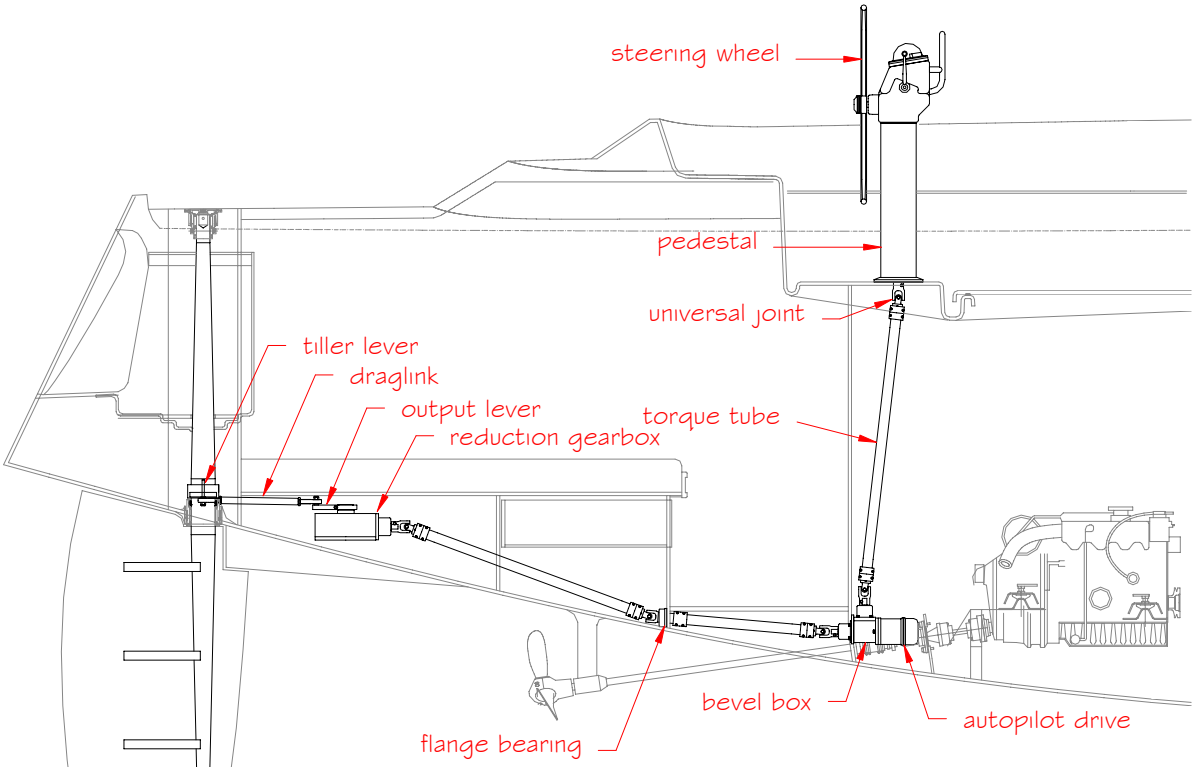
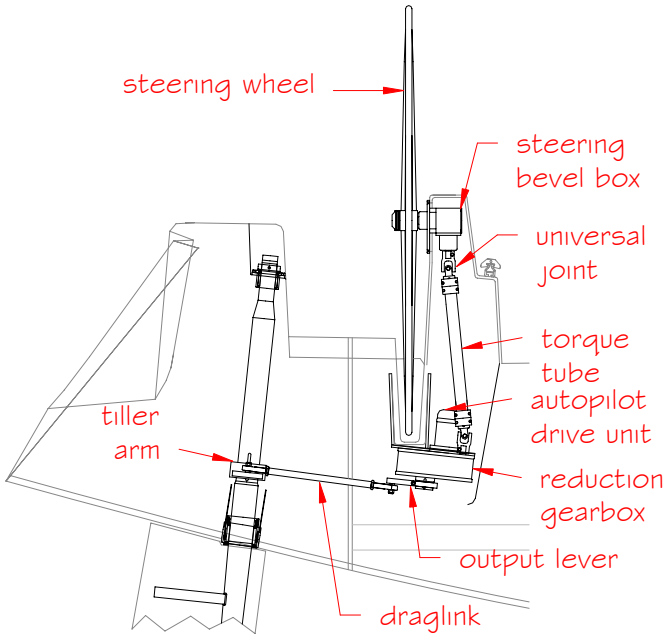
Transmission steering installation guide





Jefa Steering ApS
Nimbusvej 2
2670 Greve
Denmark
Tel: +45-46155210
Fax: +45-46155208
E-mail: info@jefa.com

CE Jefa transmission steering complies with ISO13929

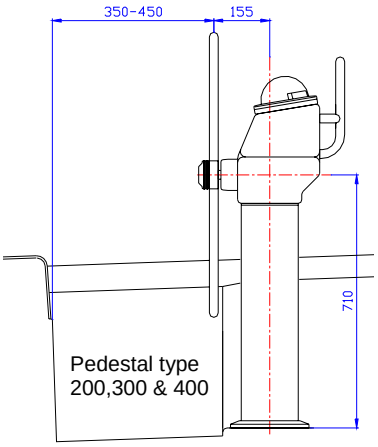
Jefa transmission steering installation guide

1.0. General information.

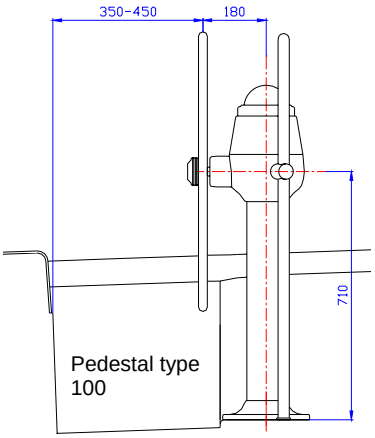
Your Jefa transmission steering system has been designed and manufactured to the highest standards to provide many years of trouble free service. To aid you with the installation we have prepared these guidelines, which are vital to follow if the systems full potential and reliability are to be achieved. The notes should be read carefully before installation is commenced. Should you encounter any problems not covered in these instructions or have any queries please contact Jefa Steering or your local Jefa distributor who will be pleased to provide technical guidance.

