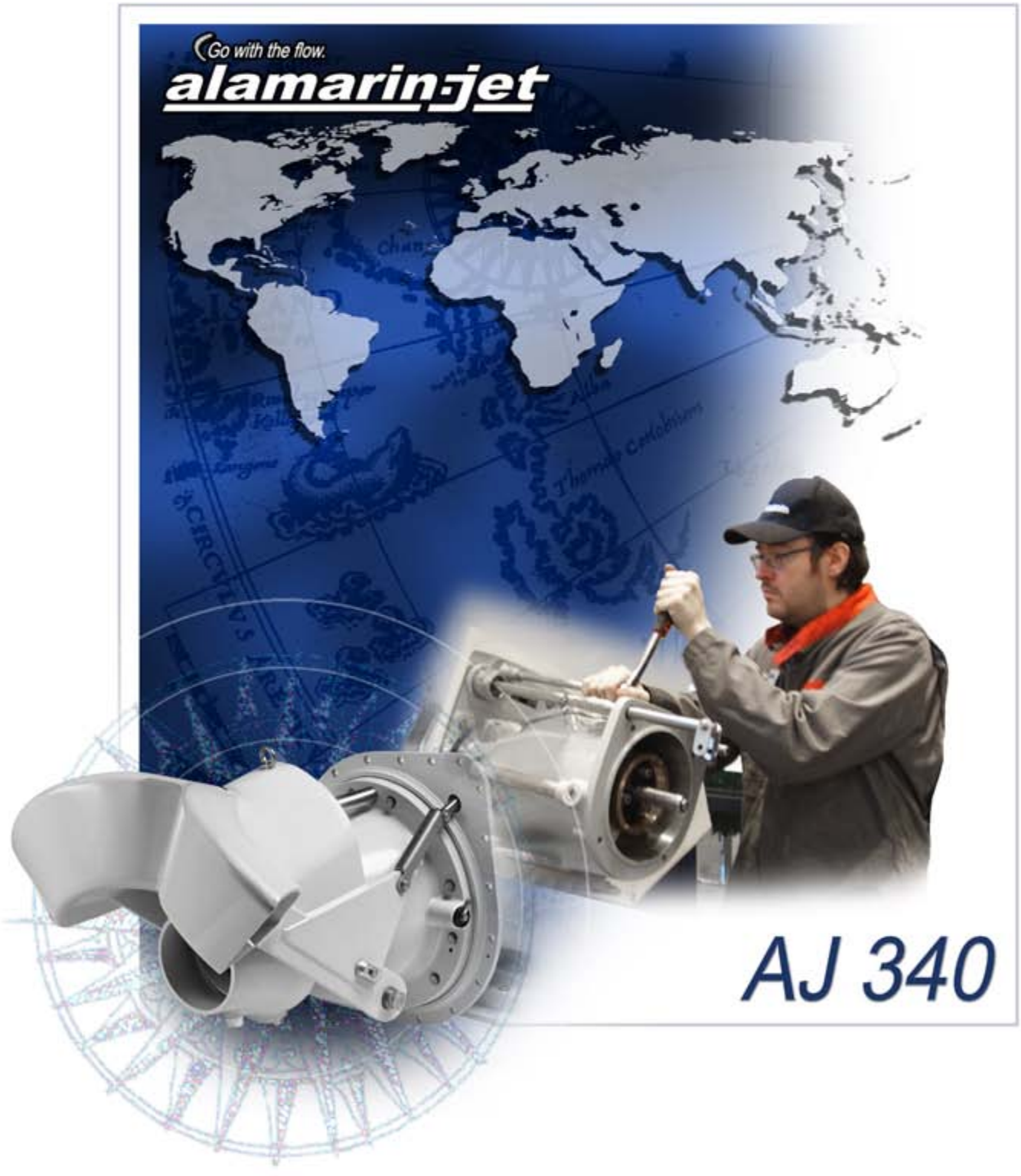
Installation Manual



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1. Introduction

This is the installation manual for Alamarin-Jet's AJ 340 water jet propulsion unit. This manual is intended for mechanics who install the Alamarin-Jet water jet propulsion unit to a suitable boat.

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1.1. Safety precautions

Read these instructions carefully before carrying out any procedures. Always follow these instructions and the safety precautions shown below.

- Only a person with adequate training is allowed to carry out the procedures described in this manual.
- The person carrying out the procedures must always wear the appropriate protective equipment.
- The work premises must be sufficiently large, safe and well-lit.
- The tools that are to be used must be clean and appropriate for the intended purpose.

1.2. Symbols

Please refer to table 1 for a description of the symbols used in this manual.

Table 1. The symbols used in the manual

Icon	Description
	DANGER Negligence in the performance of a procedure can cause a threat to your life.
	WARNING Negligence in the performance of the procedures can lead to personal injury, breakdown of equipment, or serious malfunction of the equipment.
	CAUTION The procedure involves minor danger or a possibility of minor damage to equipment.

Icon	Description
	WARRANTY The warranty is voided if the procedure is carried out incorrectly.
	NOTE Important notice or fact.
	TIP Additional information that facilitates the performance of work or a procedure.
	CARRIED OUT BY ONE PERSON One person can carry out the procedure.
	CARRIED OUT BY TWO PERSONS Two persons must carry out the procedure.
	INDICATOR ARROW
	ARROW DESCRIBING MOTION

Please note that this instruction uses the terms "jet" and "jet propulsion unit". They mainly refer to the same thing.

2. General description of installation

Alamarin-Jet water jet propulsion units can be installed on a reinforced plastic, aluminium, steel, polyethylene, or wooden boat.

Perform the installation in the following order:

1. Prepare the boat's hull for installation and install the bottom adapter (section 4. *Installation on an aluminium boat*, page 7 and section 5. *Installation on a boat made from some other material*, page 11).
2. Attach the propulsion unit and install the stern adapter (section 6. *Attaching the propulsion unit*, page 17).
3. Install the control system (section 7. *Installing the control system*, page 33).
4. Install the engine (section 8. *Engine installation*, page 41).
5. Paint the propulsion unit with antifouling paint (section 9. *Antifouling*, page 43).

   This is only necessary if the boat is used in waterways where organisms are likely to attach themselves to the propulsion unit.

3. Bottom adapter and stern adapter

The Alamarin-Jet water jet propulsion unit is installed on the boat using a bottom adapter and a stern adapter.

3.1. Bottom adapter

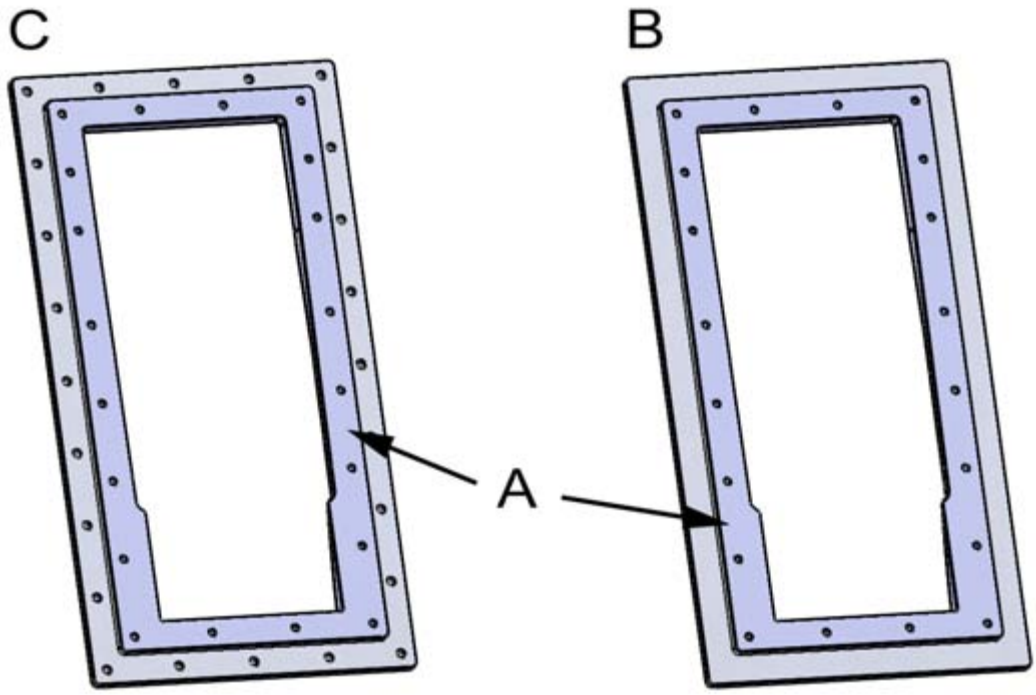


Figure 1. Mounting template

A Propulsion unit installation surface
B Bottom adapter for welding installation
C Bottom adapter for bolted installation

The aluminium bottom adapter is suitable for flat-bottom installation as is. The bottom adapter is available in versions suitable for bolted and welded installations. Their difference is in the bolt holes drilled in the bolt installation piece.

The installation surface (figure 1, point A) must be aligned with the keel. The main shaft of the propulsion unit is then slanted 5º downwards in relation to the keel. If the design of the boat requires a different thrust angle, the matter must be handled and arranged with Alamarin-Jet Oy.

3.2. Stern adapter

Figure 2. Stern adapter

The aluminium stern adapter connects the propulsion unit to the boat’s stern. The adapter is installed 5° in excess of a straight angle in relation to the keel and the installation surface of the bottom adapter. The stern area to which the adapter is attached must be at a 5° inclination in relation to the keel in such a way that the main shaft of the propulsion unit is at a 5° downward slant (figure 7, points A and B)

4. Installation on an aluminium boat

4.1. Preparations for installing the bottom adapter and stern adapter

This section explains the preparations required by the welded installation of the bottom adapter and stern adapter. Do not attach the stern adapter to the boat's stern until the jet has been attached to the bottom adapter installed in the bottom of the boat.

In order to attach the adapters, cut holes of a suitable size to the stern and bottom of the boat for attachment. The bottom adapter can be welded onto aluminium boats. In welded installation, the bottom adapter is welded to the flat bottom of the boat's hull. The stern adapter is always bolted to the stern, regardless of the boat's hull material.

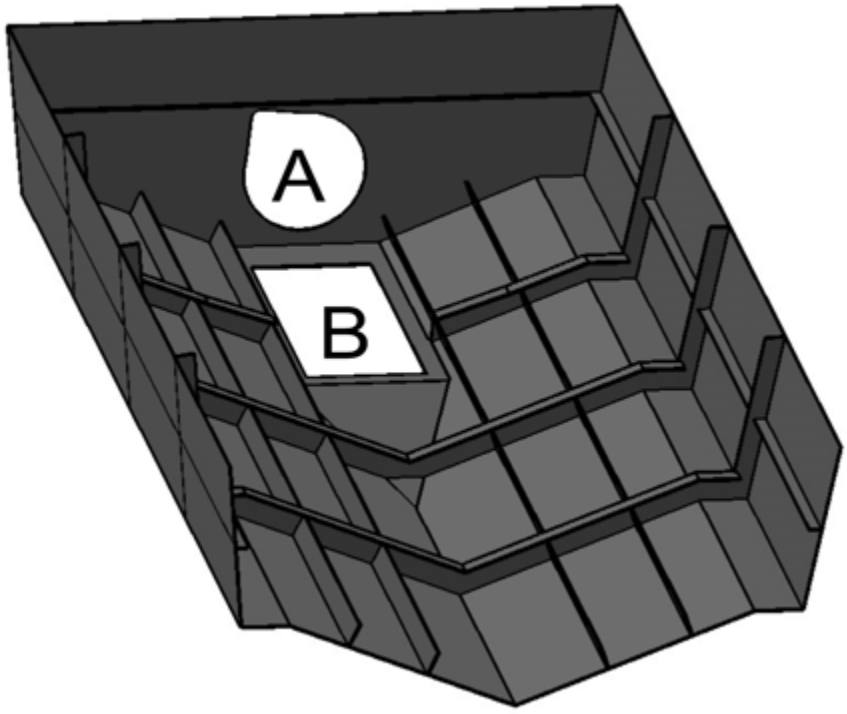


Figure 3. Bottom adapter and stern adapter holes in the hull

Cut a hole in the bottom of the boat for the bottom adapter (figure 3, point B), and cut a hole in the stern for the stern adapter (figure 3, point A).

The dimensions of the hole in the bottom must match the outer dimensions of the bottom adapter's installation flange, to ensure that the clearance between them is as small as possible. The bottom adapter must be installed in such a way that its bottom surface is flush with the boat's flat bottom (figure 4).

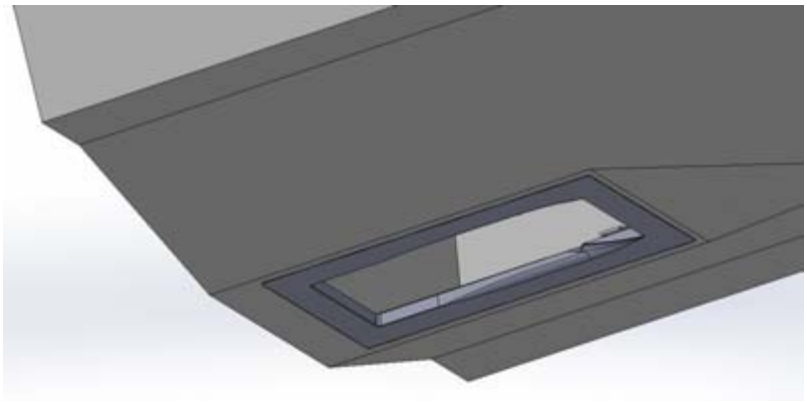


Figure 4. Bottom adapter in the flat bottom of the boat

The distance and angle between the bottom adapter and the stern adapter holes must be dimensioned precisely to enable the installation of the propulsion unit. The angle between the stern and the keel line must be 5° in excess of a straight angle at the position of the propulsion unit installation. The figure below (figure 5) illustrates the positions of the holes in a longitudinal cross-section of the boat. The dimensions are from the angle formed by the stern and flat bottom of the boat's exterior to the edge of the hole to be cut.

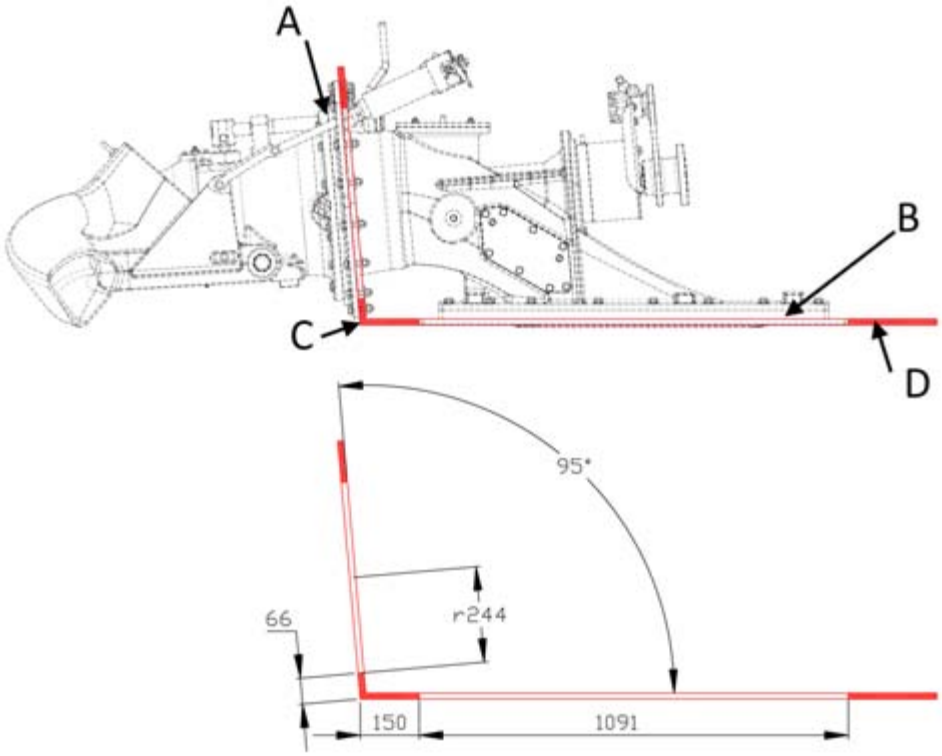


Figure 5. Hole positions in the boat hull (welded installation)

A Stern adapter

B Bottom adapter

C The angle formed by the stern and bottom of the boat outside the boat's hull

D The thickness of the boat hull shown in the figure is illustrative and does not correspond to the actual thickness of the boat hull.

Viewed from above, both holes must be positioned transversely in such a way that the centre point of the bottom adapter hole and the centre point of the larger arch of the stern adapter hole are aligned with the keel line (figure 6, point C).

