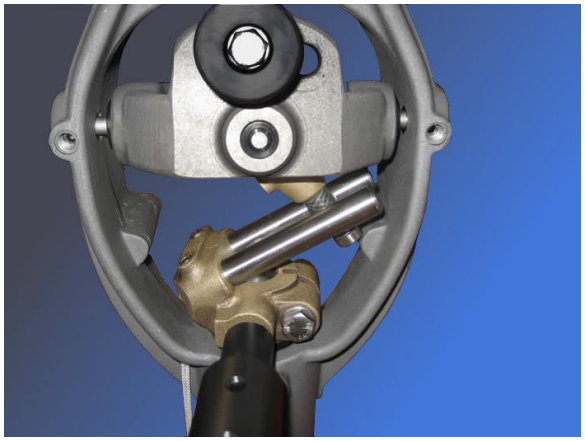
1. Insert Shaft Locking Pin #61
2. Insert Vane Locking Pin #60
3. Swing the Ratio Control Knob #21 back and forth so that the Ratio Rod #35 moves through all four positions. The Ratio Rod should move easily through all positions, between the two Drive Rods #36.

Rotate Drive Sleeve Test

1. Use your finger to rotate #19 Drive Sleeve in each of the 4 Ratio positions. The #19 Drive Sleeve should be able to be rotated in all but the 3rd or far left Ratio Setting. At that point, it may bind, but just slightly – still free enough to be moved with the touch of a finger.

   For pre-2015 units with a thinner Drive Sleeve, the Drive Sleeve MUST spin freely in ALL positions. If it does not, re-set the Fork Arm as above and be sure to use a business card spacer. See instructions under Set #58 Fork Bolt on Page 22

Finger is on the plastic Drive Sleeve



Tiller / Fork Arm assembly

Hydrovane Rudder Parallel to Centerline of Boat?

The black plastic Tiller and Rudder should be 180 degrees - parallel to the centerline of the boat. If the Rudder is off, it is like trying to walk while you are leaning 5 degrees to starboard.

Tip: All you can do is eyeball it. If it looks okay, it should be okay. If it doesn't look okay, then re-set the Fork Arm as explained in Section C.

Tiller Flipping Test

1. Remove Shaft Locking Pin #61
2. Set Ratio Control Knob in 'neutral', far right position
3. Flip the Tiller back and forth. It should move freely from side to side with only the slightest push. If it stops before going fully over, the problem can be either:

- Shaft Bottom Collar #26 is binding on Shaft Bottom Bearing #25. There must be a hair of space between the two. Loosen the set screw and re-set with space between the two.
- Lower bracket is too close to the Shaft Bottom Bearing. We suggest at least 2" (5 cm) of stainless Shaft Tube showing above the Shaft Bottom Bearing lip.

Windvane & Balance Weight Have Free Airspace

Using the Remote Course Setting Line - Rotate the Vane through the full 360 degrees. At any point where the Vane or Counterweights are near potential obstructions fully deflect and incline the Vane to see if the Vane or Counterweights touch anything.

Tip: If the Vane makes contact, please email us. The Stubby or XT Vane are always a good solution. Some have even had success shortening the Stubby Vane by an inch or so, if that's all that is needed. Contact very late into the Vane's deflection on one point of sail is more of a nuisance than a problem that would affect performance.

G. SAFETY & MAINTENANCE

Bolt Tightness

- RE-CHECK BOLTS – Check that all the Bracket and Mounting Bolts are tight after your first sail! Check at intervals afterward.

Tethers on Everything!

- TETHER THE RUDDER – Use a length of line, not less than 3/8" (10 mm) diameter, tied through the Rudder handle (or through the hole in the handle on 2020 Rudders and newer) and secured loosely to some point on the stern, to ensure that the Rudder is not accidentally lost.

  Warning: The nylon Rudder does not float! A few are living at the bottom of the ocean...
- TETHER THE LOCKING PINS – All 3 Locking pins have tethers on them
- TETHER THE VANE – the Vane Knob secures the Vane in place, but a tether is prudent.

  Warning: The Vane is lightweight and may try to fly away when being taken on or off

Reduce Vibration

- ROTATE LOCKING PINS – The Locking Pins are interchangeable. The pins will suffer from metal fatigue over time. Best to periodically change it with spares or rotate it with the other Locking Pin.
- LIMIT VIBRATION WHILE MOTORING. Some engines cause considerable vibration which when transferred to the Shaft and Rudder produces quite a chatter of the Hydrovane Rudder. Its length and weight combined with the loads created by the water and boat speed can result in hammering on the Locking Pin that holds the shaft in place – in this case, fracturing of the Shaft Locking Pin becomes inevitable. If you notice vibration, the solution is to break the harmonic chatter by cinching up the Rudder with considerable force.

  Tip: A heavy duty rubber snubber is the answer – same as is used on dock lines. Bungee cords have no effect. Take the line with the snubber from the Rudder handle onto a cleat – heave hard before tying off.
- VIBRATION WHEN SAILING – If an annoying vibration develops when sailing, the cause and solution is similar to the item above – just much subtler – not caused by engine vibration but by the slightly loose Rudder and a harmonic that has developed. One solution is to add a bit of weight to the Tiller – not too much as that would affect the Hydrovane performance.

  Try putting a bilge pump handle in the hole of the Tiller. If that doesn't lessen the harmonic sound, add shaft zincs or something heavier.
- REDUCE RUDDER HOLE WEAR – Take the Rudder off when not in use, especially for weeks or months at a time.

Maintenance and Cleaning

- SOAP AND WATER – When washing the boat, also wash down the Hydrovane with fresh water.
- WD40 – Every few months the whole of the unit, including castings, should be cleaned well with fresh water and soap. When dry, the unit, again including castings, should be thoroughly sprayed with a light aerosol oil such as WD40.
- SPRAY CASTINGS WITH CORROSION INHIBITOR – The gray metal aluminum castings could use periodic spraying with a corrosion inhibitor, especially the Brackets as they are closer to the water
  - CorrosionX
  - T-9
  - LPS3

- Warning: DO NOT GREASE ANYTHING! Every joint should rattle.

  If any of the Axles, Shafts, or Bearings are removed for cleaning or adjustment (although no reason to do such), the unit should be reassembled so that there is a slight but noticeable end play between the moving parts. As mentioned before, the Hydrovane is designed to 'rattle' – so, do not re-set those joints to remove the 'rattle' or 'looseness'.

Check Axles

Axles are not usually in need of adjustment, especially not on a new unit, but we have heard of it. This can also happen after 'sloppy' passages.

The two levers that rock back and forth, the Vane Lever (part #65) and the Bottom Lever (part #69), should be firmly in place – unable to slide laterally.

There are a total of eight small stainless steel Axles that allow all the movement in the mechanism. The Bottom Lever casting has a total of four Axles: on each side and also fore and aft. The Bottom Lever should comfortably rock up and down on its Axles but should have no lateral movement sideways or fore and aft – should be firmly held by those Axles. It is self-evident if any of those four Axles are loose as the end that sticks out should look the same for each.

For the upper Vane Lever casting, the Axles are more evident – two side by side on each side. Please note that the two Axles holding the black plastic Bobbin stick out more than the others and do not look even. The test is that the Bobbin cannot slide laterally – can only rock up and down.

Loosen the Axle Screw (pre-2016 units: 3/8", post-2016 unit: M10), reset the Axle in the Axle Sleeve, re-tighten Axle Screw with Loctite. See Operation & Troubleshooting Guide for more detail.

H. GO SAILING!

Congratulations on your installation! We love to receive photos!

Please refer to the Operation & Troubleshooting Guide.