Transmission systems are always a combination of various transmission parts. There are numerous combinations possible. The most simple transmission system is a pedestal or steering bevel box with a reduction box linking to the rudder (see bottom layout on page 1). When the distance between the rudder(s) and steering position(s) is bigger, one or more bevel boxes are used to achieve 90° angles. Angles up to 25° can be made with universal joints. All gearboxes are connected with torque tubes and universal joints. The transmission system always ends in a reduction gearbox which translates a rotational movement in to a push-pull movement via a draglink to the rudder lever. A transmission system can have two or more steering positions (twin wheel steered boat and catamarans) and two or more reduction gearboxes (twin rudder boats or catamarans). Due to these numerous combination, it's not possible to make an installation guide for your typical system. This guide will cover the installation of all components with the consequence that some described parts will not be present in your typical system.

1.1. Positioning the pedestal (for systems without a pedestal, continue at chapter 2)



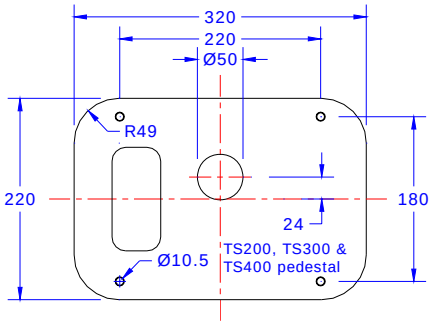
The pedestal should be installed in a position where there is adequate space to fully control the craft at all times whilst providing sufficient shelter for the helmsman to brace himself in severe sea conditions. Care should be taken to ensure that it will not obstruct members of the crew from operating bilge pumps, sheet winches and cockpit locker lids, etc. Alternatively these items may require repositioning. Where the pedestal is situated near the mainsheet a guard should always be fitted to help prevent the sheet snagging the pedestal in an inadvertent gybe. The optimum position for mounting the pedestal relative to a helmsman's seat is shown in the right figure.



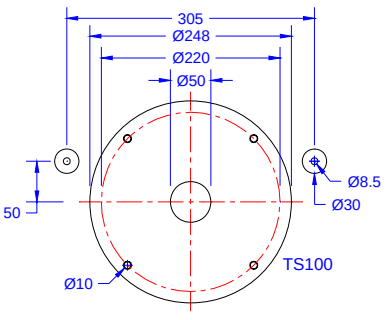
1.2. Reinforcement of the cockpit floor

The cockpit sole must be sufficient rigid to withstand the steering loads or the force of the helmsman thrown onto the wheel in severe sea conditions without deflecting significantly. As a guideline for GRP boats, the cockpit floor should have a total thickness of at least 40 mm.

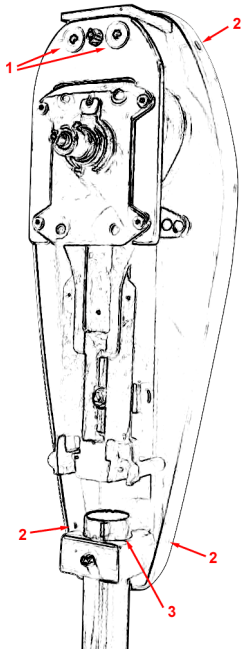
1.3. Drilling of the cockpit floor and the fitting of the pedestal



After finding the correct pedestal position in the cockpit the cockpit floor can be drilled according to the figures depending on the type of pedestal used. The holes for the mounting bolts should be drilled to 10.5 mm. Put the pedestal on place and mount the wheel. Carefully measure to both ship centrelines if the pedestal is positioned correctly. Use a sealant to seal off the pedestal. The type 200, 300 and 400 pedestals require an extra hole for the engine control- and other cables.