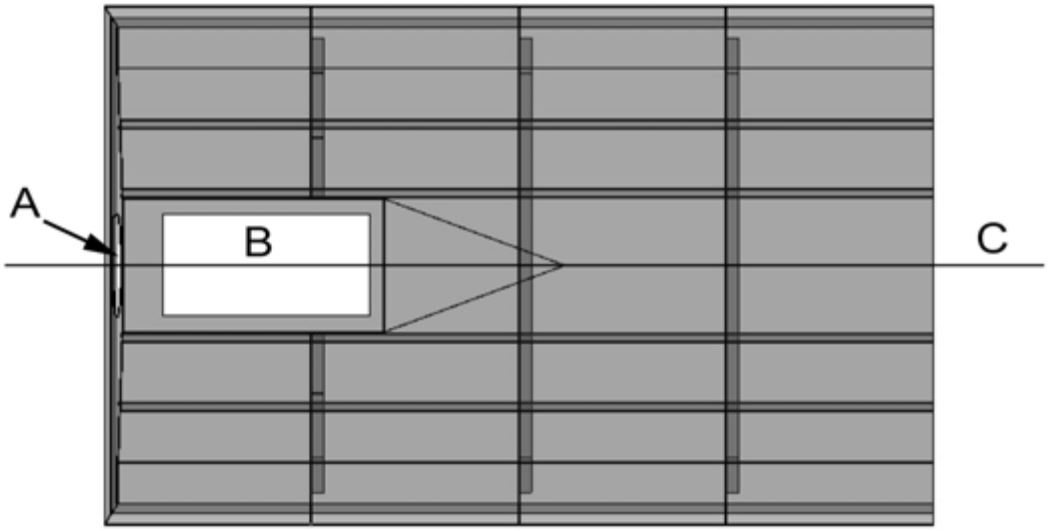


Figure 6. Hole position in relation to keel line

A Stern adapter hole
B Bottom adapter hole
C Keel line

Tentatively fit the adapters in the boat hull before the final installation and ensure that they sit firmly in place in relation to the edges of the cut holes, and that the angle between them enables the installation of the propulsion unit (figure 7).

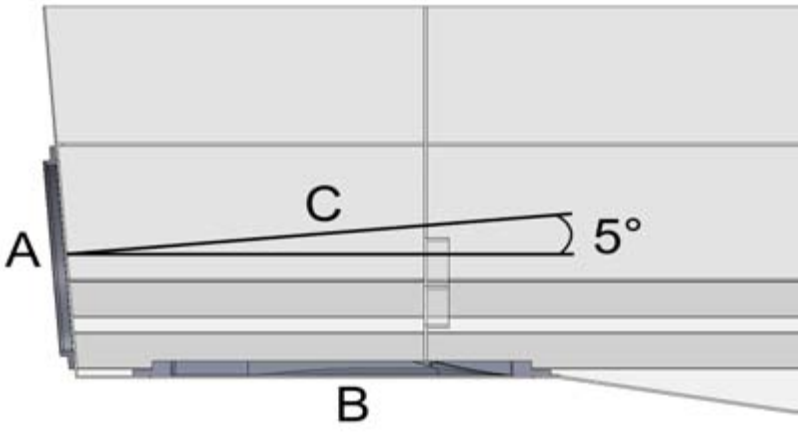


Figure 7. Fitting in the bottom adapter and stern adapter

A Stern adapter
B Bottom adapter
C Shaft line

When the adapters are installed correctly, the main shaft is at a 5° downward slant (figure 7, points A and B).

NOTE!

The lower surface of the bottom adapter must be level with the outer surface of the boat’s flat bottom (figure 4).

The edge of the bottom adapter must be parallel with the boat's keel (= the edge of the hole).

If this is not the case, the boat’s bottom will have differences in elevation that may cause ventilation or cavitation.

The distance and angle between the bottom adapter and stern adapter must be dimensioned carefully to enable the installation of the jet.

4.2. Installing the bottom adapter

Before installation, cut a hole in the bottom of the boat (section 4.1. *Preparations for installing the bottom adapter and stern adapter*, page 7).
The aluminium bottom adapter can be attached to an aluminium boat hull by welding. Bolted installation is also possible, but welding provides certain benefits over using bolts:

- A good welded seam seals the seam between the bottom adapter and boat hull.
- In this way, the bottom adapter becomes a fixed part of the hull, which minimises the number of possible leaks and ensures a more balanced power transmission between the propulsion unit and hull.

1. Weld the bottom adapter to the hull from the inside and outside in a waterproof manner.
2. Grind the weld seams. Any uneven spots at the bottom must be trimmed by caulking, for example.

The bolted installation of the bottom adapter is explained in section 5. *Installation on a boat made from some other material*, page 11.

5. Installation on a boat made from some other material

5.1. Preparations for installing the bottom adapter and stern adapter

This section explains the preparations required by the installation of the bottom adapter and stern adapter on a boat made from a material other than aluminium. Do not attach the stern adapter to the boat's stern until the jet has been attached to the bottom adapter connected to the bottom of the boat.

In order to attach the mounting template and stern adapter, cut holes of a suitable size to the stern and bottom of the boat for attachment.

NOTE!

Sandwich laminate boats:

The installation area of the propulsion unit must be solid laminate. Bevel the core material of the sandwich laminate surrounding the area to ensure that the structure transitions from sandwich laminate to solid laminate in a sufficiently even manner.

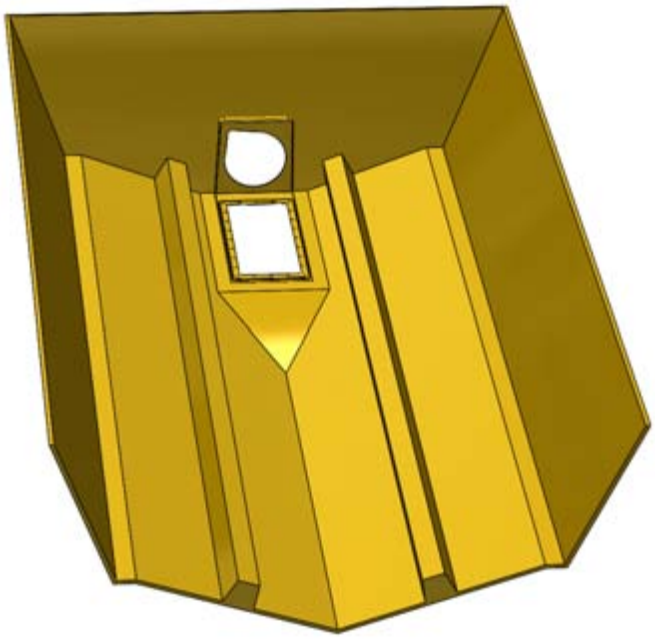


Figure 8. Bottom adapter and stern adapter holes in the hull

Bolting the bottom adapter to the boat's hull requires the installation area to be shaped differently than that of the welded installation used for aluminium boats. The flat bottom of the boat must feature an indentation to ensure that the lower surface of the bottom adapter is installed flush with the outer surface of the boat's flat bottom. The cross-section below (figure 9) indicates how the bottom adapter settles in the indentation in the flat bottom so that the lower surface (figure 9, point B) is flush with the lower surface of the flat bottom.

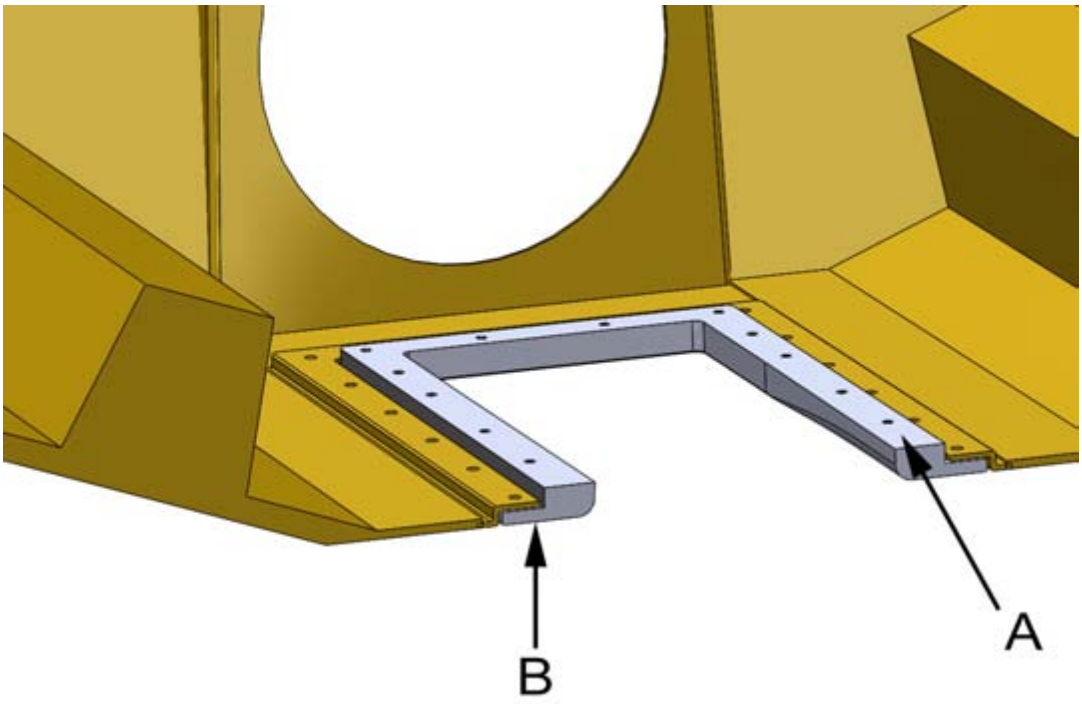


Figure 9. Indentation in the flat bottom

A Installation surface for the propulsion unit on the bottom adapter
B Lower surface of the bottom adapter

Cut a hole the size of the external dimensions of the bottom adapter's installation surface for the propulsion unit (figure 9, point A) in the boat's bottom in such a way that the installation surface goes inside the boat, as shown in the cross-section above. The figure below illustrates the positions of the holes measured from the same point.

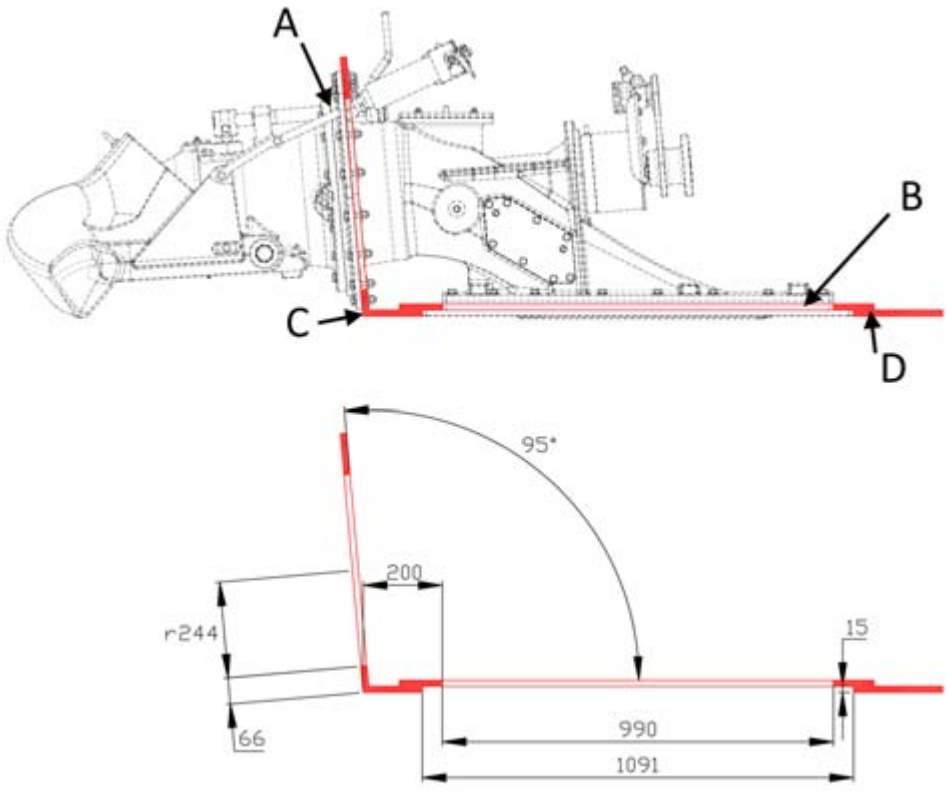


Figure 10. Hole positions in the boat hull (bolted installation)

A Stern adapter

B Bottom adapter

C The angle formed by the stern and bottom of the boat outside the boat's hull

D The thickness of the boat hull shown in the figure is illustrative and does not correspond to the actual thickness of the boat hull.

Viewed from above, both holes must be positioned transversely in such a way that the centre point of the bottom adapter hole and the centre point of the larger arch of the stern adapter hole are aligned with the keel line.

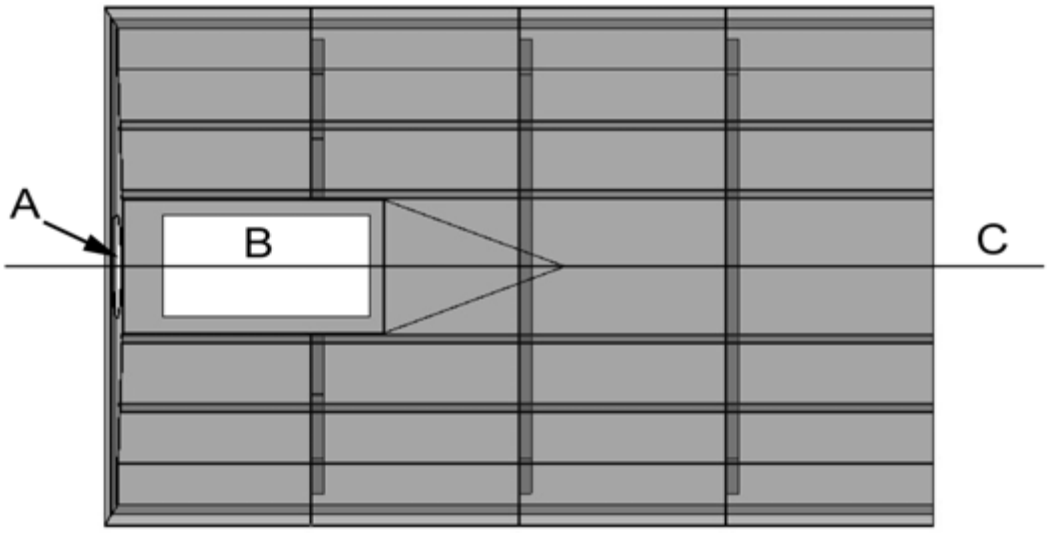


Figure 11. Hole position in relation to keel line

A Stern adapter hole
B Bottom adapter hole
C Keel line

5.2. Installing the bottom adapter

If the material of the boat's hull is something other than aluminium (e.g. polyethylene, steel, wood, reinforced plastic), the bottom adapter must be installed with bolts.

The installation of the bottom adapter can be initiated if a correctly sized hole has been cut in the boat's bottom and the shape of the bottom enables the installation, section 5.1. *Preparations for installing the bottom adapter and stern adapter*, page 11.

1. Use the bottom adapter to determine and mark the positions of the bolt holes around the hole cut in the boat's bottom.

   The bottom adapter is attached to the flat-bottomed area with 24 M14 bolts. However, please note that the bottom adapter must be removed for the duration of drilling the holes.

2. Seal the seam between the bottom adapter and boat bottom with the appropriate sealing compound (e.g. Sikaflex 221).

   Before spreading the sealing compound, ensure that the surfaces to be sealed are sufficiently clean and dry, and as even as possible. In addition to this, each bolt hole must be carefully sealed with sealing compound. Spread sealing compound on the surface of the bottom adapter and the boat's bottom. The quantity applied must be such that when the bottom adapter is attached to the boat's bottom, some compound is squeezed evenly out of the adapter seams, both inside and outside the hull. If sealing compound is not squeezed out of a part of the seam, it must be assumed that the section in question is not tight and sealing compound must be added. The manufacturer's instructions must be observed when using sealing compound.

3. Set the bottom adapter in place so that the bolt holes in the boat's bottom and the bottom adapter are aligned.

4. Apply sealing compound on the bolts and threads, and push the bolts through the holes from outside the boat so that the nuts can be installed inside the boat.

5. Tighten the bolts.

   Ask an assistant inside the boat to help you tighten the bolts. Ensure that a sufficient amount of sealing compound is squeezed out of the seams, in accordance with the instructions in section 3.

