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Jefa Rudder SYSTEMS

# Installation in GRP or Wood Core Hulls

1-05192023

## General Installation Issues

**ATTENTION!!! NEVER PUT ANY GREASE BETWEEN THE ROLLERS**

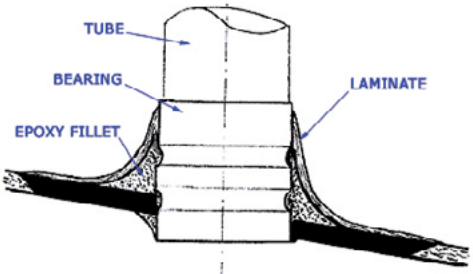
- Standard (non self-aligning) bearings can only be installed in combination with the rudder stock mounted in the vessel. As the tolerance between the bearings and shaft is only a couple of hundreds of millimeters, one can't afford any misalignment between the bearings and rudder shaft. This means that it has to be physically possible to mount the rudder shaft in the hull. It's also advisable to have the keel mounted as any misalignment between the rudder and keel will be very obvious. When it's not possible to mount the rudder one should either mount the bearings at a later stage, use self-aligning bearings, or produce a dummy shaft which is an exact reproduction of the rudder shaft part excluding the rudder blade (this latter option is often used with production boats).
- Do not install bearings into a cored part of the hull. Insure that there is a sufficiently large region of solid laminate around the rudder to create a good skin-joint and to prevent water ingress into the core. This region should be no less than the 3 times the rudder bearings diameter.
- A proper skin joint must have a minimum thickness of at least 70% of the total thickness of an adjacent sandwich panel.
- Aluminium surfaces must be clean and the surfaces should be roughened before lamination (sandpaper 60 roughness). An epoxy is recommended because it will bond to the aluminium better than a polyester resin will. For an ideal bond etch the surface (ask your epoxy supplier what is recommended for bonding with aluminium).
- Be careful in keeping the inside of the bearings free of any adhesive sealants and resins! Check after the glassing if the rollers can rotate freely.
- In the case of self aligning bearings try to keep them as much inline as is possible, this will help to insure that there is still enough rotation in the direction of the boats neutral axis to compensate for bending of the rudder stock.
- The rudder system should be electrically disconnected from the rest of the yacht. Please read our electrolysis page for further information.

## Mounting Procedure For Jefa Rudder Systems In GRP And Wood Epoxy Hulls

1. Align and drill the hole for the lower bearing. We recommend a hole-saw for this. Remember that the diameter of the hole should be a bit larger than the outside diameter of the housing. This will give the flexibility to align the rudder to the keel. The centre of the hole should correspond as accurate as possible with the rotational axis of the rudder stock.
2. Now you can cut the hole for the upper bearing. If the angle of the mounting surface of the top bearing is more than a couple of degrees out, produce a wig (teak or delrin) to adjust the top surface angle.
3. If the ship is tiller steered, both bearings should be provisional mounted, so the tube length can be determined. Cut the tube to the appropriate length. If the ship is wheel steered, try to calculate the height of the tiller arm or quadrant of the boat. Measure the tube length, bearing in mind that the top of the tube has to clear 70 mm from the bottom of the tiller arm or quadrant. The top of the tube has to be located more than 100 mm above the final waterline. (If you have any doubts, please consult our sealing system page). If the 100 mm can't be achieved, one should use double lip seals and add a gaiter for extra security. Please note that when the top of the sealing system is underneath the waterline, a potential dangerous situation is created and an alternative steering arrangement should be considered.
4. Now that the tube is on it's final length it can be assembled with the bottom bearing. Grind and clean the inside register of the bottom bearing and the part of the tube that will go into the bottom bearing carefully. Put a small film of polyurethane sealant compound around the outside bottom edge of the rudder tube just prior to fitting it into the lower bearing. Do your best not to gum up the inside of the bearing with sealant, or contaminate any of the surfaces with sealant. Make sure that the joint between the rudder tube and the bearing is well sealed to keep any resin from running down into the bearing during lamination. One could laminate the bearing and tube combination directly into the hull, but to achieve the best bonding it's advisable to laminate 2 layers of 300 gram/m$^2$ around the bearing and bottom of the tube, after hardening clean and sand the surfaces.
5. Prepare all the relevant surfaces for lamination. Both the lower bearing and rudder tube should be degreased, and abraded to give some "teeth" to the bond. The hull laminate should be freshly sanded in the area around the rudder bearing as to insure a good bond. All surfaces should be free of dust and contaminants.
6. Slide the plastic spacer ring over the top of the stock so that it rests on the top of the rudder blade. Remove the key, if present, out of the keyway as it could damage the rollers. Slide the lower bearing assembly while rotating on the rudder stock. If lip seals are mounted in the bearing, please use some detergent (i.e. soap, do not use grease!) on the shaft to prevent damaging the seals and possible flipping over. Don't forget to put the gaiter (if used) over the tube as there will be no possibility any more to mount it.
7. We are now ready to slide the entire assembly up into the boat for installation. With the spacer ring, lower bearing, rudder tube, and gaiter in place run the rudder stock up into the top deck hole. Secure the rudder blade in position and slide the top bearing over the shaft while rotating.