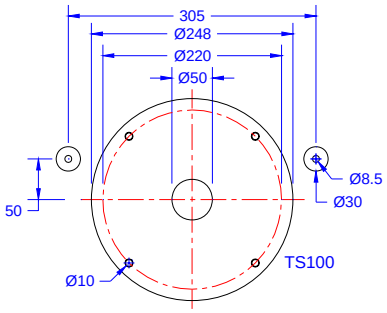


1.4. Fitting the engine control mechanism and housing (optional on type 100 pedestals)

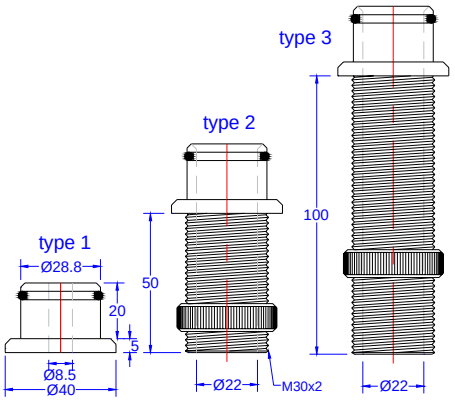


The Jefa TS100 pedestal can be fitted with an optional TFX engine control mechanism. For the ease of mounting the engine control cables (not included), dismount the mechanism by unscrewing bolts with number 1. Follow the instructions in the accompanying TFX installation manual. Reinstall the mechanism with the attached cables back in the mounting bracket and tighten bolts 1 again. Make sure the bottom tube ends at least 5 mm above the bottom bracket (see position 3). Put both cover parts in place and carefully tighten the 4 off 4.2 x 9 mm self tapping screws (position 2). Don't over tighten these screws as it will damage the housing. Mount the Jefa stainless steel engine control handle. Make sure the handle reaches the end of the splined shaft. Carefully hit it with a rubber hammer if necessary. Tighten the 2 set screws at the bottom of the handle. Check in the machine room if both the throttle and gearbox levers reach the outer positions and if they are set up correctly in the neutral position. With the red push button one can disengage the gearbox and operate the throttle independently for starting up the engine.

1.5. Mounting the engine control feet on the TS100 pedestal



When the pedestal is correctly mounted, it's time to mount the guardrail and guardrail feet. The correct guardrail centres are 305 mm and the forward offset to the pedestal centre line is 50 mm. Drill a 8,5 mm hole when foot type 1 is used and a 30 mm hole when foot type 2 & 3 are used. Type 1 is required when no cables have to go through the cockpit floor. Type 2 allows cables to pass the cockpit floor with a maximum floor thickness of 45 mm and type 3 allows cables to pass the cockpit floor with a maximum thickness of 95 mm.



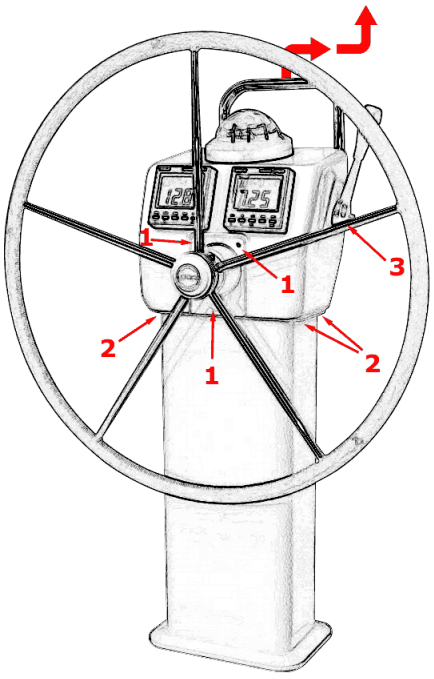
Type 1 has to be through bolted with a 8 mm bolt going through the cockpit floor and firmly tightened.

Type 2 & 3 need some sealant underneath the flange and have to be pushed into the 30 mm hole drilled in the cockpit floor. The nut should only be tightened by hand and not with the aid of a tool.

Type 3 is normally only supplied when specially ordered (no surcharge).

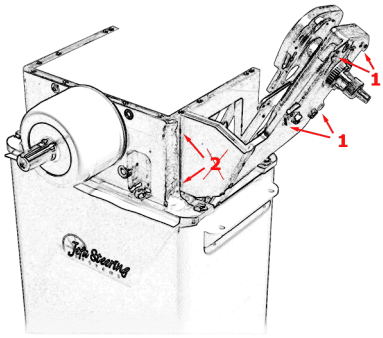
1.6. Fitting the engine control mechanism and housing (optional on type 200,300 & 400 pedestals)

The Jefa TS200, 300 & 400 pedestal can be fitted with an optional TFX engine control mechanism. To access the engine control, the head of the pedestal has to be dismounted. This should be done with care as the GRP of the head could be damaged when dismounted on the wrong way. Remove the head as follows:



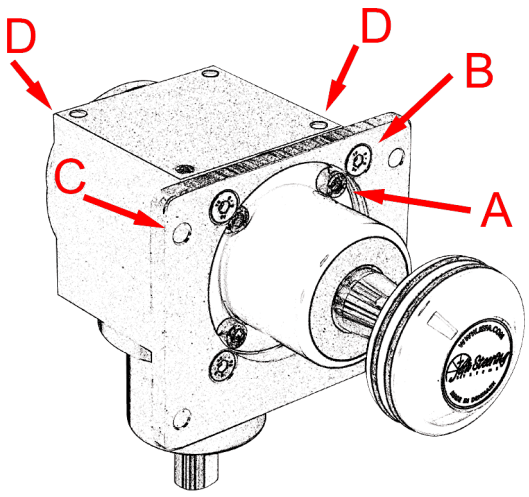
- Remove the three bolts holding the front cover (position 1) and pull the front cover forward.
- Remove the four bolts that attach the head to the pedestal (position 2).
- Remove the 2 set screws in the bottom of the mechanism handle (position 3) and pull the mechanism handle off.
- Lift up the head a few centimetres and tilt the top towards the mechanism shaft. As soon as the shaft disappears in the head carefully continue to pull upwards.