6. Attaching the propulsion unit

The propulsion unit is attached to the boat one part at a time. Attachment is carried out in the following order:

1. Propulsion unit body
2. Lubrication system for the bearings
3. Hydraulic cylinder
4. Hydraulic pump
5. Cooling line for hydraulic cylinder oil

6.1. Preparations

Detach the following parts of the propulsion unit:

1. stator anode, plug, anode conductor (figure 12) and the screw in the same place on the opposite side of the stator
2. reversing deflector

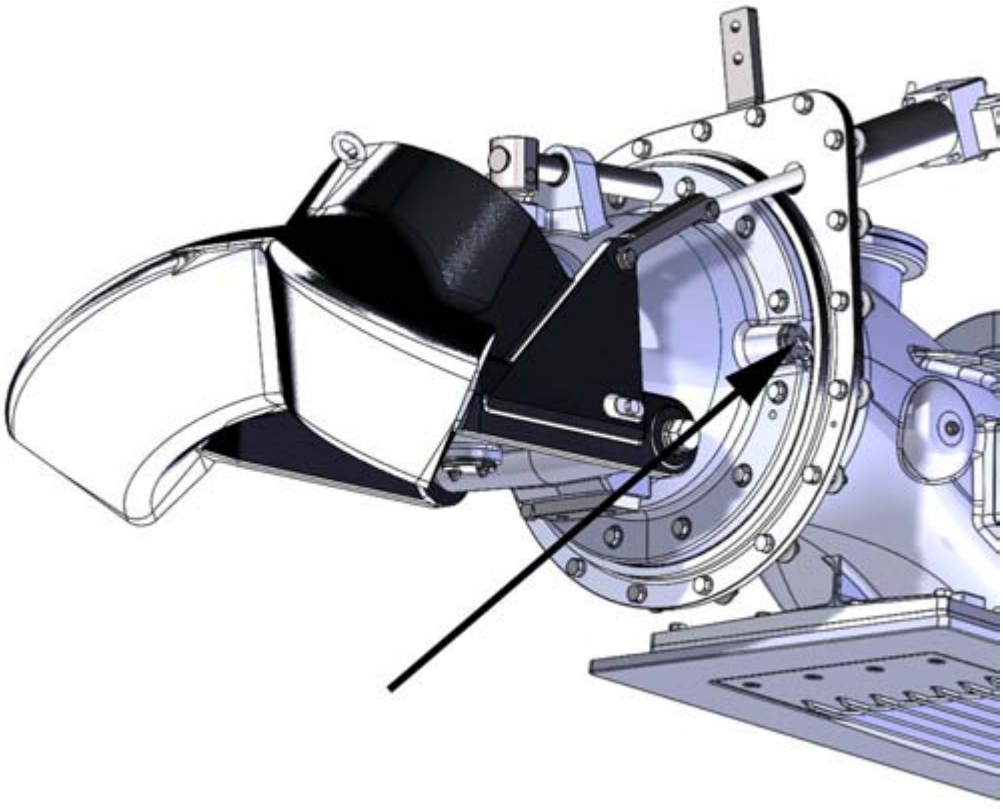


Figure 12. Stator anode, plug and anode conductor

WARNING!

When removing the hydraulic cylinder, the piston rod must not twist 180°. The cylinder will not work properly if that occurs.

6.2. Attaching the body

Attaching the body of the propulsion unit to the boat:

1. Ensure that the hole cut for the stern adapter is in the correct position in relation to the propulsion unit body. If this is not the case, patch or cut the hole to a suitable form.

2. Apply sealing compound (e.g. Sikaflex 221) on the outer edge of the attachment surface on the bottom of the propulsion unit body, and on the edge on the intake duct side (figure 13, point A). Sealing compound should also be applied on the installation surface of the bottom adapter.

   The propulsion unit body should be lifted to a position that enables easy lifting into the boat after the sealing compound has been applied.

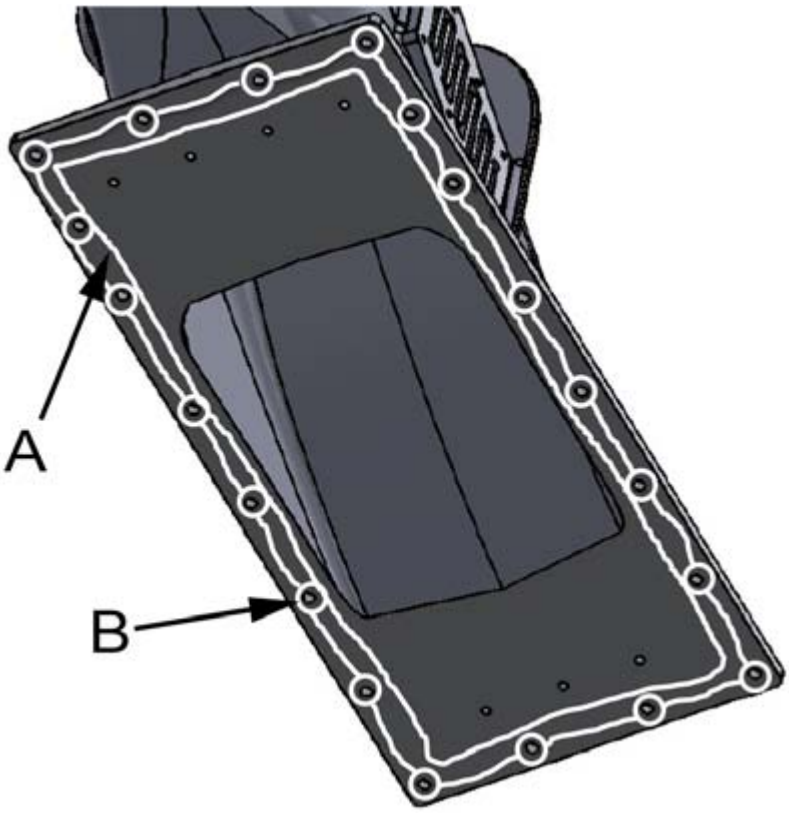


Figure 13. Installation surface on the bottom of the propulsion unit body

3. Apply compound in the fastening bolt (20 pcs) holes (figure 13, point B).

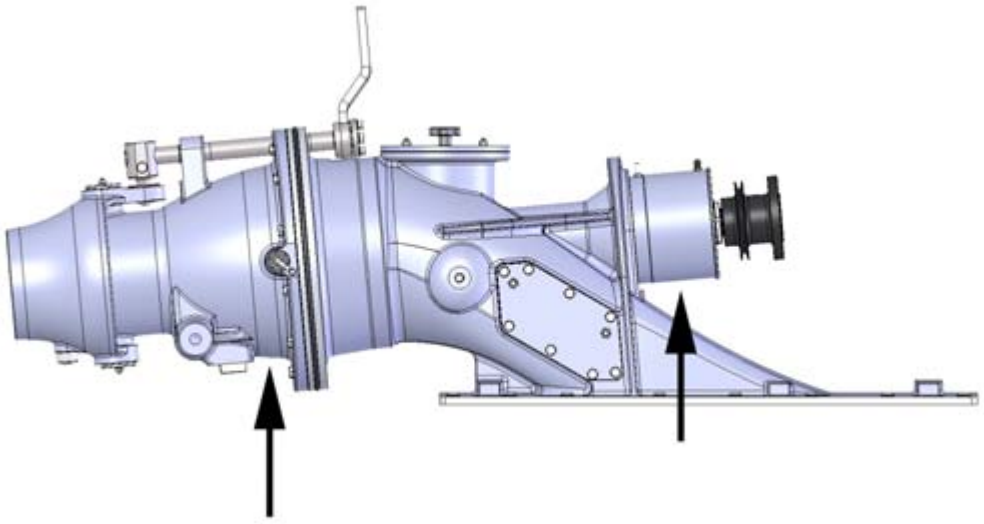


Figure 14. Lifting points

4. Lift the propulsion unit body into place on the bottom adapter and push the fastening bolts into the holes.

   The lifting points of the propulsion unit are shown in the figure above (figure 14).

5. Ask your assistant inside the boat to fasten the nuts.

6. Tighten the nuts evenly on opposite sides at the same time, and make sure that some sealing compound is squeezed out on every side.

7. Wipe the excess compound off the outer edges and intake duct.

6.3. Installing the stern adapter

Do not install the stern adapter until you have attached the propulsion unit to the bottom adapter installed in the boat's bottom. The stern of the boat must feature a correctly sized hole for installing the adapter (section 4.1. *Preparations for installing the bottom adapter and stern adapter*, page 7).

CAUTION!

The rotation position of the stern adapter must be correct. If this is not the case, the propulsion unit cannot be installed correctly and the hydraulic cylinder and intermediate rod are subjected to twisting forces.

The adapter is attached to the stern with 20 M12 bolts, for which matching holes must be drilled into the stern.

1. Place the adapter on the stern-side installation flange of the propulsion unit body and mark the positions of the boreholes in the stern.

   However, you must remove the stern adapter for the duration of drilling the holes.

2. Drill the holes in the stern.

3. Seal the seam between the adapter and boat stern with the appropriate sealing compound (e.g. Sikaflex 221).

   Before spreading the sealing compound, ensure that the surfaces to be sealed are sufficiently clean and dry, and as even as possible. In addition to this, each bolt hole must be carefully sealed with sealing compound. Spread sealing compound on the surface of the adapter and the stern. The quantity applied must be such that when the bottom adapter is attached to the boat's bottom, the compound is squeezed evenly out of the adapter seams both inside and outside the hull. If sealing compound is not squeezed out of a part of the seam, it must be assumed that the section in question is not tight and sealing compound must be added. The manufacturer's instructions must be observed when using sealing compound.

4. Attach the O-ring seal (figure 15, point A) into the groove in the rim of the stern-side installation flange (figure 15, point B).

   Apply waterproof petroleum jelly onto the surface of the sealing ring to prevent the seal from being damaged during installation.

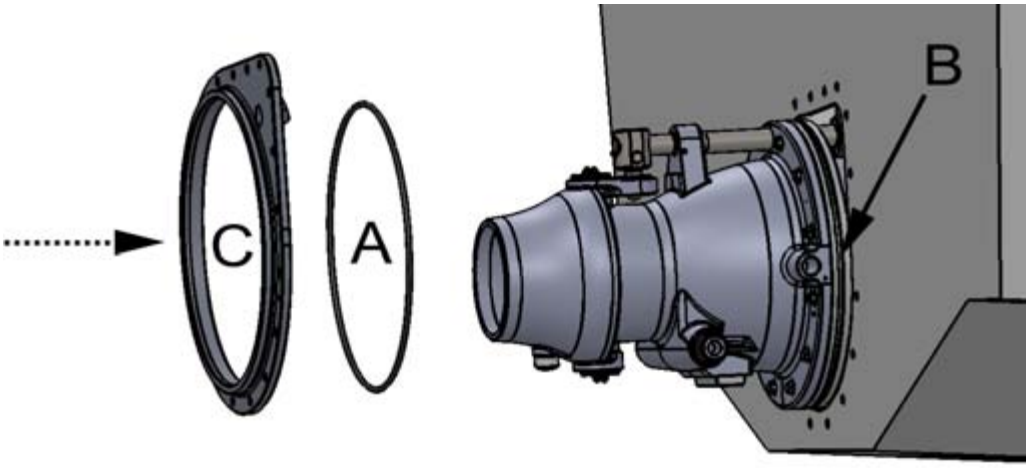


Figure 15. Sealing ring

A Sealing ring
B Sealing ring groove
C Stern adapter

5. Set the stern adapter in place so that the bolt holes in the boat's stern and the stern adapter are aligned.

6. Apply sealing compound on the bolts and threads, and push the bolts through the holes from outside the boat so that the heads remain outside the boat.

7. Tighten the bolts.

   Ask an assistant inside the boat to help you tighten the bolts. Ensure that a sufficient amount of sealing compound is squeezed out of the seams, in accordance with the instructions in section 3.

8. Wipe the excess compound off the outer edges and intake duct.

6.4. Installing the reversing deflector

Attach the reversing deflector to the holes in the stator body with two M24 bolts. A plastic bearing and sleeve go on both sides between the bolt and reversing deflector (figure 16).

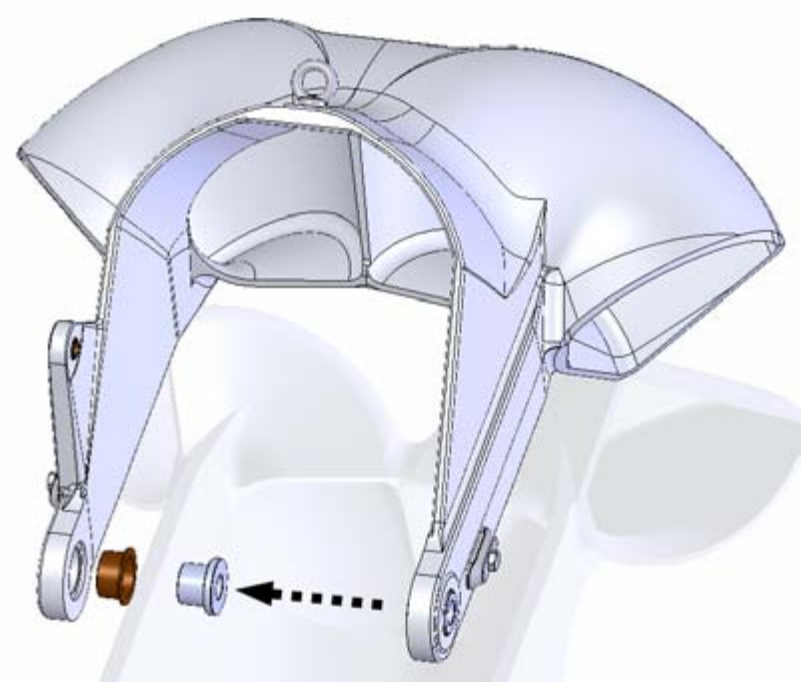


Figure 16. Reversing deflector sleeve and plastic bearing

1. Lift the reversing deflector into place in such a way that the holes in the deflector and stator body are aligned.

2. Insert locking washers and washers on the bolts, and push the bolts through the holes in the reversing deflector (figure 17).

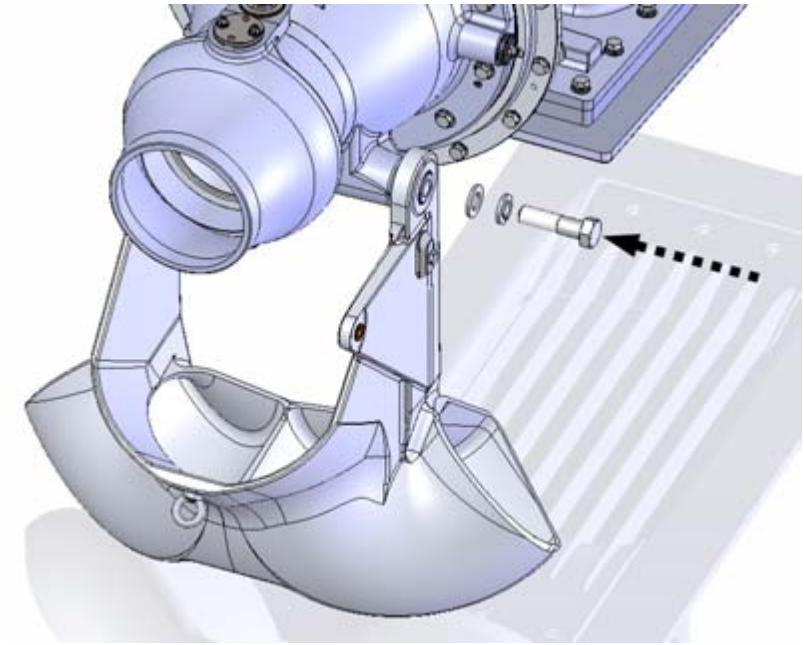


Figure 17. Attaching the reversing deflector

3. Tighten the bolts.

   The tightening torque of the M24 bolt is 250 Nm.

6.5. Installing the bearings and lubrication system

6.5.1. Front bearing

The front bearing carries the axial and radial loads. The bearing is oil-lubricated and the housing is secured with mechanical sealing.

When the shaft rotates, the oil circulates through the reservoir and impurities gather at the bottom of the reservoir on the drain plug magnet.

The oil reservoir included in the system is installed in a suitable place. The need for maintenance (oil change) must be taken into consideration when selecting the location. It must be possible to check the oil level when necessary.

The bearing housing is filled with oil when it is delivered from the factory. The installation must be carefully performed in accordance with the instructions so that the lubrication functions well from the beginning and as little air as possible escapes into the system.

Front bearing installation:

1. Make sure that the oil reservoir is installed (section 6.7. *Attaching the hydraulic pump*, page 27).

   The hoses attached to the reservoir connectors are marked IN and OUT. The side of the bearing housing has the corresponding markings (figure 18, A = IN and B = OUT).