8. Carefully align the rudder to it's theoretical position using wigs between the bearings and the holes in the hull. Please note that if the keel isn't at its optimal angle under the ship it could be wise to also misalign the rudder to accommodate the same angle as the keel, as every misalignment between the rudder and keel will be very obvious when standing behind the ship.

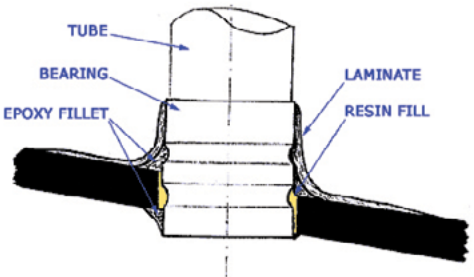
9. Drill the appropriate holes for the top bearing. Remove the bearing, clean the bottom on the flange and deck and put a proper film of polyurethane sealant underneath the flange of the top bearing. If your rudder system doesn't consist of self-aligning bearings it's very important to not just bolt down the top bearing on the deck as the surface of the deck and the flange of the bearing will always be misaligned a bit. One can use the sealant to adjust for this small misalignment. Tighten the bolts lightly, just as far as the sealant starts to be pressed from underneath the flange. Wait at least 24 hours for the sealant to harden, before you finally tighten the bolts permanently. If a self-aligning type of top bearing is used, one can tighten the bolts permanently as the bearing will align itself to the rudder shaft.




10. Now the glassing in of the bottom bearing can start. As there is no absolute law how this should be done, and if one would give the same job to three different boat builders, all three would come up with a different

**GUIDELINE 1:** ***Appropriate for thin to medium thick wall (± 30 mm or less) hulls with solid laminate around the bearing.***

Wet-out the surfaces to be laminated with some epoxy resin, but don't splash around with to much resin, as it will run out between the lower bearing and the hull and drip onto your rudder. When all surfaces are wetted you should run a 30 – 50 mm radius fillet between the hull and the bearing using a high density filleting mix. (As thinner the hull, the bigger the filler radius). Use a piece of rounded multiplex as a profile to get a nice rounded shape. Using strips of biaxial glass, bond the bearing in place making sure that you have run the glass at least 75 mm high, and a minimum of 1½ bearing diameters out into the surrounding hull. The laminates thickness in millimeters should be at least 1.5 x (1.8+(LWL in meters/1.8) and can be tapered down to zero over the last 30 % of it's run. Gaps between the under side of the hull and the bearing can be fillet with a epoxy filler. If the filler surfaces are big, one could consider adding a layer off glass as top surface.