For the ease of mounting the engine control cables (not included), dismount the mechanism by unscrewing it from the bracket (position 1). Do not remove the bracket from the pedestal (position 2) as this bracket is carefully positioned relative to the head and it will be difficult to find the correct position again. Follow the instructions in the accompanying TFX installation manual. Reinstall the mechanism with the attached cables back in the mounting bracket and tighten bolts 1 again. Mount the GRP head in reverse order. Tilt the head a bit and put the mechanism shaft back through the hole in the side of the head. Carefully put the head back on it's end position, tighten bolts 2 (upper picture). Put the cover plate back in place and tighten bolts 1 (upper picture). Mount the Jefa stainless steel engine control handle. Make sure the handle reaches the end of the splined shaft. Carefully hit it with a rubber hammer if necessary. Tighten the 2 set screws at the bottom of the handle. Check in the machine room if both the throttle and gearbox levers reach the outer positions and if they are set up correctly in the neutral position. With the red push button one can disengage the gearbox and operate the throttle independently for starting up the engine.

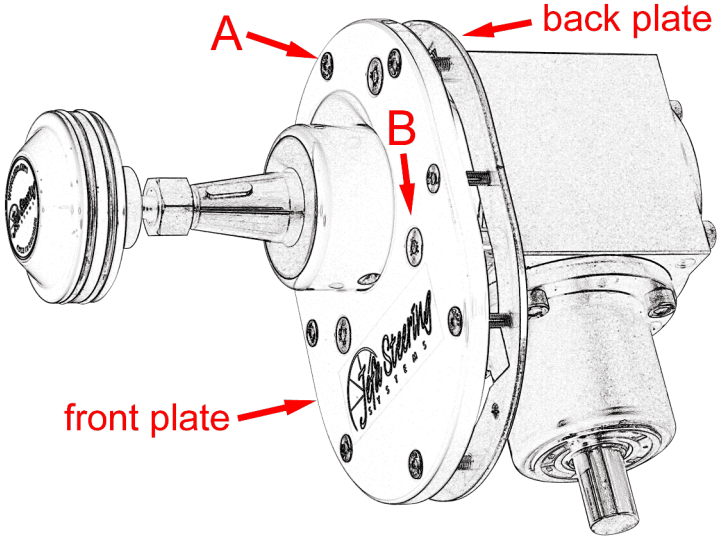


2.1. Fitting the BG12 & BG15 steering bevel box (for systems without a standard pedestal)

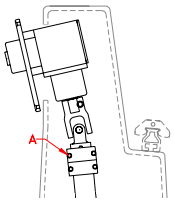
The BG12 & BG15 bevel boxes (same as BG12 but the reduction is not 1:1, but 1,22:1) are used as steering position in a bulkhead or yard made pedestal. For wheels up to 1500 mm diameter a Ø 25 mm steering shaft is fitted. For wheels above 1500 mm diameter the steering shaft is Ø 30 mm.
Before installing, first check the best position for the mounting flange. The mounting flange can be mounted in four positions: front (standard), aft, top and bottom. To change the mounting flange position, undo bolts B. Do not undo bolts A as these are used to mount the input socket to the bevel box housing. Position the mounting flange at the preferred side of the box and mount the bolts using loctite.
Mount the gearbox using holes C to the designated place.



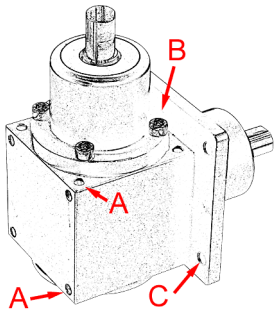
2.1. Fitting the BG12QM & BG15QM steering bevel box (for systems without a standard pedestal)



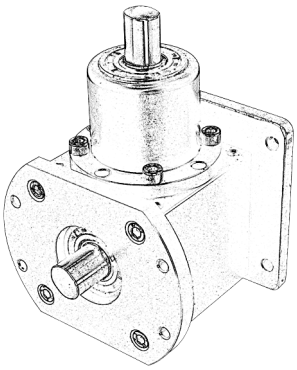
The Jefa BG12QM "quick mount" steering box is used when the mounting has to be done from the outside of the pedestal or bulkhead. The big advantage over the BG12 box is the fact that there is no inspection cover or opening needed in the pedestal. The installation order is as follows: A cut out is made by using the inside profile of the stainless steel back plate as template (undo bolts A, but not the bolts marked B). The plate is moved through the hole and glued to the inside of the pedestal. The universal joint is attached to the gearbox with the clamp and torque tube mounted. The complete assembly can be entered through the hole and the bolts that holt the front plate to the stainless back plate (A) can be mounted.
The BG12QM steering box has a 1:1 gear ratio, when more turns of the wheels are required, one should use the step ratio gearbox BG15QM with a reduction of 1,22:1.