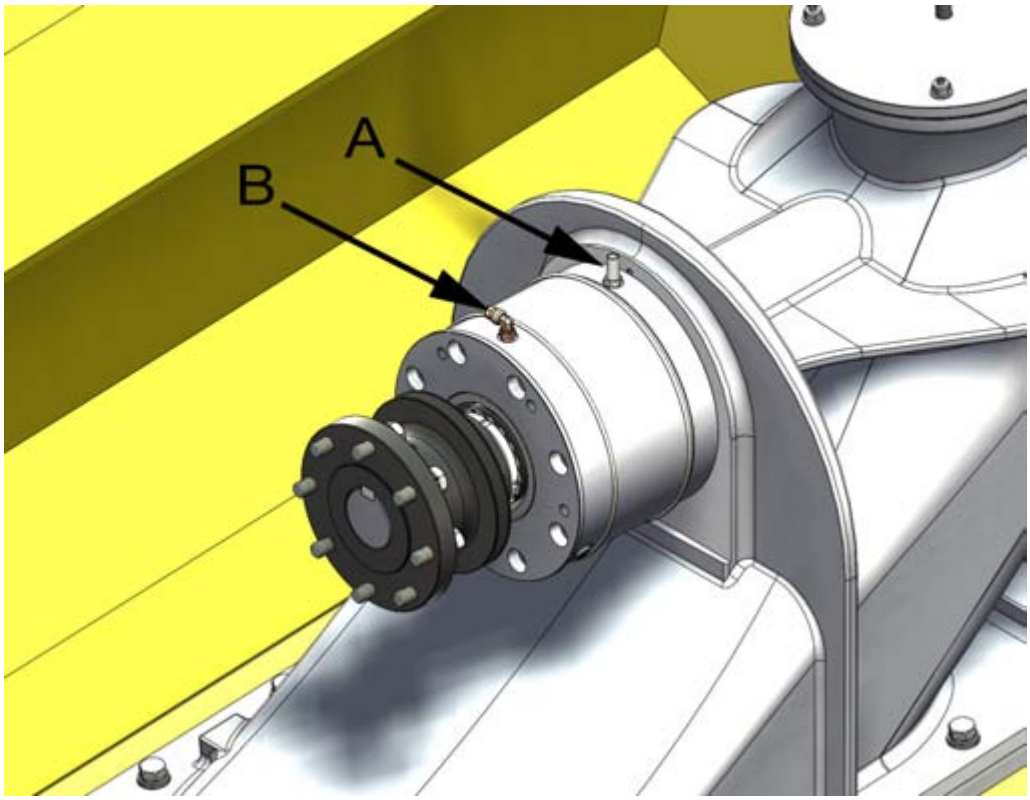


Figure 18. Bearing housing connectors

2. Remove the plugs of the bearing housing’s IN and OUT connectors, insert the hose from the reservoir to the IN connector and tighten the joint with pipe straps.
3. Pour oil into the reservoir and let the hose fill up for approx. 5 minutes.

   The type of oil to use is described in appendix 2. *Oil recommendations*, page 46.

   Keep the hose as straight as possible and shake it occasionally to prevent air pockets from forming. The bearing housing is full of oil when oil seeps out of the OUT connector.
4. Clean the OUT connector, connect system return hose and tighten the joint with pipe straps.
5. Keep adding oil into the reservoir so that as little air as possible drifts into the system.

6.5.2. Rear bearing

The propulsion unit's rear end bearing is either water or grease lubricated, depending on the model. In contrast to the grease-lubricated model, the water-lubricated model may not be used dry. Ample water supply must be ensured to the rear bearing to ensure sufficient lubrication.

The water-lubricated rear end bearing is an open system, and its maintenance interval depends on the water quality.

The rear end bearing of the grease lubricated model is lubricated with petroleum jelly through a grease nipple. The lubrication channel runs from the grease nipple to the rear bearing housing.

The properties of the grease to use are described in appendix 1. *Grease recommendations*, page 45

6.6. Attaching the hydraulic cylinder

Installing the hydraulic cylinder:

1. Treat the threads of the hydraulic cylinder nut (figure 19, section A) with sealing compound (e.g. Sikaflex 221).

2. Screw the nut all the way down on the thread at the end of the cylinder pipe (figure 19, point B).

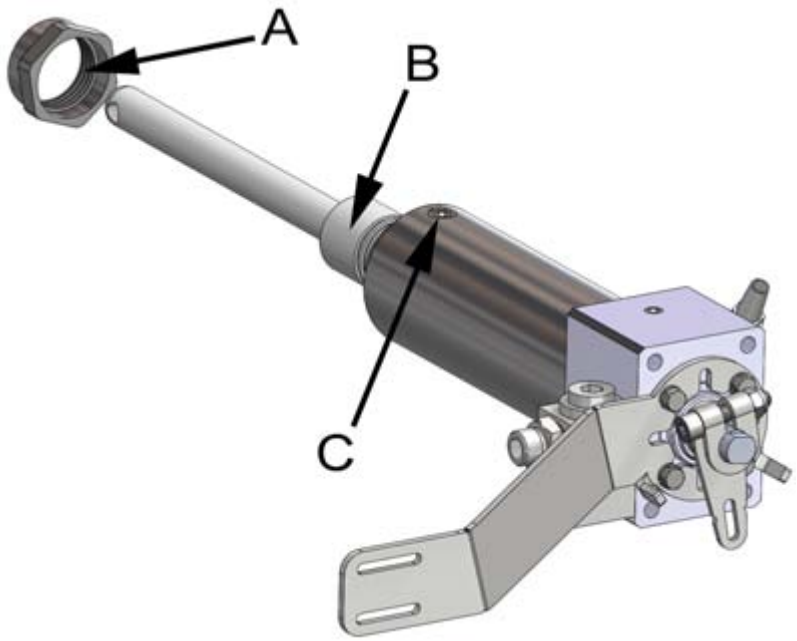


Figure 19. Hydraulic cylinder nut

3. Apply sealing compound (e.g. Sikaflex 221) on the bushing thread of the adapter part in such a way that bushing hole is sealed completely.

4. Screw the hydraulic cylinder onto the adapter bushing (figure 20, point B).

   The hydraulic cylinder (figure 20, point A) must be screwed far enough onto the threads to reach the correct measurement (X=31 mm, figure 22). The correct position of the hydraulic cylinder is determined by the plugs in the cylinder pipe (figure 19, point C), which must face upwards.

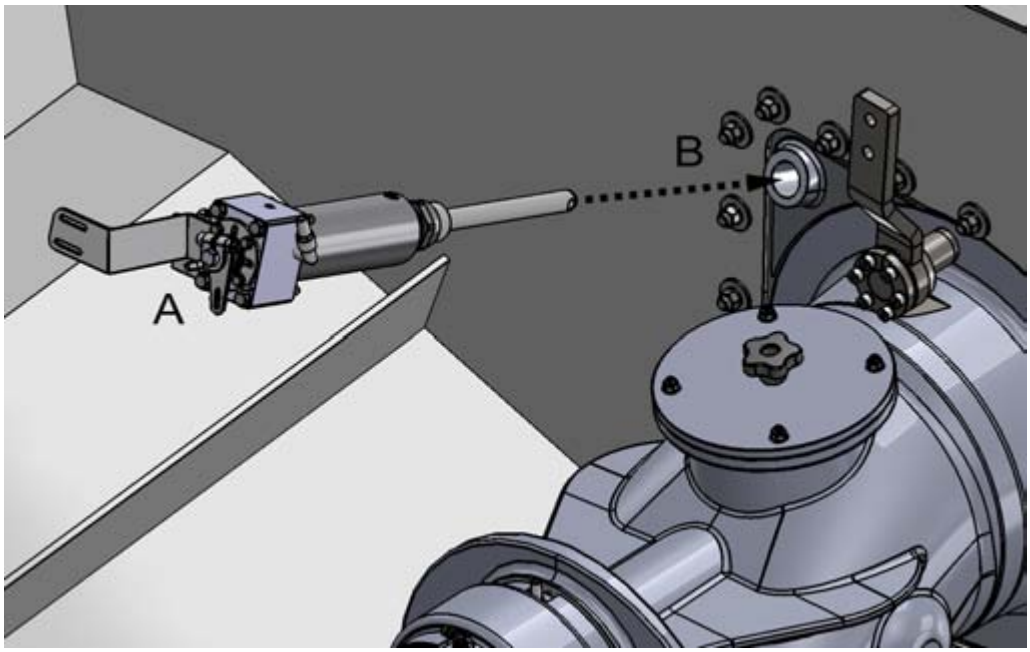


Figure 20. Attaching the hydraulic cylinder

5. Tighten the nut against the adapter part.

   The nut prevents the hydraulic cylinder from moving on the adapter bushing thread.

6. Ensure that sealing compound has been squeezed out of the seams throughout, and wipe the excess compound off the piston rod.

7. Once you have installed the reversing deflector, install the rod between the cylinder and the deflector (figure 21).

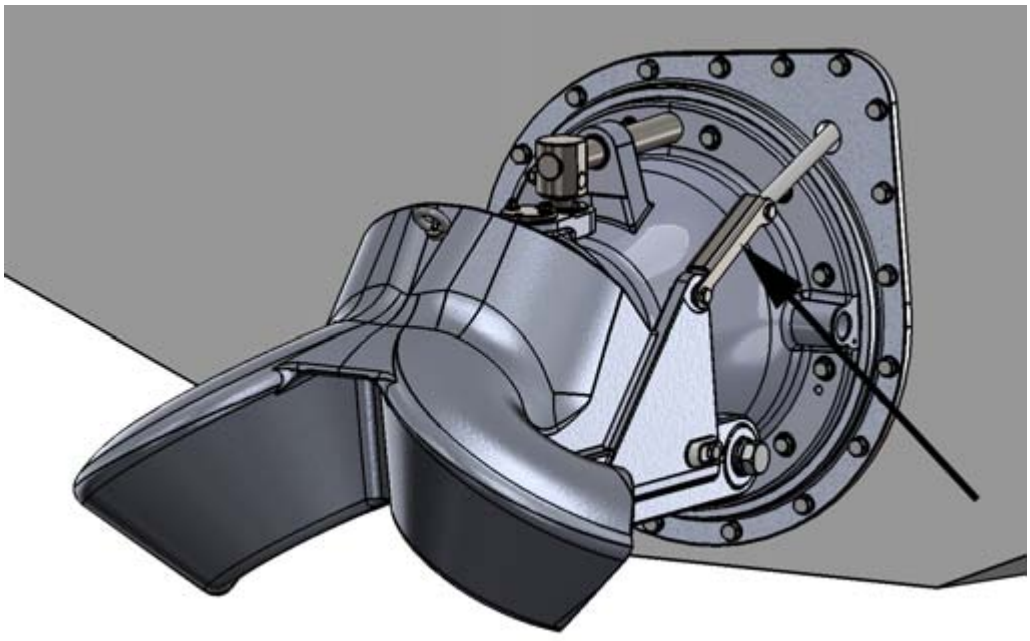


Figure 21. The rod between the hydraulic cylinder and the reversing deflector

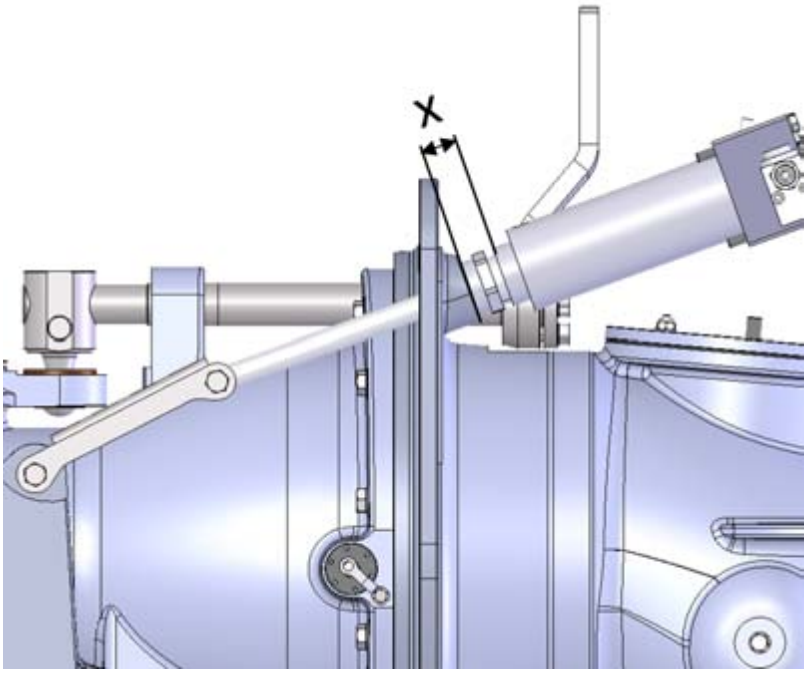


Figure 22. Installation distance of the hydraulic cylinder

8. Ensure that the reversing deflector moves the correct amount.

   Instructions for adjusting the cylinder's movement area are provided in section 7.1.2. *Cylinder adjustment,* page 37.

9. Install the anode and plug (figure 23) and the screw on the opposite side (figure 24) back onto the stator body.

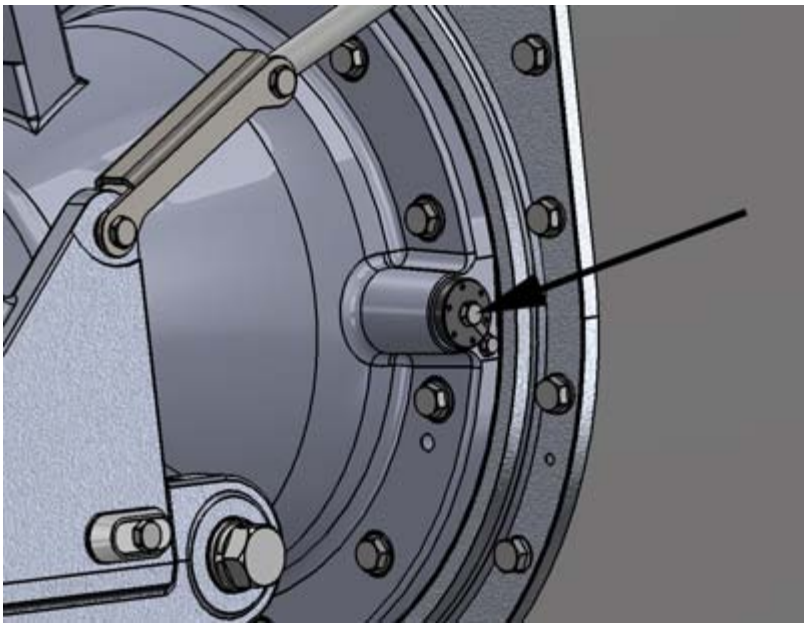


Figure 23. Stator anode

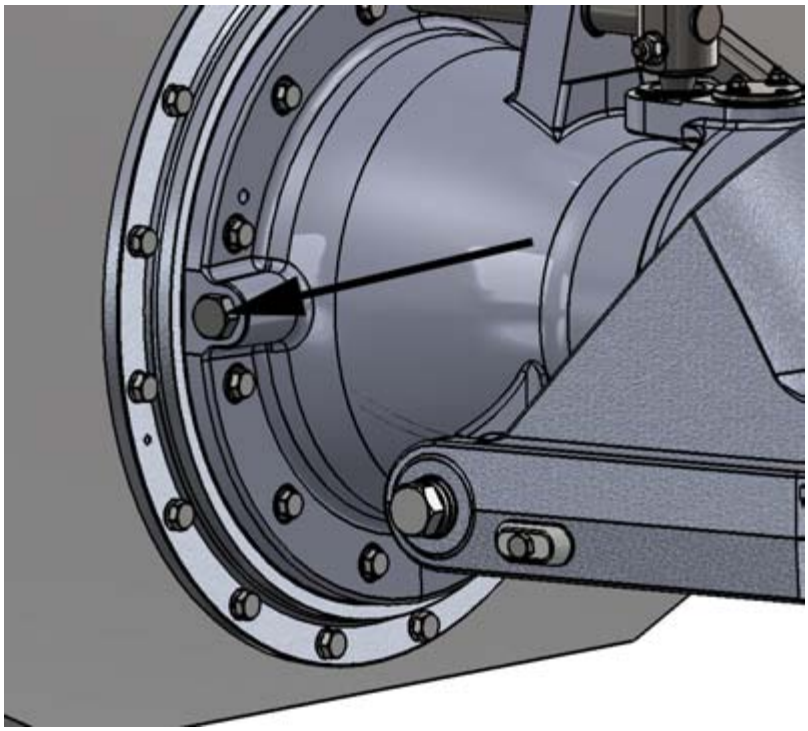


Figure 24. Stator screw

6.7. Attaching the hydraulic pump

Attaching the hydraulic pump:

1. Install the pump rack and the pump with screws to the front surface of the bearing housing.

   Leave the screws slightly loose. There are a total of four screws, two on both sides (figure 25, points C and D).