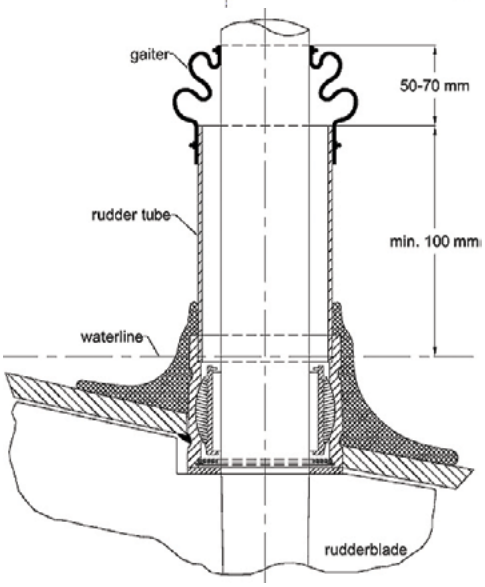



**GUIDELINE 2:** ***Appropriate for thick wall (± 30 mm or more) hulls.***

Hulls of this thickness will contain a sandwich core. If the core material is relatively soft and weak (foam, balsa wood, strong plank, etc.), it will have to be replaced with solid epoxy. One should remove 30 to 50 mm of core material and fill the space created carefully with epoxy fillet.

If the core material is relatively strong and hard like western red cedar, no strength adjustments will have to be done. In both cases it is very important to avoid any water to ingress the sandwich construction. This will be achieved by filling the space between the bearing and hull with epoxy resin.

First wet-out the surfaces to be laminated with some epoxy resin. When all surfaces are wetted you should run a 20 – 30 mm radius fillet between the inside hull and the bearing and a small fillet between the outside hull and the bearing using a high density filleting mix. Use a piece of rounded multiplex as a profile to get a nice rounded shape. Let the epoxy harden a bit and drill a hole in the top fillet. Inject thin resin epoxy into the hole. A second hole can be made if an air pocket is expected. Using strips of biaxial glass, bond the bearing in place making sure that you have run the glass at least 75 mm high, and a minimum of 1½ bearing diameters out into the surrounding hull. The laminates thickness in millimeters should be at least 1.5 x (1.8+(LWL in meters/1.8) and can be tapered down to zero over the last 30 % of it's run. If the filler surface at the outside of the hull is big, one could consider adding a layer off glass as top surface.




11. The final part of the installation is the sealing system. If you are using lip seals, please make sure the height of the seals is well above the waterline. For extra security one can add a gaiter. The top surface of the lip seals should be free of any dust and dirt, as this could drop between the lip surface and the rudder shaft causing leakage. It's wise to cover the seals with some plastic and tape up until the yacht is ready for launch.

    The gaiter should not be installed completely stretched out. The distance between both jubilee clips should be between 50 and 70 mm. Please make sure the rudder is in the amidships position when tightening the jubilee clips. After the rudder stops have been installed, one should check if the gaiter allows to rotate the rudder to both end positions without being stretched. If the ship is intended to make a long world tour, it's advisable to purchase an extra unglued gaiter with a tube of neoprene glue. This way one can replace the gaiter quick and easy, without having to drop the rudder.

12. Now the vertical locking can be installed. There are tree ways of vertical locking: A rudder head or locking ring on top of the top bearing, the use of a top bearing with an integrated vertical roller bearing (type 4....Z) and if a vertical locking around the top bearing isn't possible, the use of a locking ring on top of a bottom bearing with lip seals.

    In all cases one should use grease or anti seize paste on the tread of the set screws of the locking rings, especially when used above deck. Tighten the screws when the shaft is at the correct height. Remove the screws, drop the shaft a bit, and drill a small hole a few millimeters deep so the set screws will enter the shaft a bit. This will make sure that the rudder will never drop down.

We hope these guidelines will provide a trouble free installation of the Jefa rudder system. If you have questions or problems please email us at info@pyiinc.com