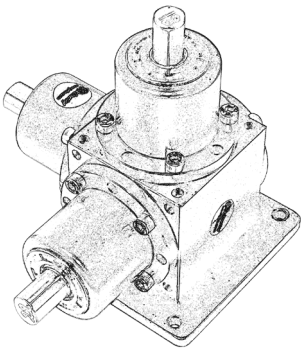
2.2. Fitting bevel boxes



2- way bevel box



3- way bevel box with optional autopilot flange



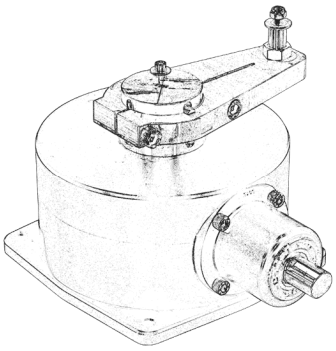
4 -way (3 planes) bevel box

Bevel boxes are used when the routing of the transmission system requires a 90 degrees angle and are made in 2-way, 3-way and 4-way versions. Mount the bevel boxes firmly to a bulkhead using the mounting holes C. In the case of a wooden bulkhead, make sure you use a backing plate at the other side of the bulkhead. Wood acts as a spring while under compression and could become permanently compressed in time, loosing the preload of the bolt connections and resulting in loosing the bolt connection and subsequently steering failure. Always use loctite on the mounting bolts, as the steering system is continuously exposed to vibrations from the rudder (especially while motoring). Before installing, first check the best position for the mounting flange. The mounting flange can be mounted in four positions: front (standard), aft, top and bottom. Use tap holes A for the alternative positions. Do not undo bolts B as these are used to mount the input socket to the bevel box housing. Position the mounting flange at the preferred side of the box and mount the bolts using loctite. It's always wise to use at least one 3 way box in the system (even when only 2 shafts are used). Sometimes the routing has to be changed in the installation phase what could case is a change of rotation (resulting in the boat going port when steered to starboard). The 3 way boxes are designed to be 180° rotated without any change in main dimensions and shaft positions. Please be aware that the mounting flange also has to be swapped from front to aft.

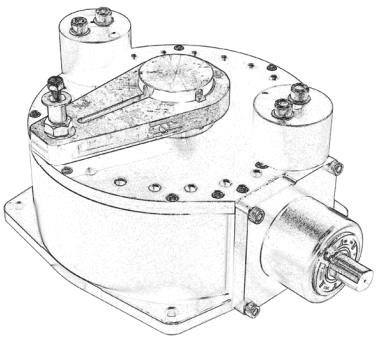
Step-ratio bevel boxes: Normally bevel boxes have 2 off 20 teeth gears resulting in no reduction or increasing of speed (turns of the wheel for 72° rudder travel). Step ratio bevel boxes (BG13, BG14 & BG15) are mostly used to increase the amount of turns of the steering wheels. The gears in these boxes are 18 and 22 teeth resulting in a reduction of 1,22:1 and increase the amount of turns with a factor 1,22. Jefa will always mark the output shafts of step ratio boxes with either 18 or 22 (amount of teeth on shaft). Normally the shaft with marked 18 points in the steering wheel direction, increasing the amount of turns. 4-way boxes are always step ratio. Please take absolute care in positioning these boxes on the right way so the intended increase or decrease of turns is achieved.

It's wise to order at least one bevel box in the system with an autopilot flange and shaft (-AP option) so a Jefa transmission autopilot drive can be fitted resulting in the most robust and simple autopilot drive installation possible.

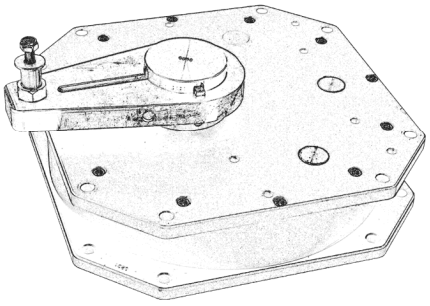
2.3. Fitting the reduction gearbox.



1:5 reduction bevel box BRG10-50



1:6,7 reduction bevel box BRG10-67

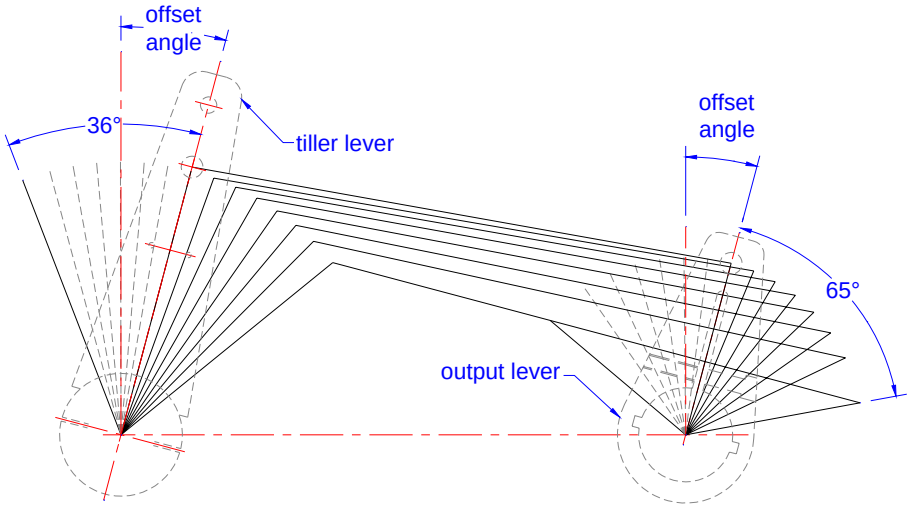


1:5 reduction box RG10-50

The transmission system always ends in a reduction gearbox close to the rudder shaft which translates a rotational movement in to a push-pull movement via a draglink to the rudder lever. Mounting this gearbox firmly to the hull structure is very important as all rudder forces are transmitted to this gearbox. Reduction gearboxes are available with reductions from 1:3,2 to 1:10. The size of the reduction box is determined by the rudder torque, the wheel size and type of boat (racing, cruising-race or cruising). If you have any doubts on the size of the gearbox you are fitting please double check the specifications on our transmission pages on the web or consult your local distributor or Jefa factory.