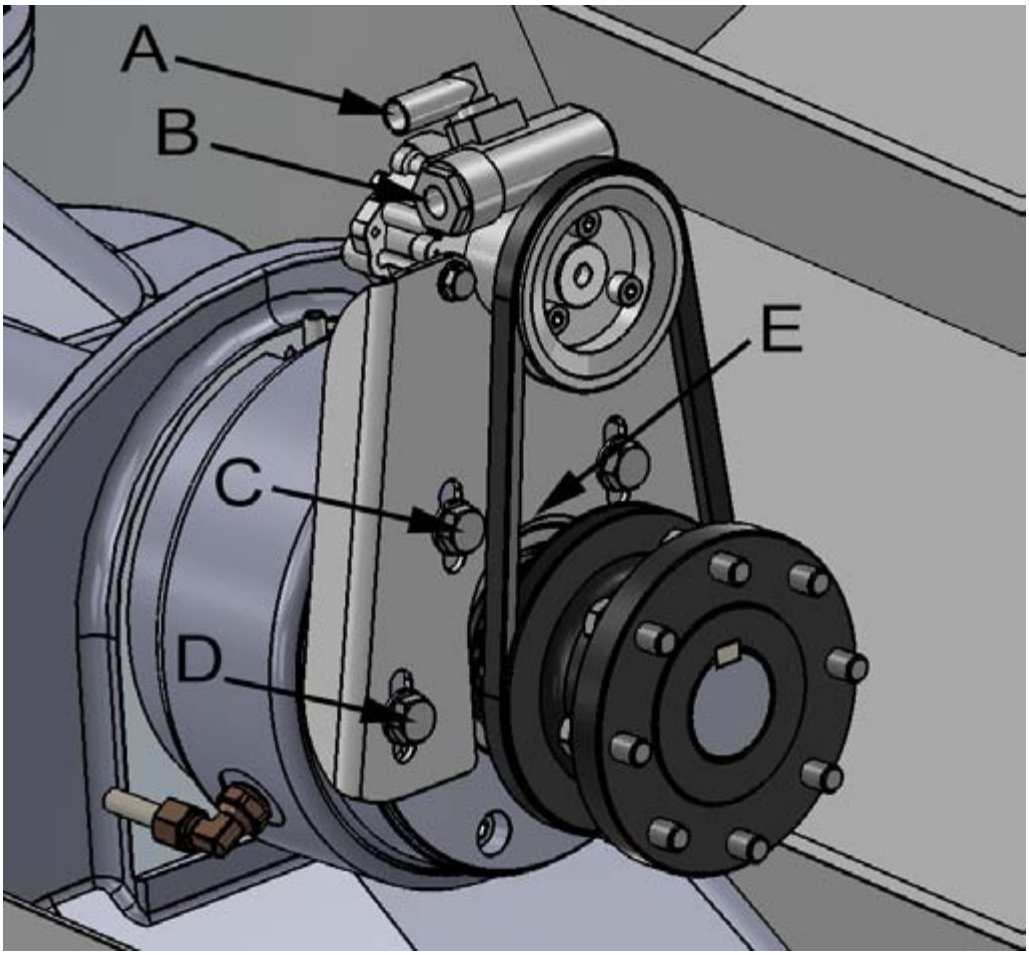


Figure 25. Attaching the hydraulic pump

2. Fit the belt in place.
3. Lift the rack by cranking it from point E indicated in figure 25 .
4. Tighten the screws.

   The tightening torque is 79 Nm.
5. Attach the pressure hose to the connectors (figure 25, point B and figure 26).

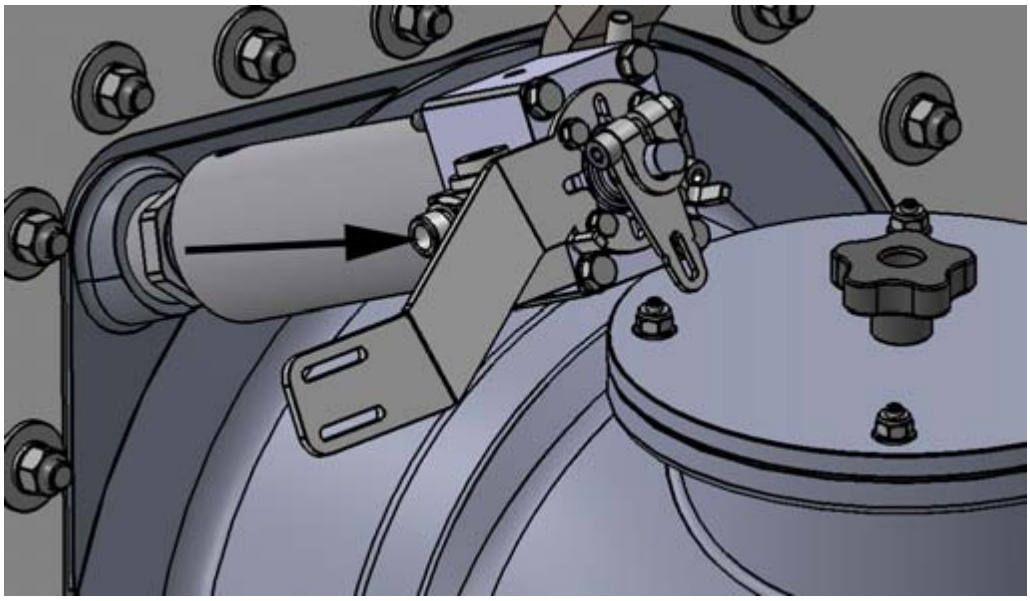


Figure 26. Pressure hose connector in the hydraulic cylinder

6. Attach the oil reservoir hose to connector A (figure 25).

7. Install the oil reservoir and its rack to a suitable place above the pump.

Figure 27. Oil reservoir and rack

Figure 27 The 16 mm (5/8'') connector (A) is intended for the hose that goes to the pump and the 12 mm (1/2'') connector (B) for the return hose.

Checking the oil level

The system must have the right amount of oil. If it is necessary to add oil to the system, add it through the oil reservoir cap (figure 28, point C). There is a dipstick on the reservoir cap with markings for maximum and minimum oil levels (figure 28). The type of oil to use is described in appendix 2. *Oil recommendations*, page 46 .

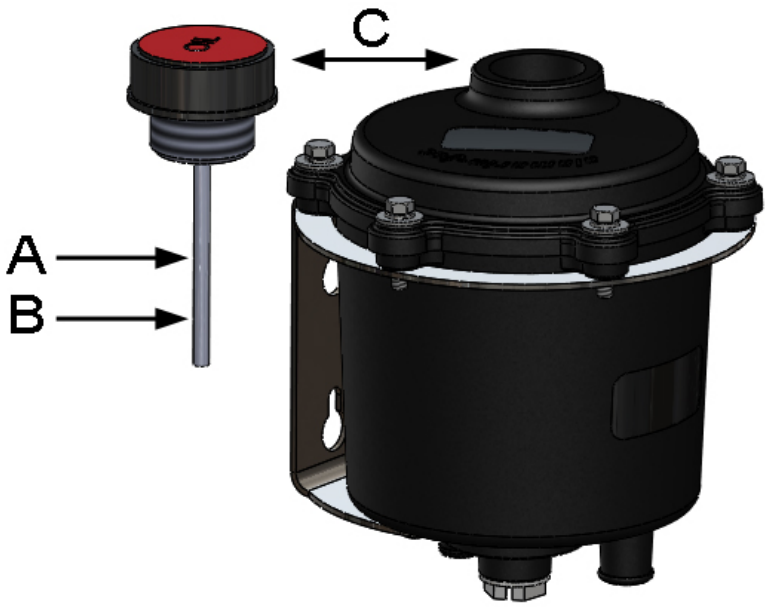


Figure 28. Checking the oil level

A	Maximum level
B	Minimum level
C	Cap

6.8. Installing the cooling line for hydraulic cylinder oil

WARNING!

The system’s pressure is high during operation (max. 82 bar).

Make sure that the hoses do not rub against sharp edges. The bursting of a pressure hose can cause serious danger.

The oil return hose must run to the reservoir through a cooler. The side of the jet features an oil cooler, which can be used to cool hydraulic cylinder oil.

WARRANTY!

If the cylinder oil is not cooled, the guarantee does not cover pump/cylinder failures due to overheating.

Note the following when installing the line:

- The hose that runs from the cooler to the reservoir should be fitted so that it does not have any “swan necks”.

- When you use the propulsion unit for the first time (=after engine installation), check the movement of the reversing deflector and observe the oil level. If the oil level continues to lower even after the line is filled, there is a leak in the system. Find the leak and fix the problem.

6.9. Grass rake

The grass rake (figure 29) is attached with seven M12 screws in front of the intake duct.

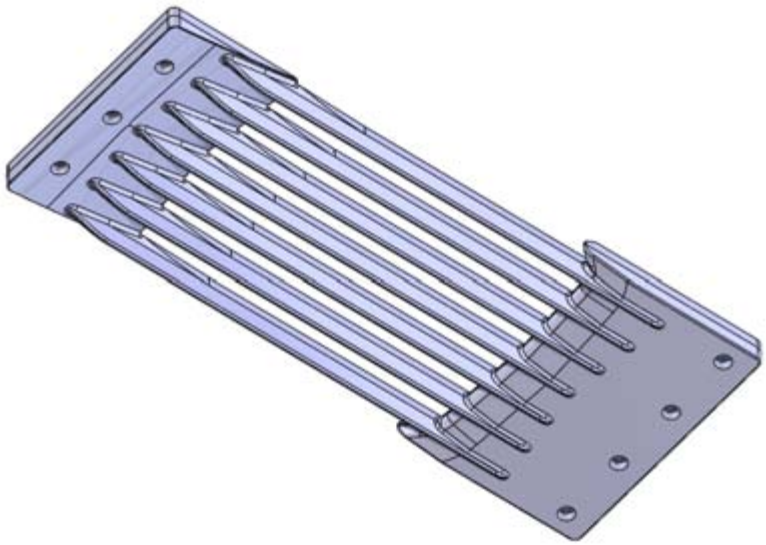


Figure 29. Grass rake

Attaching the grass rake:

1. Seal the fixing area in the same manner as when installing the propulsion unit body.
2. Fit the grass rake in place in the intake duct and tighten the screws in place.

   The normal tightening torque for an M12 screw is 79 Nm.

7. Installing the control system

The propulsion unit's control system must be installed correctly. Incorrect installation of the system will reduce performance.

Because the propulsion unit can be used with or without gears, there are various methods of installation.

Installation Options

- The gear is located between the propulsion unit and the engine.

  A control with two levers, one of which controls the gearbox and the accelerator and the other the reversing deflector.

- Between the propulsion unit and the engine, there is only the intermediate shaft.

  A control with two levers, one of which controls the accelerator and the other the reversing deflector.

- Two propulsion units with a gear.

  Two separate controls with two levers or one control with four levers. The two adjacent levers are used to control the gears and accelerators of both engines, and the other two to control the reversing deflectors.

7.1. Connecting the reversing deflector to the control system

The control cylinder of the reversing deflector is used with the lever (figure 30, point A) that is at the end of the cylinder. The lever has a cable terminal when it is delivered from the factory. However, the cable's inlet direction can be different than the standard direction of the cable support (figure 30, point B). You can turn the cable support plate to point in the desired direction in accordance with the cable's inlet direction.

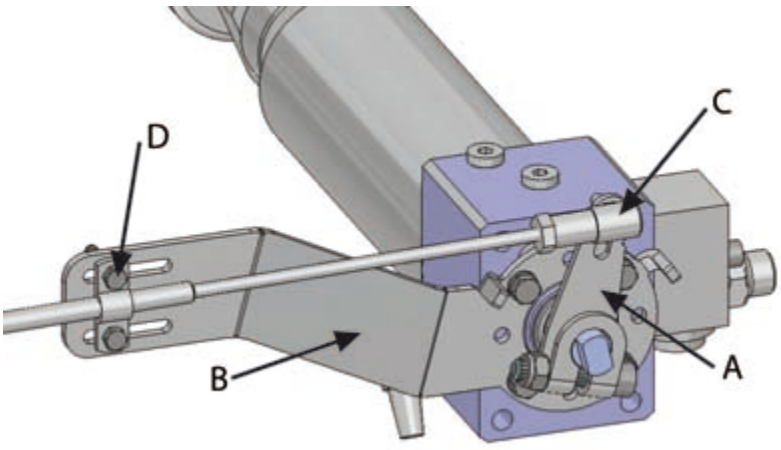


Figure 30. Hydraulic cylinder

Changing the position of the cable support:

1. If the control cable is attached, detach the end of the cable (figure 30, point C) from the cylinder's operating lever and detach the cable fastener from the support plate (figure 30, point D).

2. Loosen the operating lever's fastening screw and pull the lever off the shaft (figure 31).

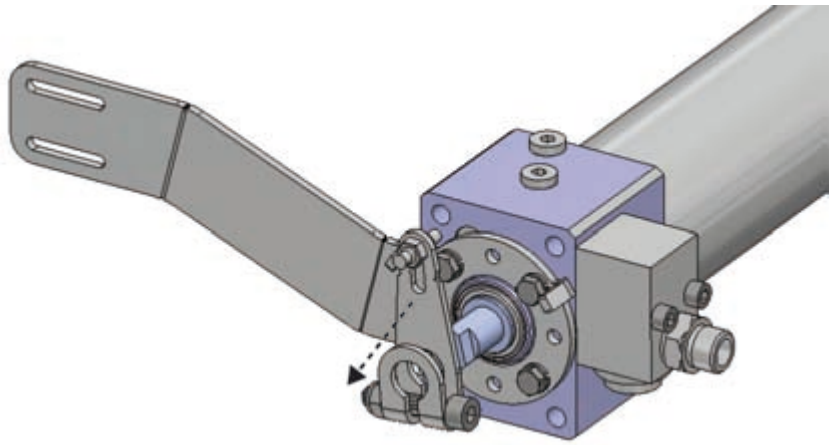


Figure 31. Removing the operating lever

3. Open the fastening screws (four in total, figure 32) that attach the support plate to the cylinder.

   Note that the same screws attach the valve housing to the cylinder pipe. However, if you are careful the valve housing will remain in the cylinder pipe.

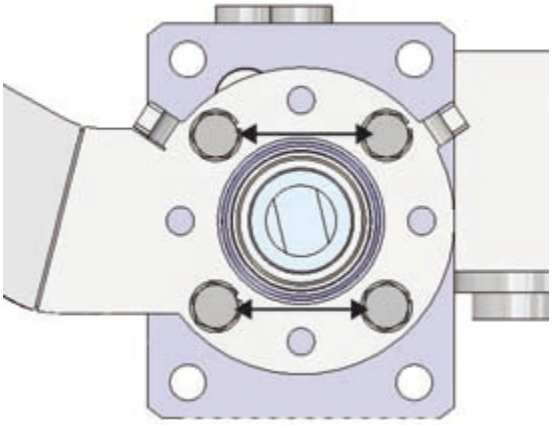


Figure 32. Support plate fastening screws

4. Turn the support plate into the desired position and attach it with screws to the valve housing (tightening torque: 10 Nm (7 lb ft)).

   Check that the support plate or control cable do not interfere with the rotating intermediate shaft, for example.

   The support plate has eight holes, so you can turn the plate at 45° intervals. In figure 33 the plate has been turned 135°.

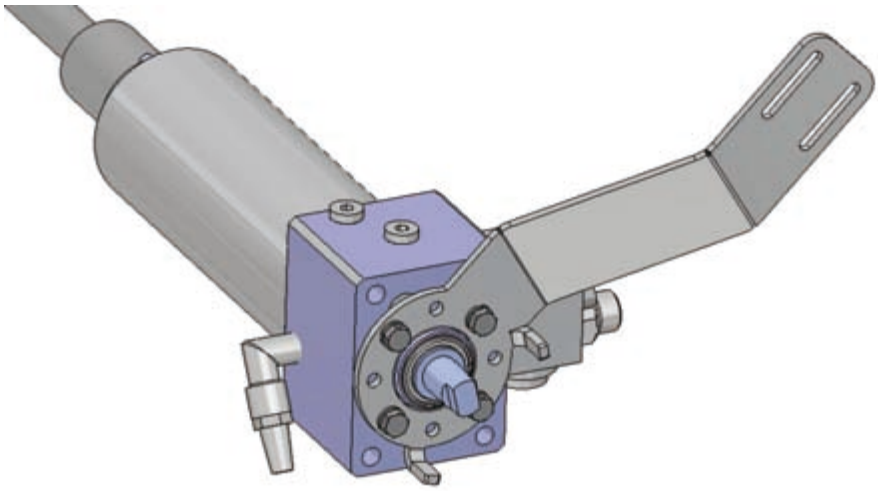


Figure 33. Turned support plate

5. Place the lever (figure 34, point A) on the operating shaft so that it lies between the limiters on the support plate (figure 34, point B).

   The tightening torque of the lever screw is a non-standard 10 Nm (7 lb ft).