2.3.1. Wide angle geometry.

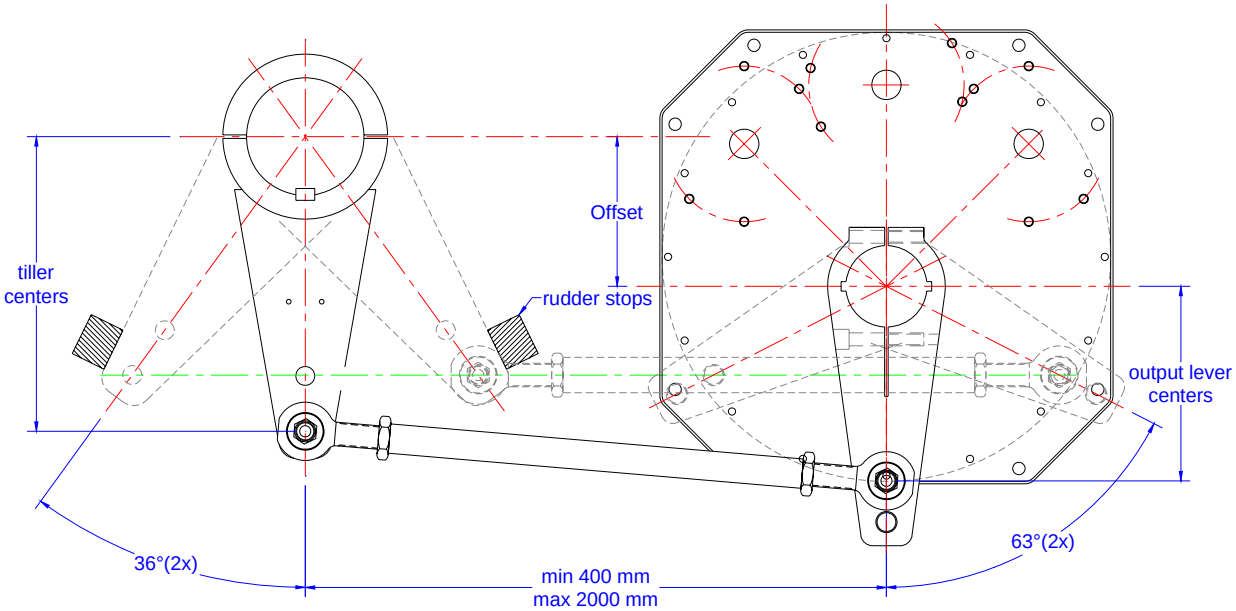
The total reduction and the consequent amount of turns of the wheel is a combination of the gear reduction and lever geometry reduction. To achieve more reduction and to make it proportional (smaller reduction midships so more direct steering and bigger reduction full rudder) the centres of lever on the gearbox and the centres of the tiller lever relate a factor 1:1,54. This results in 130° (2 x 65°) travel of the output lever to achieve the 72°(2 x 36°) of the tiller lever. This setup is called “wide angle geometry”. The below illustration shows the wide angle geometry and next to it is the table showing the extra reduction resulting from this in relation to the rudder angle. Roughly one can say that the lever reduction is 1:1,5 midships and 1:3 at full rudder. As example: The 1:7 reduction gearbox has a total rudder torque reduction of 1:10.5 midships and 1:21 full rudder. To achieve an equal movement in port and starboard direction, the levers need an initial angle called the “offset angle”. This offset angle is depending on the distance from the gearbox to the rudder shaft. One can work around this offset angel by using an offset distance which is independent of the distance gearbox – rudder shaft which will be explained further on. The supplied gearbox and lever are setup for a rudder angle of 36°, when more rudder movement is required, different centres have to be used on the tiller lever. Do not use the standard centres as the gearbox lever will go over “dead centre”. **Always consult Jefa when the rudder angle has to be more than 36°**.



Rudder Angle	mech. advantage
0°	1.54
5°	1.54
10°	1.55
15°	1.59
20°	1.66
25°	1.78
30°	2.00
36°	2.92