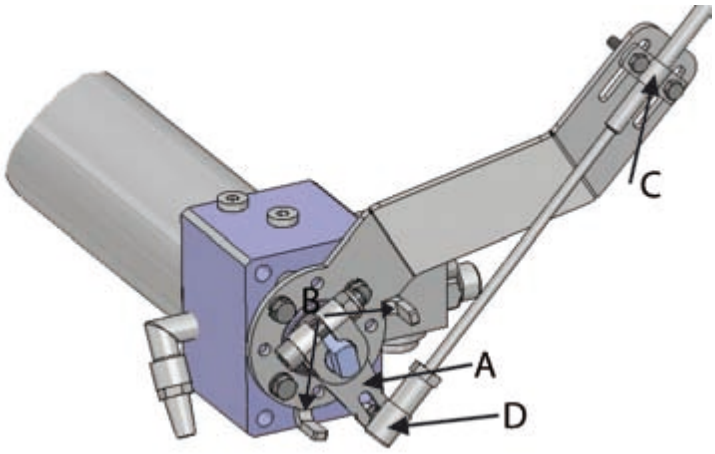


Figure 34. Attaching the operating lever

6. Attach the control cable with a fastener (figure 34, point C) to the support plate and with an angle joint (figure 34, point D) to the lever ball screw.

   The height of the screw attachments at the end of the lever affects the control system stroke length. See appendix 6. *Lever movement ranges* , page 51.

   See the cylinder adjustment instructions in chapter . 7.1.2. *Cylinder adjustment*, page 37.

7.1.1. Connecting the control cables

The control cables are connected from the control system to the reversing deflector, as indicated in figures 35–37 .

Idle running

Both levers (B and C) are in the centre (figure 35)

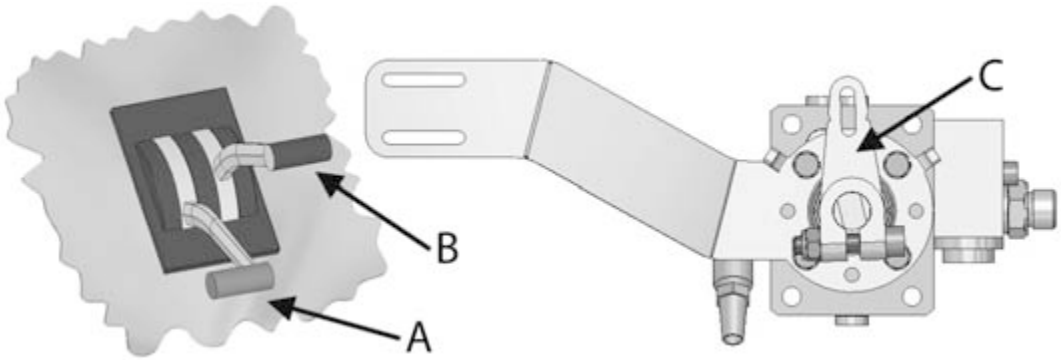


Figure 35. Idle running

A Accelerator
B Reversing deflector
C Steering cylinder's operating lever

Full astern

The control lever is down, the cylinder operating lever on the left (figure 36)

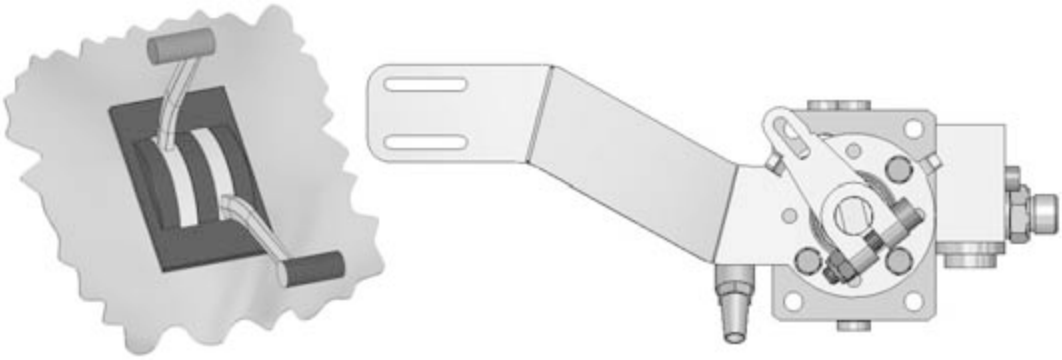


Figure 36. Full astern

Full ahead

The control lever is up, the cylinder operating lever on the right (figure 37)

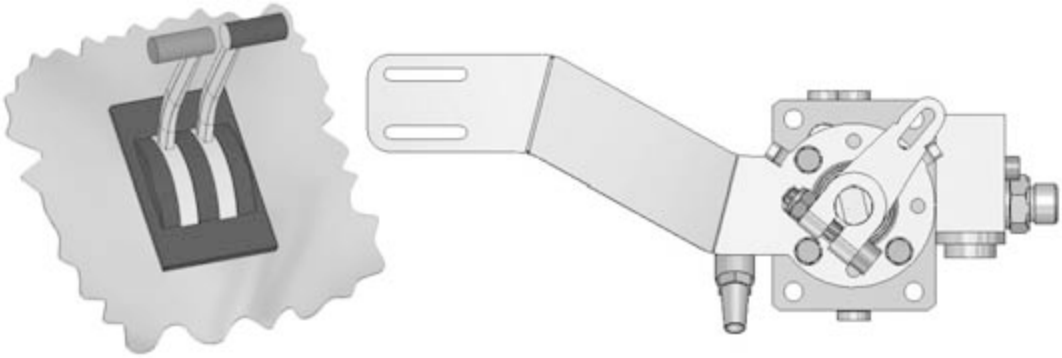


Figure 37. Full ahead

7.1.2. Cylinder adjustment

When you start the engine for the first time, make sure that you have oil available to add to the reversing deflector control hydraulic system.

Fill the reservoir with oil before you start the engine. After you start the engine and put it into forward gear, the oil is transferred from the reservoir into the system and the pump automatically removes air from the system. If the oil level decreases in the reservoir, add some oil. There is a dipstick in the reservoir that you can use to check the oil level (figure 28). Occasionally move the hydraulic cylinder's operating lever back and forth (figure 34, point A) so that the cylinder fills with oil.

Adjusting the cylinder:

1. Detach the control cable from the end of the cylinder operating lever (figure 38, point A).

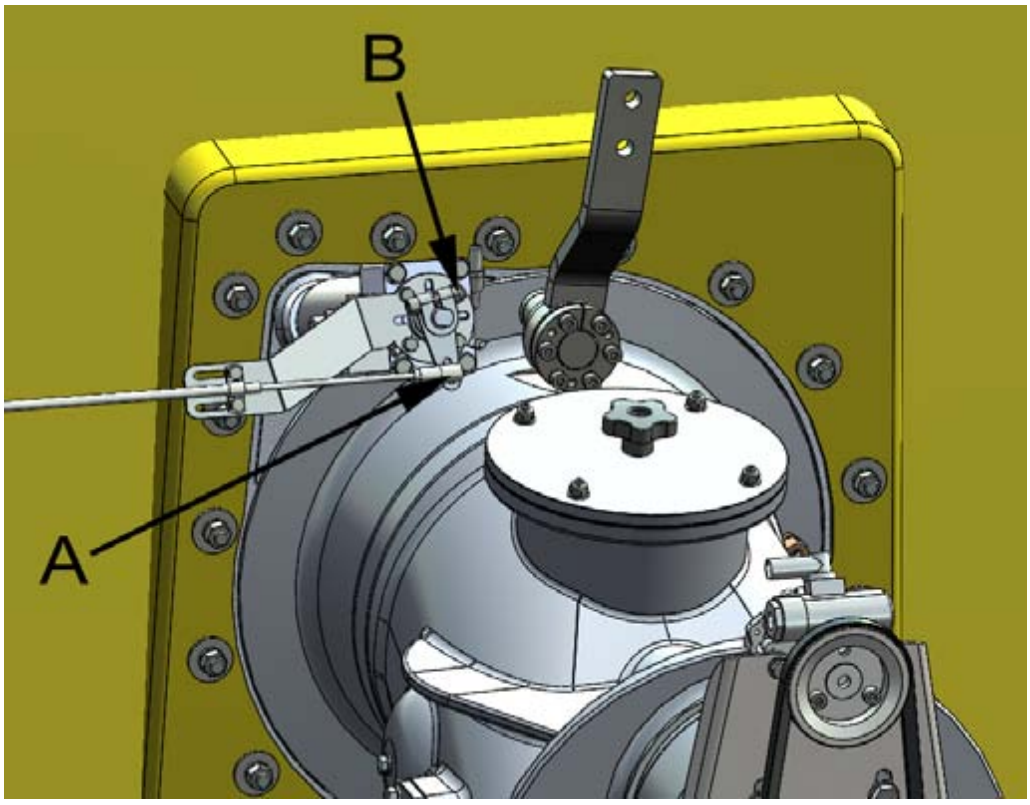


Figure 38. Removing the control cable

2. Loosen the operating lever screw (figure 38, point B) but do not pull the lever off the shaft yet.

3. Place the lever against the limiter on the shaft (figure 39, point A).

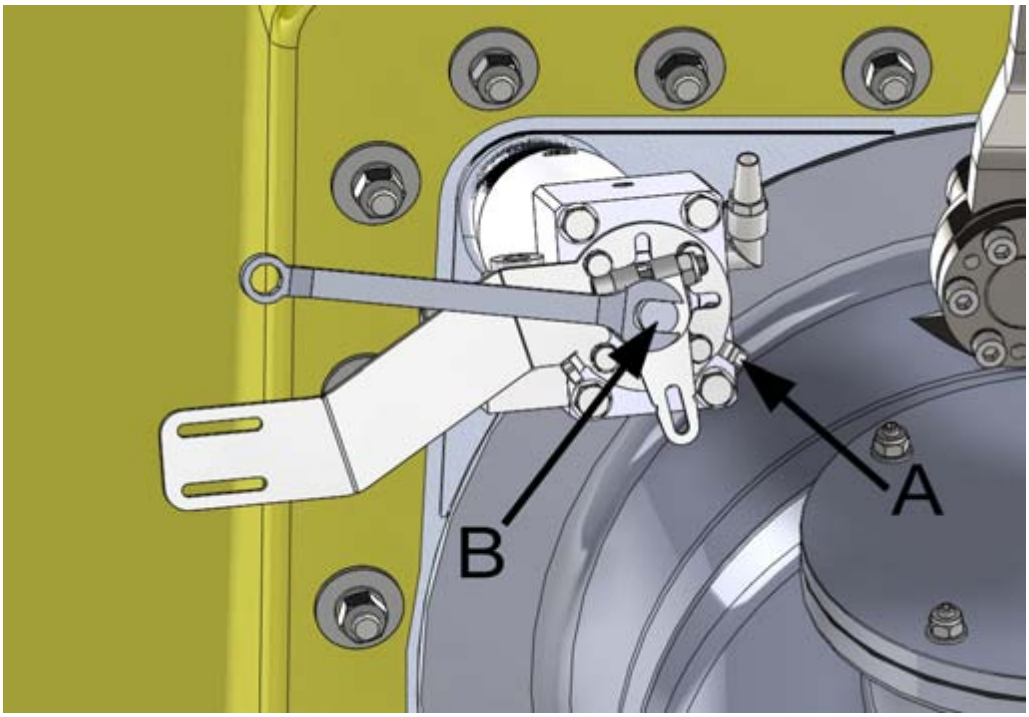


Figure 39. Operating shaft and limiter

4. Turn on the engine and put it into gear.

5. Using a wrench, turn the operating shaft (figure 39, point B) 13 mm (0.4") clockwise so that the reversing deflector is down, blocking the jet flow.

   If you turn the shaft too much, it will no longer move smoothly, indicating that the cylinder has reached the end of its movement range. If this happens, turn the shaft back slightly.

6. Attach the operating lever to the shaft with a screw and tighten the screw to a torque of 10 Nm (7 lb ft).

   Do not tighten the screw too much!

7. Attach the control cable to the screw at the end of the operating lever (figure 38, point A).

8. Use the control system in the cabin to check that the deflector can move to the up and down positions.

   In the up position, the deflector does not block the jet flow (figure 40). In the bottom position, the lower edge of the reversing deflector (figure 41) is parallel with the propulsion unit’s shaft.

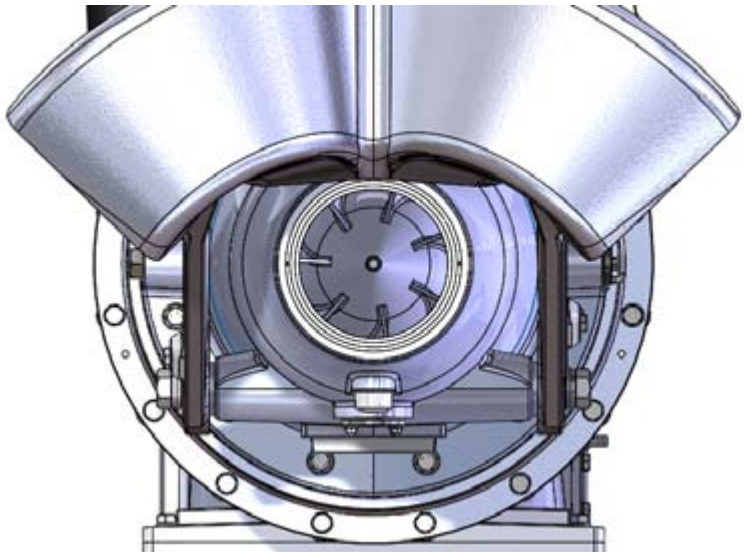


Figure 40. Deflector in the up position

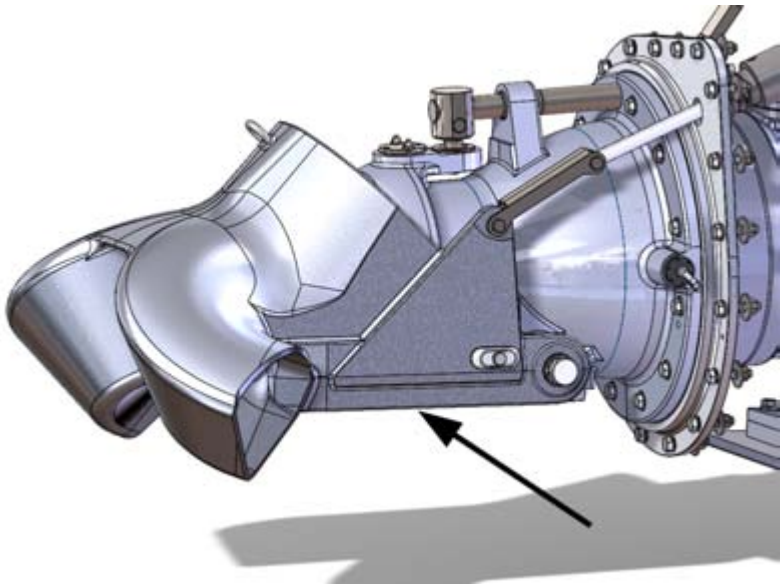


Figure 41. Deflector in the down position

7.2. Connecting the steering nozzle to the control system

There is a lever for the operating device at the end of the nozzle control shaft (figure 42). Operation can be hydraulic, electronic, or mechanical. The most important thing with the operation of the system is that the movement range of the operating device suits the movement range of the lever. The movement range of the lever has to be restricted in case the movement range of the operating device is too long.

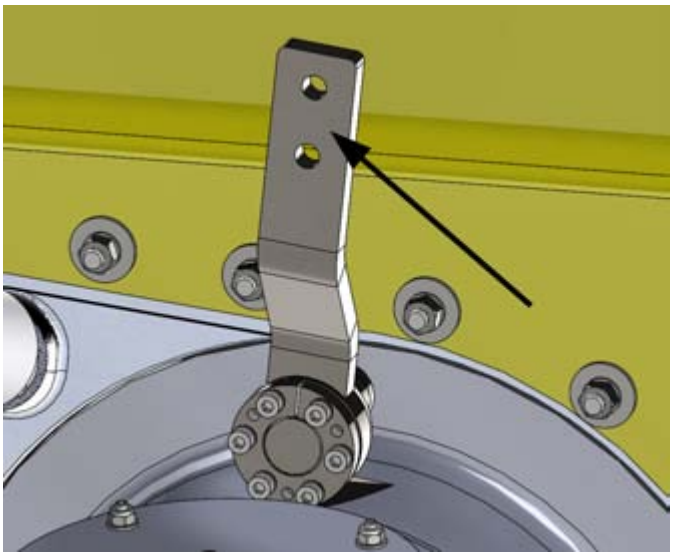


Figure 42. Operating device lever

WARNING!

If the movement range of the nozzle operating device is too long, the propulsion system can break down due to overload.

The control lever has holes ready at different heights so that different operating devices can be connected. See appendix 6. *Lever movement ranges* , page 51.