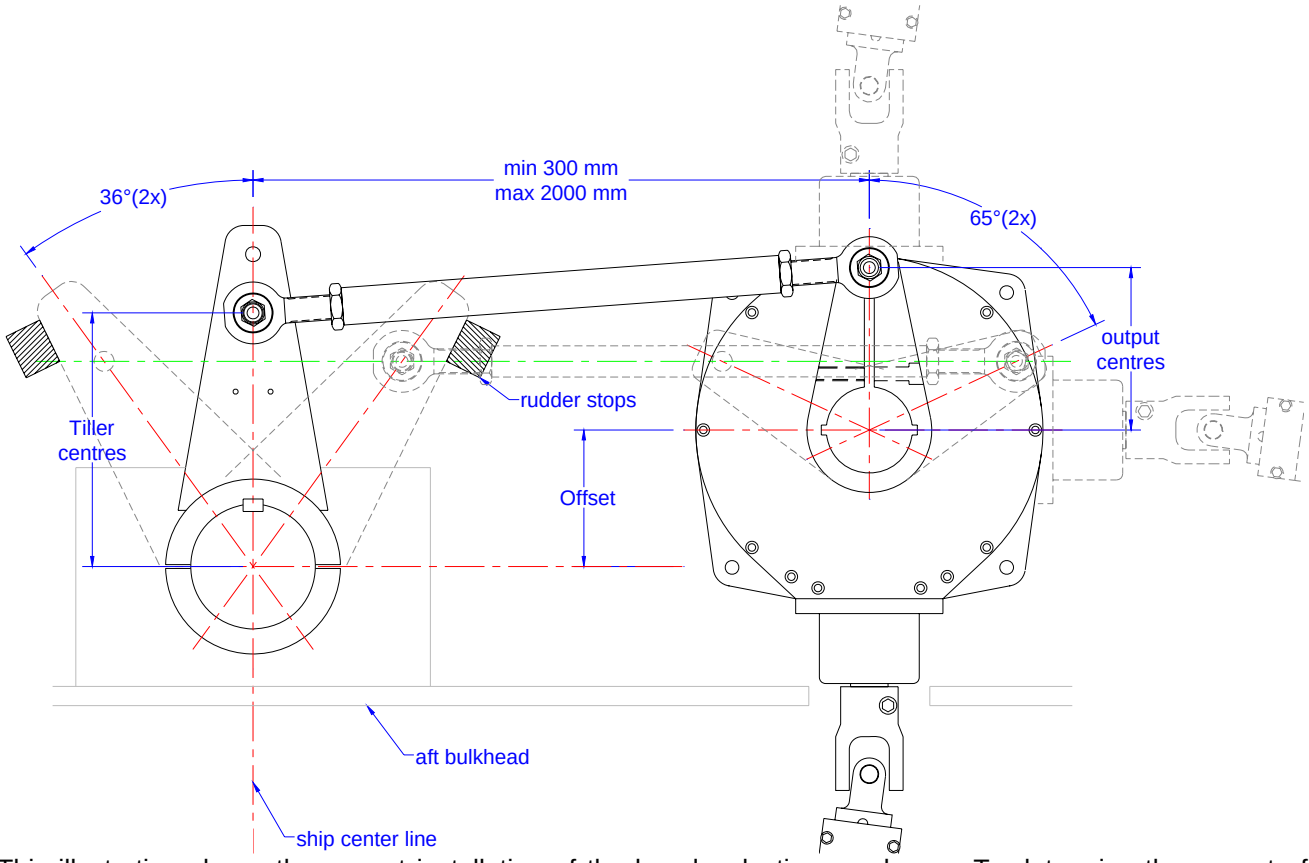
2.3.2. Setting up the gearbox geometry.

Offset angles can be avoided when the complete gearbox is put on an offset distance. The offset is independent of the distance between the gearbox and rudder stock and which centres are used on both levers. A good confirmation of the correct geometry is to check if all 4 endpoints of the lever pins are in one line (see the green line in the layout). This illustration shows the correct installation of the flat gearboxes (RG10-50, RG10-70, RG10-100, etc..) These gearboxes are used when the link to the steering wheel goes up to the deck.



To determine the correct offset distance, please look at the table on next page. A good confirmation of the correct geometry is to check if all 4 endpoints of the lever pins are in one line (see the green line in the layout).

Offset table for all Jefa reduction gearboxes, valid for 72° (2 x 36°) rudder travel.		
Gearbox centres (mm)	Tiller lever centres (mm)	Offset distance (mm)
130 (standard lever)	200	106
165 (long lever)	250	127
200 (extra long lever)	307	162



This illustration shows the correct installation of the bevel reduction gearboxes. To determine the correct offset distance, please look at the table. A good confirmation of the correct geometry is to check if all 4 endpoints of the lever pins are in one line (see the green line in the layout).

2.4. Fitting the tiller lever.

The tiller lever should always have a perfect fit to the rudder shaft. Between the two tiller lever parts should always be a gap to make sure the tiller arm can be clamped. The tiller lever should be slided in vertical direction to achieve the best possible horizontal run of the draglink. The angle of the draglink should not exceed 5° to the horizon or in case the rudder stock isn't vertical, the draglink has to be within 5° perpendicular to the rudder stock. The tiller arm should be firmly locked for rotation around the rudder shaft. **Never** use just clamping to achieve this rotation locking. The best rotational locking is achieved by a keyway in the shaft and lever combined with a stainless steel key. The torque for the 4 mounting bolts of the tiller lever is 45 Nm. Incorrect tightening torque and locking method will result in steering failure! Tubular rudder stocks and carbon rudder stocks should use a through bolt to achieve a proper rotational locking.

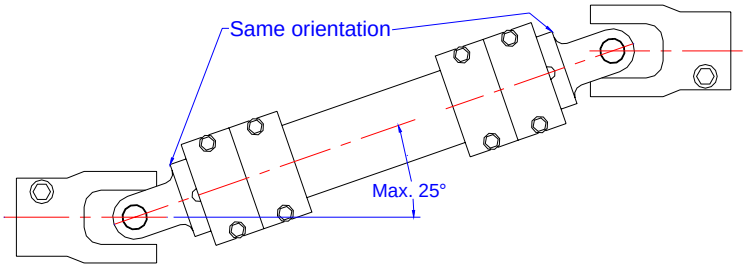
2.5. Fitting the draglink.

Make sure the rudder and gearbox levers are parallel and in the exact amidships position. Carefully measure the distance between the two pin centres. Rotate the rose joints of the draglink to achieve the correct length and lock them with the locking nut. Slide both sides over the pin and tighten the lever bolts firmly.