Connecting the lever to the shaft:

1. Clean the surfaces of the shaft and the cone sleeve of grease.
2. Tighten the screws of the cone sleeve, and make them finger-tight.

   This way the lever can slide on the shaft and you can find the correct position for it.
3. Find the correct position for the lever, and tighten it to the shaft using the cone sleeve.

   Tighten the cone sleeve screws evenly by tightening each screw in turn by several revolutions of the tightening ring while making sure that each screw is tightening the cone sleeve evenly. The self-locking Nord-Lock washers keep the tightened screws in place, which means that a thread-locking agent is not required.

   Do not over-tighten the cone sleeve or the cone will stretch the outer ring of the lever. An excessively tightened cone will collapse and lose its grip.

   In double installation, the operating device is installed to the steering lever of one jet and the power is transmitted to the steering of the other jet with a connecting rod. The length of the connecting rod is determined by the distance between the jets (appendix 4. *Connecting rod for double installation*, page 48).

8. Engine installation

This section deals with engine installation in relation to the propulsion unit. Otherwise, engine installation must always be carried out in accordance with the engine manufacturer's instructions.

The Alamarin-Jet 340 propulsion unit can be used with various engines, either with gears or with a direct connection to the flywheel adapter. The gear is selected in accordance with the engine power and speed. Check the correct gear by contacting a representative of Alamarin-Jet Oy.

CAUTION!

Before installing the engine, make sure that the gear possibly connected to it is correct. The wrong gear ratio decreases the performance of the propulsion unit or can completely prevent its use.

Aligning the engine with the propulsion unit

Correct sizing and aligning of the intermediate shaft is especially important for the operating life of the whole system. Different intermediate shafts allow different angles and it is imperative that you know the manufacturer's recommendations for maximum angles when installing.

Constant velocity shaft

At both ends of the constant speed shaft, there is a joint based on balls rolling on a spherical surface. Amongst the shafts used with propulsion units, an intermediate shaft of this type allows the most freedom in terms of alignment. The joints can be at angles that are different from each other (figure 43).

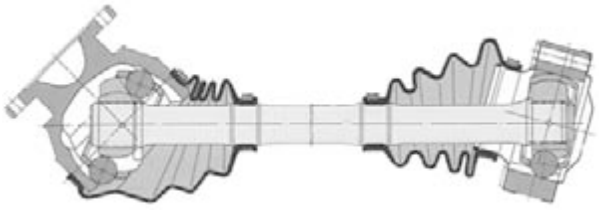


Figure 43. Constant velocity shaft

Cardan shaft

The cardan shaft joints are diagonal. This is why alignment is more demanding. To ensure that the shaft rotates without vibration, the joint angles must be equal. Figure 44 shows examples of permitted angle configurations.

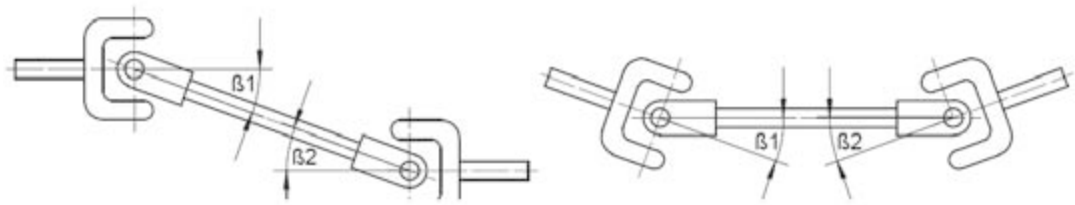


Figure 44. Cardan shaft

Intermediate shaft with rubber stop

Shafts with rubber stops effectively prevent vibrations that travel along the shaft to the hull of the boat. This is why they are particularly popular in boats with a metal structure. In the example shaft in figure 45 , there is a rubber joint at one end and a constant speed joint at the other.

Figure 45. Intermediate shaft with rubber stop

CAUTION!

Always ask the manufacturer of the intermediate shaft for installation and operation instructions and follow them carefully.

Installing the intermediate shaft

Note the following when installing the intermediate shaft:

- The shaft must be of such quality that it meets the general shaft-manufacturing standards. A poor-quality shaft may, for example, be balanced incorrectly, causing damage as it rotates.
- The ends of the shaft must be exactly in place against the flange surface before the screws are tightened. Incorrect position leads to wrong joint angle and unbalance. This may cause extensive damage to the system.
- The tightening screws of the intermediate shaft should be tightened a little at a time.

WARNING!

A rotating auxiliary shaft is dangerous. It must be protected with a detachable protector to prevent personal injury.

9. Antifouling

If the boat is going to be used in waterways where the growth and sticking of organisms around the boat's bottom and the propulsion unit is heavy, the propulsion unit can be painted with antifouling paint after installation.

Generally speaking, antifouling paints are based on various soluble substances, such as copper. Because the propulsion unit is made mainly of aluminium, copper forms a highly unfavourable galvanic couple with the propulsion unit. In other words, the aluminium starts to corrode because it functions as an anode.

WARNING!

Painting the propulsion unit with antifouling paint that contains copper will result in heavy corrosion and destruction of the propulsion unit.

Do not use any other antifouling paints for painting the propulsion unit, except those intended for aluminium surfaces!

Instead, a boat bottom made of reinforced plastic can be painted using copper bearing antifouling paint. In this case, leave a 50 mm (2") unpainted area around the propulsion unit in the stern and on the bottom of the boat (figure 46).

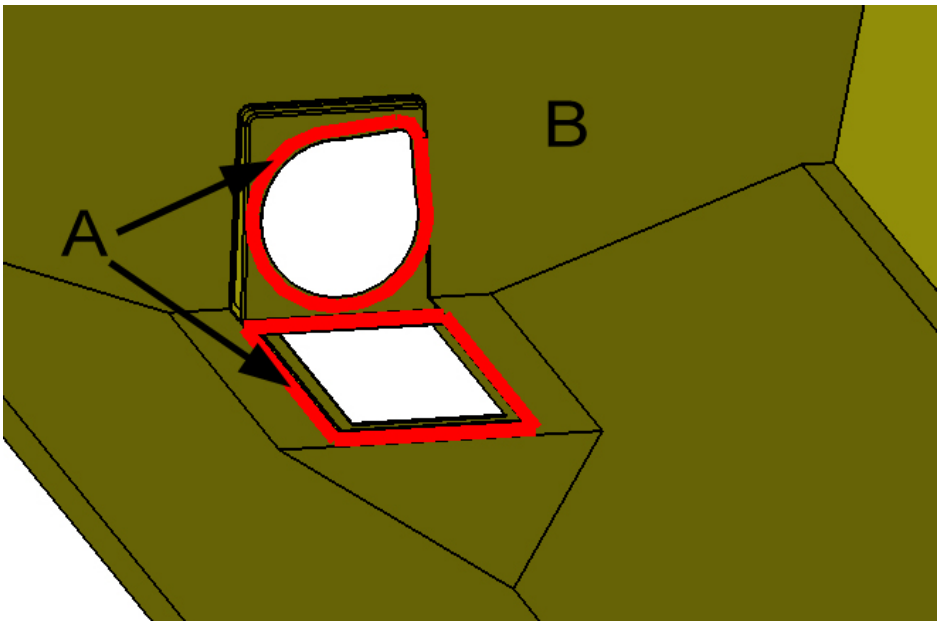


Figure 46. Antifouling

A Unpainted area
B Painted area

WARNING!

Anodes and their fastening screws must not be painted with antifouling paint.

Appendix 1. Grease recommendations

The grease used for lubricating the propulsion unit bearing must meet the following requirements:

- lithium soap and a thickener with EP additives
- mineral oil as a base oil
- NLGI class 2
- operating temperature range -25 to 130°C (-13–266 °F)
- continuous operating temperature min. 75 °C (167 °F)

Recommended grease brands:

- Würth Multi-Purpose Grease III
- FAG Multi2
- FAG Load 220
- Mobil XHP 222
- Neste Allrex EP2
- Shell Retinax Grease EP2

A grease that has equivalent properties to those mentioned above can also be used for lubrication.

Appendix 2. Oil recommendations

The operating hydraulic system of the reversing deflector and the lubrication of the front bearing are designed to use oil that is specifically intended for automatic transmission systems. The oil must meet the following requirements:

Kinematic viscosity 40℃	33-36 mm^2/s
Kinematic viscosity 100°C	7.1-7.7 mm^2/s
Viscosity index	min. 170
Density 15°C	0.835–0.890 g/cm^3
Pour point	max. -42 ℃
Flashpoint	min. 180 ℃

Recommended oil brands:

- Mobil ATF 320
- FormulaShell ATF DEXRON III
- Neste ATF-X
- BP Autran DX III

Appendix 3. Tightening torques

Use the tightening torques from the table 2 when tightening the propulsion unit screws. The strength grade of an acid-proof A4-80 screw is equivalent to a class 8.8 screw.

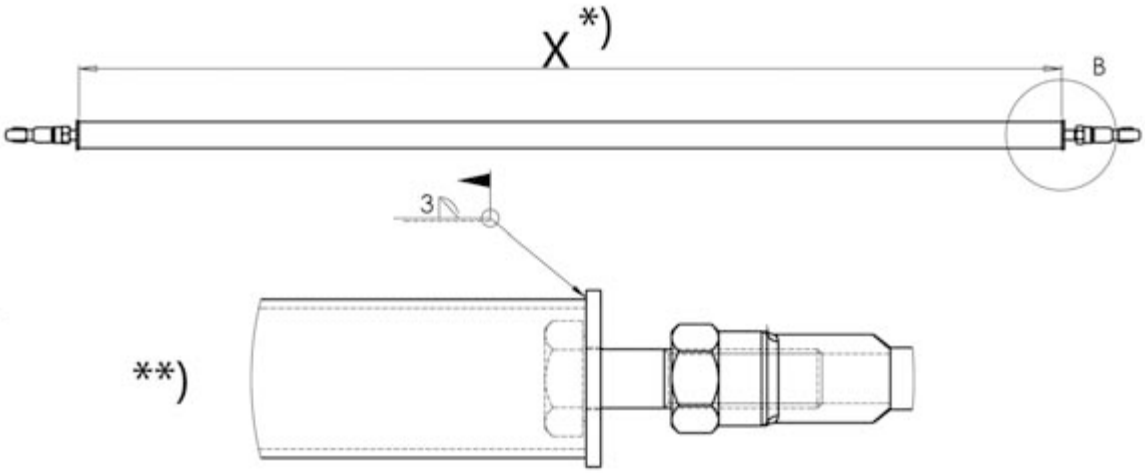
Table 2. Tightening torques of the screws

	Strength grade		
	8.8	10.9	12.9
Thread	Tightening torque (Nm) (*)		
M5	5.5 (4)	8.1 (6)	9.5 (7)
M6	9.6 (7)	14 (10)	16 (12)
M8	23 (17)	34 (25)	40 (30)
M10	46 (34)	67 (49)	79 (58)
M12	79 (58)	115 (85)	135 (100)
M16	145 (107)	215 (159)	250 (184)

(*) The tightening torque in pound-feet (approximate value) is marked in the table in parentheses after the corresponding value in Nm.

A suitable thread locking compound that is good for all purposes is one of medium strength, for example. Loctite 242 or similar.

Appendix 4. Connecting rod for double installation

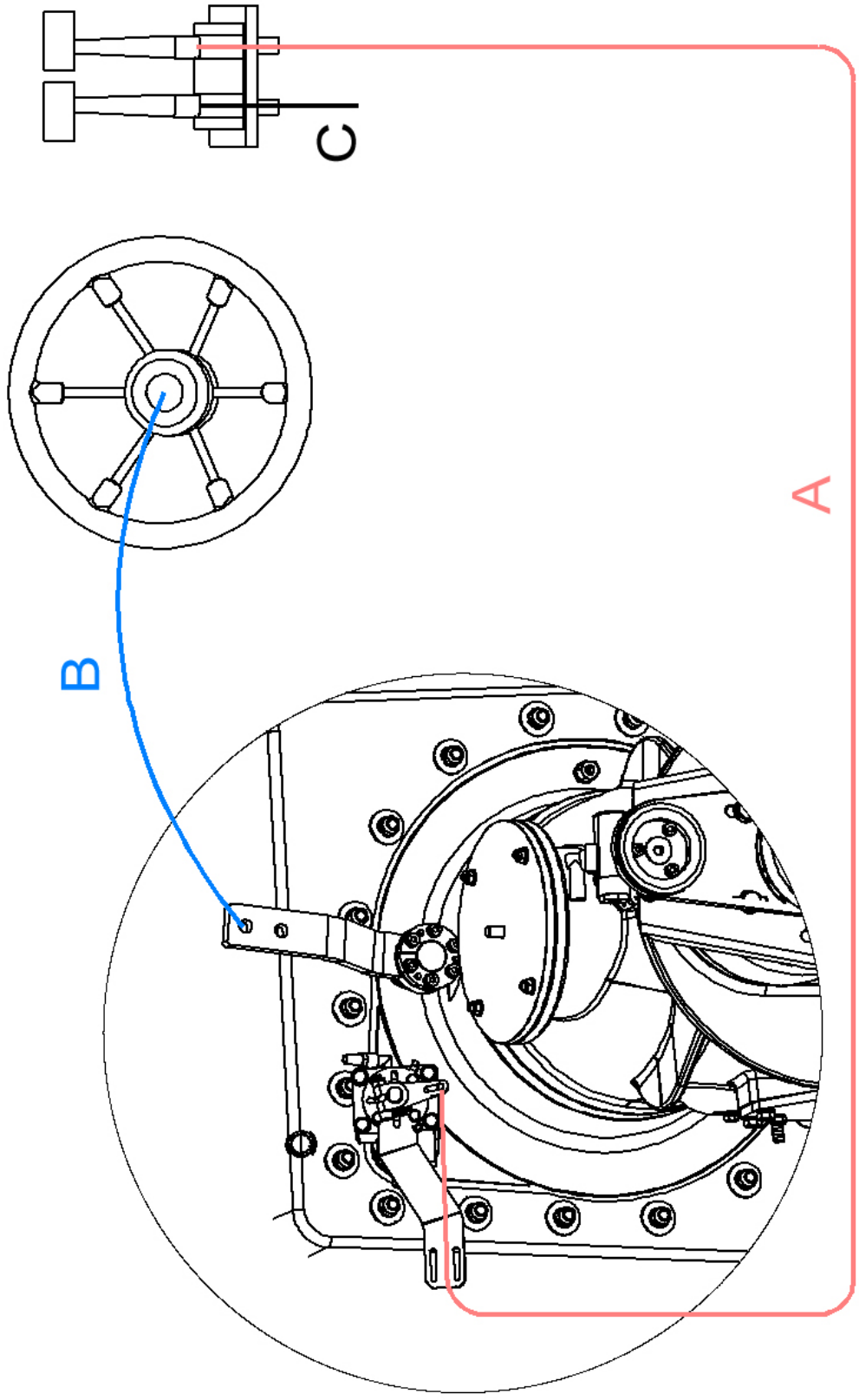


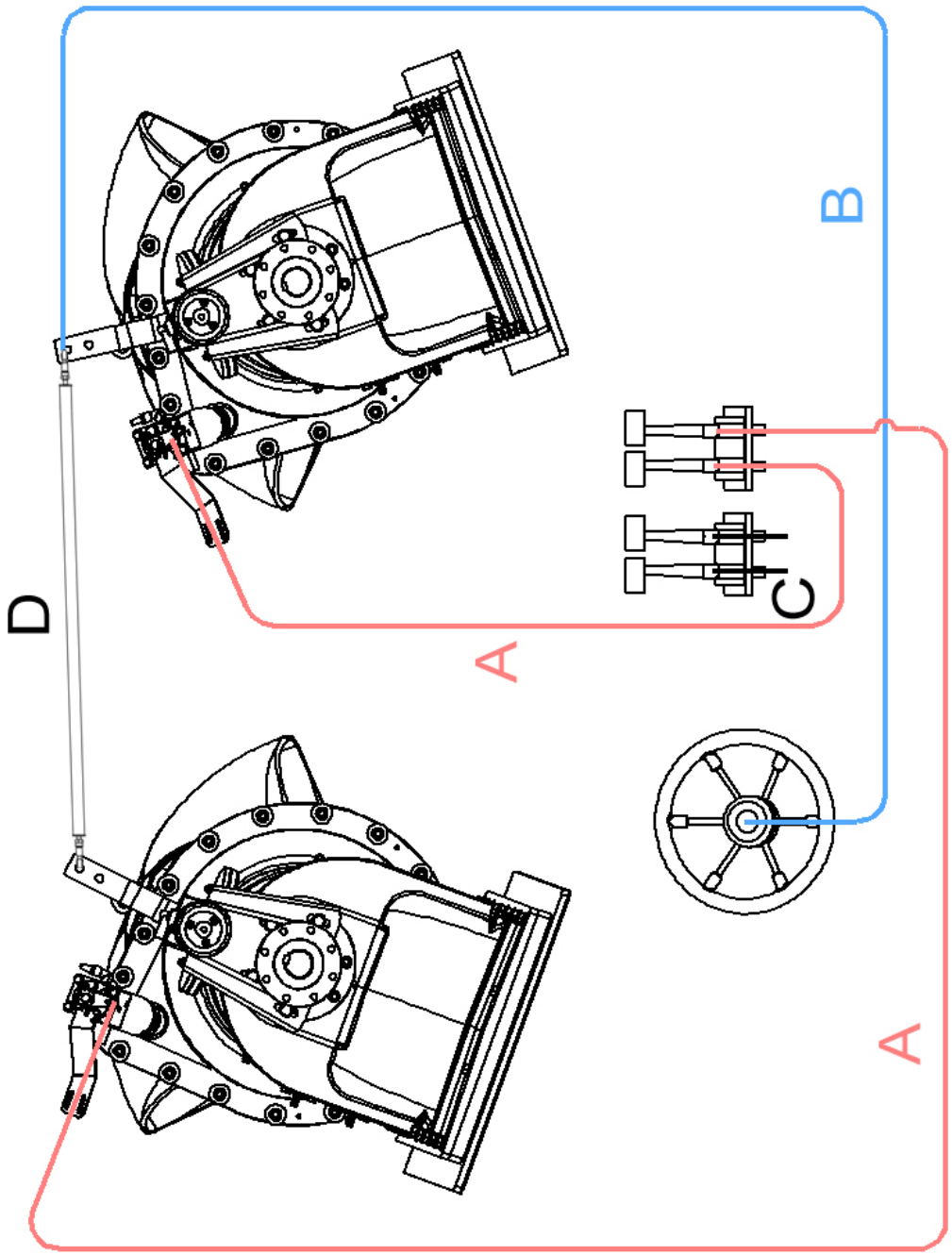
*) Measure x is determined by the distance between the jets.