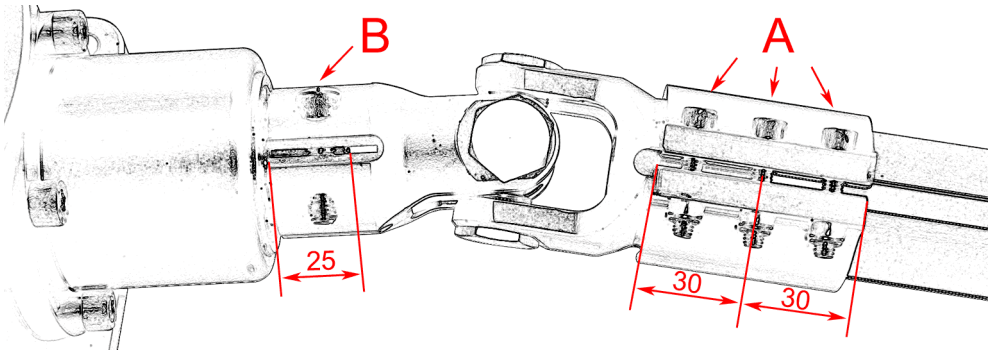
2.6. Fitting robust rudder stops.

All above illustrations show rudder stop blocks limiting the rudder on 2 x 36° movement. The urgency to fit correct positioned and robust rudder stops can't be overemphasised. Stop forces when cruising backwards and loosing the wheel can get as high as 4 times the maximum forces when cruising forward. **The absence of proper rudder stops can jeopardise the life of all crew members and will result in steering failure in time.** Jefa Steering accepts no legal responsibility for systems fitted without proper rudder stops (travel limiters).

2.7. Fitting the torque tubes and universal joints.

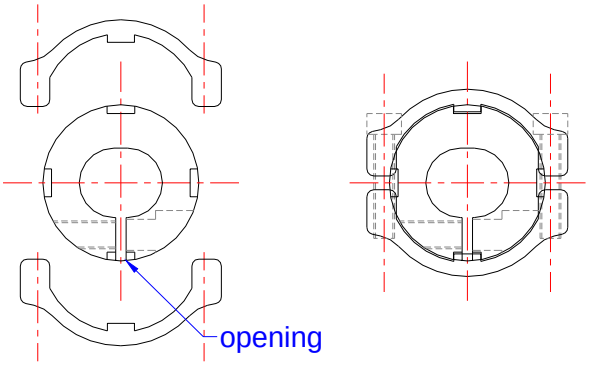


When all gearboxes are mounted, the universal joints can be mounted on the oval shafts so the lengths of the torque tubes can be determined. The maximum allowable working angle of the universal joints is 25 degrees. Each universal joints has to be in the correct position relative to the other. Universal joints have an inequality in rotation, but working as a set and correctly aligned, the inequality disappears as the other universal joint has the opposite inequality.



Don't cut the torque tubes too short as it's very important to have a full overlap in the clamp and on the oval shaft. The oval shaft should have 25 mm overlap and the torque tube and universal joint each should go 30 mm in the clamp. It's very important to correctly tighten the universal joint and clamp bolts. M8 bolts B have to tightened with 32 Nm (3.2 Kgm). The 6 off M6 bolts of the clamp (A) have to be tightened with 15 Nm (1,5 Kgm).

When mounting the clamp on the universal joint, make sure the key of the clamp is in the opening of the universal joint.



3.0. Test the system

Ask a colleague to slowly turn the wheel from lock to lock and check that:

- The tiller arm reaches the rudder stops and the geometry of the gearbox and tiller lever is correct and equal to port and starboard (2 x 36°).
- All four end points of the lever pins are on one line (see green line in setup illustrations).
- The rotation of the system is correct, so when steered starboard, the boat goes starboard.
- The amount of turns of the steering wheel is correct (1.8 turns for 1:5 boxes, 2.4 turns for 1:6,7 boxes, 2.5 turns for 1:7 boxes and 3.5 turns for 1:10 boxes). When step ratio bevel boxes or 4 way bevel boxes are used, this figure has to be multiplied with 1.22 for each step ratio.
- The draglink and torque tubes don't foul on the boat structure.
- The rose joints do not exceed their designed working angle and bind.

If the above points check out O.K. then ask a colleague to apply the maximum allowed CE loading of 20 Kg on the rim of the wheel with the tiller up against each rudder stop and check that the stops, the gearboxes and the cockpit floor do not flex significantly. When you apply this load, and you feel or hear a sudden clonk, one ore more of the universal joints or clamps aren't tightened properly.

The installation of the Jefa transmission system is now complete.

We hope you enjoy your Jefa transmission system – the finest system afloat!

4.0. Maintenance hints

Your Jefa transmission steering system has been designed and manufactured to the highest standards to provide many years of trouble free service. To get the best from your system there are some simple maintenance hints:

- At least twice a season thoroughly clean the pedestal in fresh water and apply a coat of good quality car wax polish.
- If any paint has accidentally chipped, immediately rub down the area using a fine grade of wet and dry abrasive and touch in with yacht enamel designed for aluminium surfaces. (RAL colour 9010).
- Periodically check that the pedestal bolts, gearbox mounting bolts, universal joint bolts, torque tube clamps bolts, draglink bolts and the tiller lever bolts are securely fastened.
- Check that the system has proper rudder stops.
- Depending on the time used, the delrin balls in the rose joints could ware. These balls are easy to replace by rotating them 90 degrees and pushing them out. Replacement balls are available with part number DLB16.

This is version 1.2 of the Jefa transmission steering installation manual, updates may be available at our online web catalogue www.jefa.com in the installation section.

Jefa Steering ApS
Nimbusvej 2
2670 Greve
Denmark
Tel: +45 46 155210
Fax: +45 46 155208
info@jefa.com