**) Welding method TIG.

Materials to be welded EN 1.4436.

Appendix 5. Control System

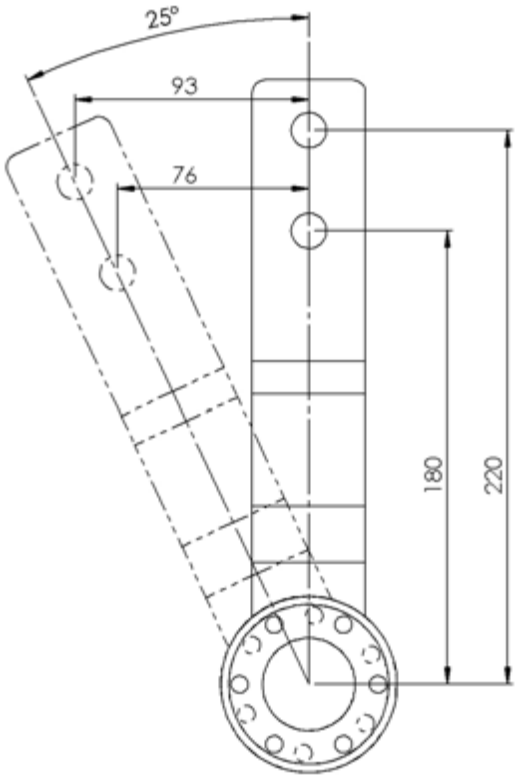




A Reversing deflector's control cable
B Steering device (cable or hydraulic)
C Accelerator and gear control cables
D Connecting rod for double installation

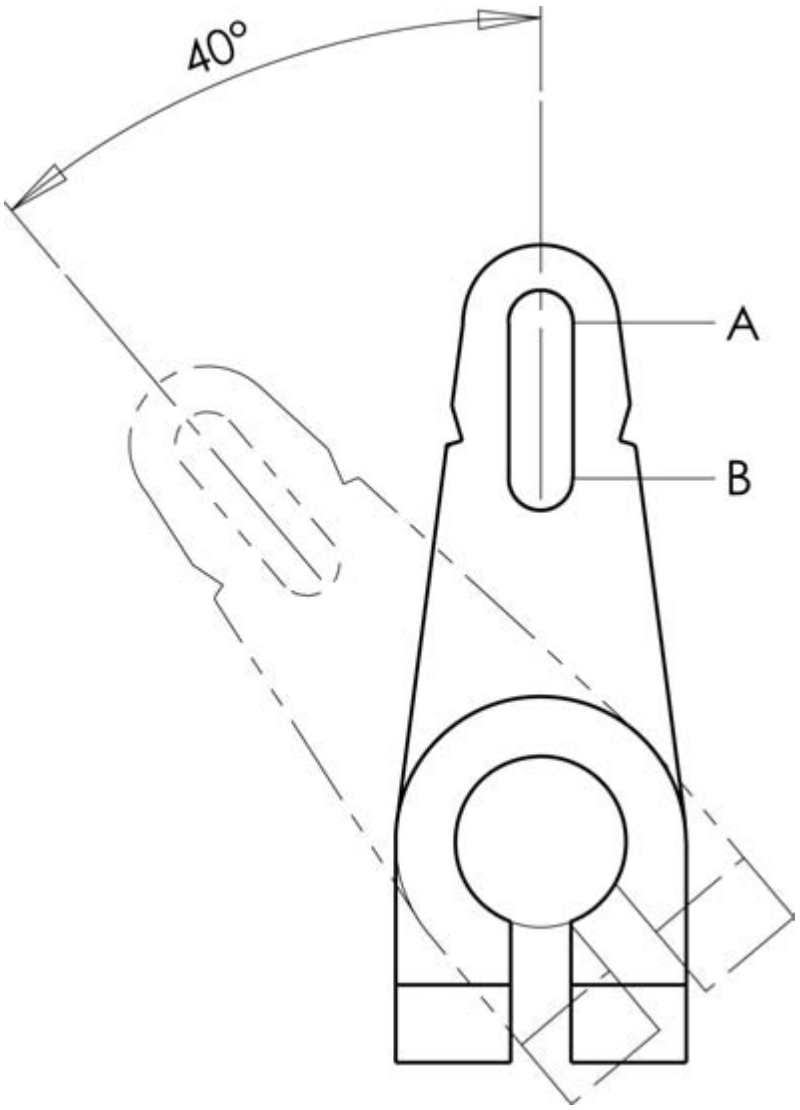
Appendix 6. Lever movement ranges

Steering lever



Units in millimetres

Hydraulic cylinder control lever

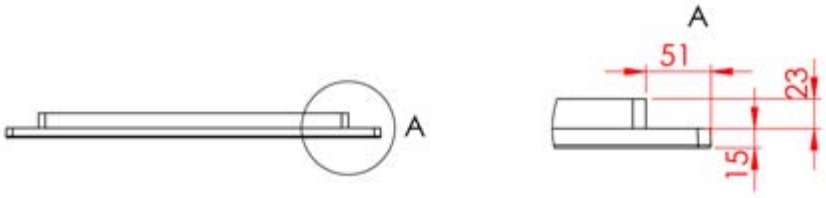


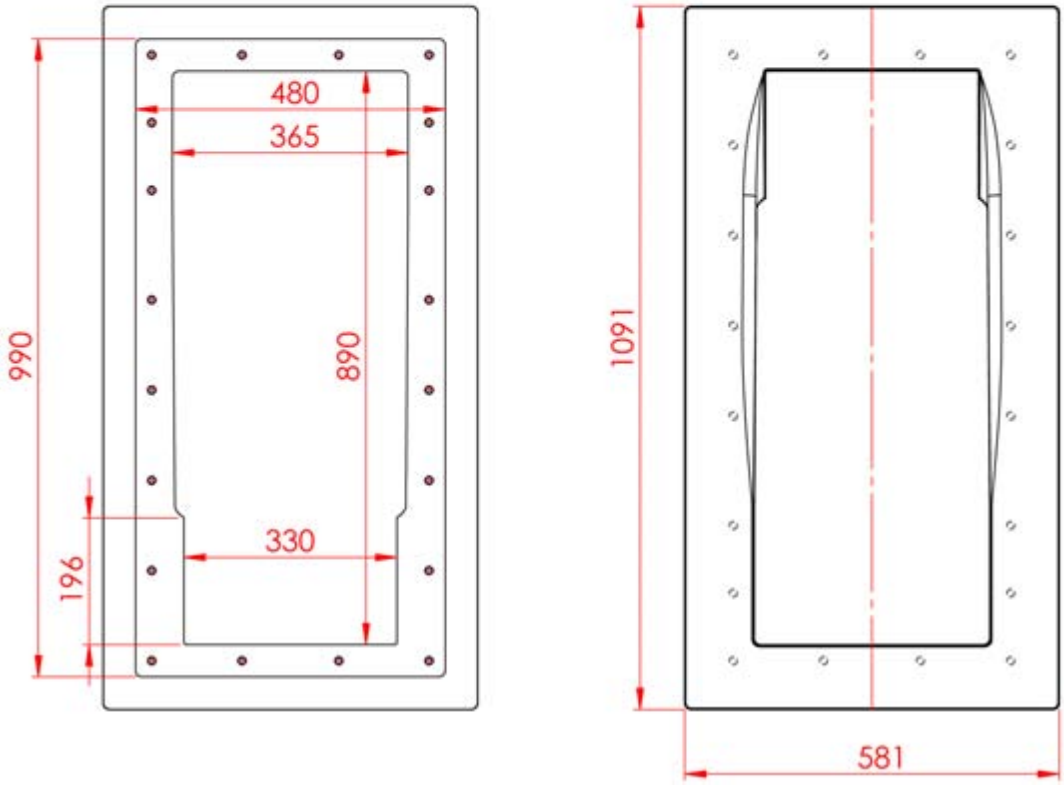
The length of a full stroke at point A is approx. 64 mm (2.5").

The length of a full stroke at point B is approx. 46 mm (1.8").

Appendix 7. Adapter dimensions

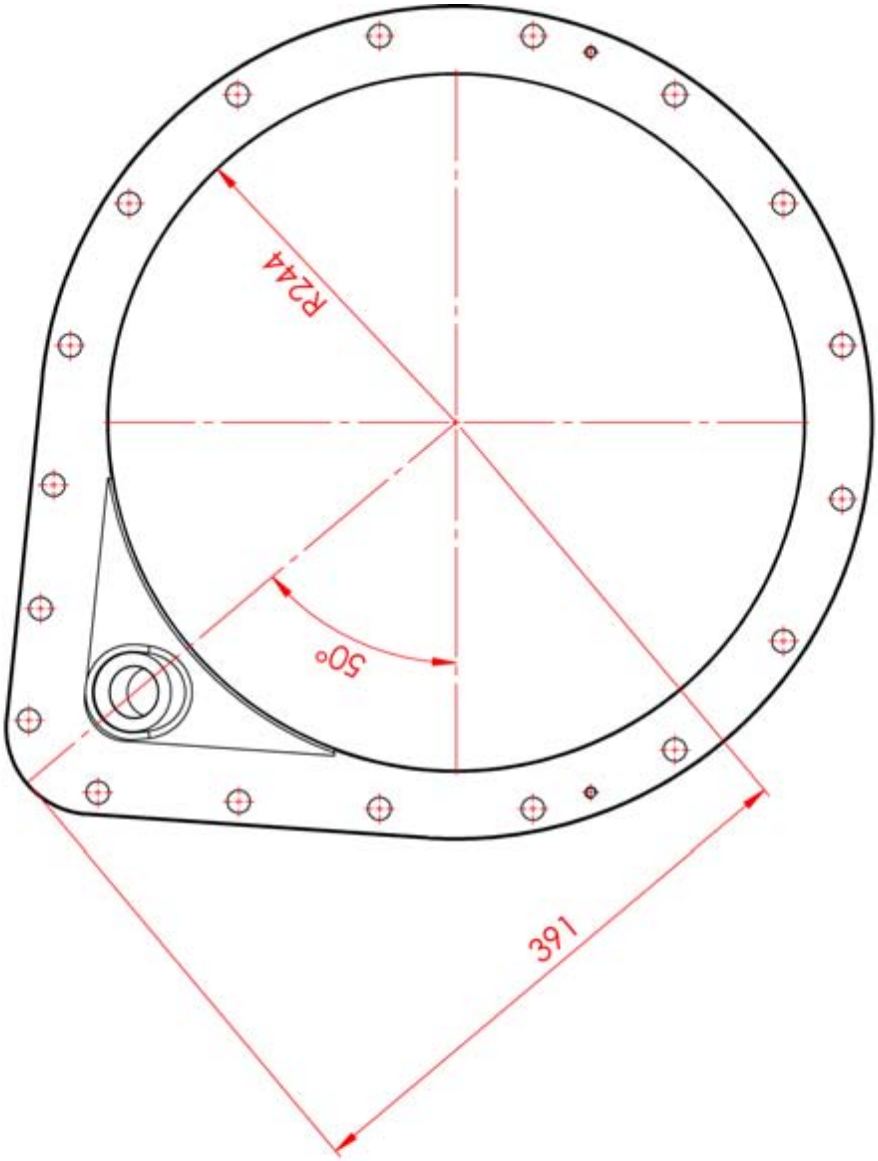
Bottom adapter

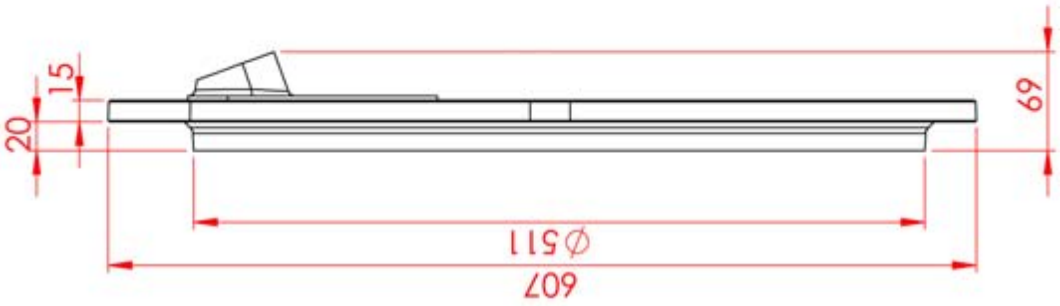




Units in millimetres

Stern adapter



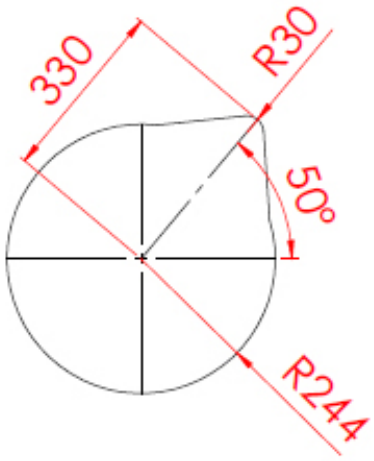


Units in millimetres

Appendix 8. Dimensions of the holes to be cut

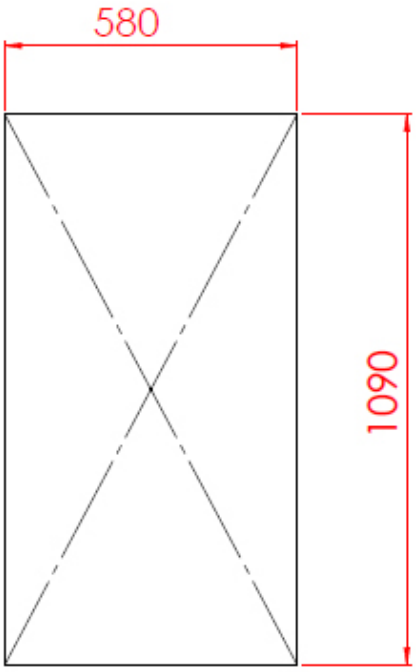
The hole to be cut for the stern adapter for both installation methods – viewed from the stern.

Port

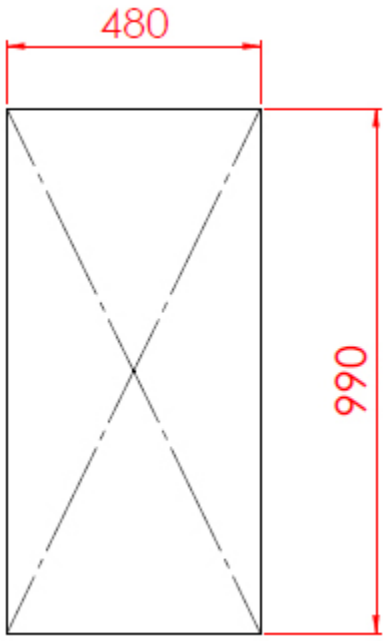


Starboard

The hole to be cut for the bottom adapter **in a welded installation**



The hole to be cut for the bottom adapter **in a bolted installation**



Units in millimetres