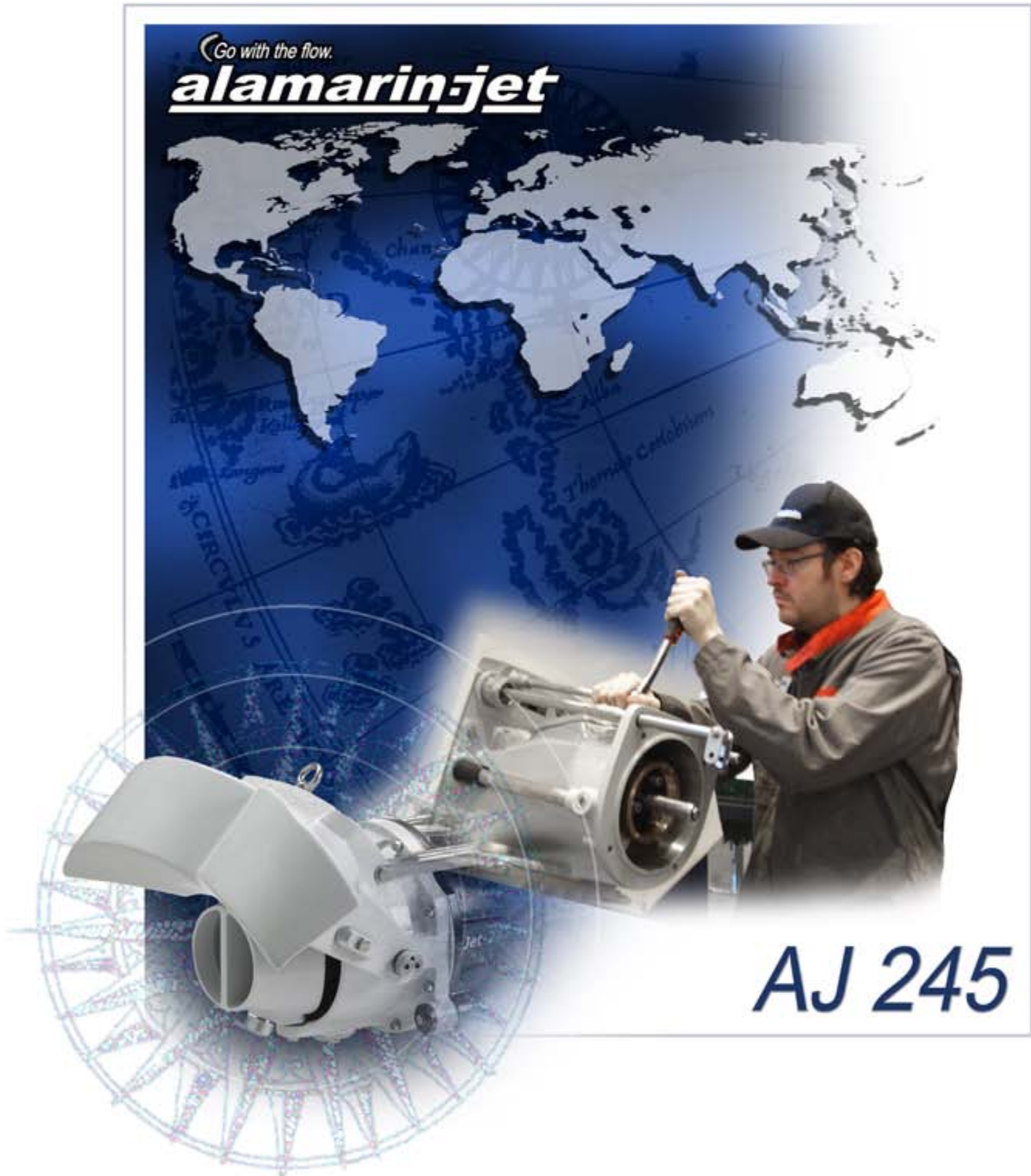


# ***Installation Manual***



***AJ 245***



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## WARRANTY TERMS

Warranty for the Alamarin-Jet products is 12 months from the first sea trial. However no longer than 18 months from the date of delivery from our factory.

Alamarin-Jet Warranty covers defects in Alamarin-Jet workmanship and materials for the Warranty period. Alamarin-Jet warranty terms will not cover normal part wear nor following cases with external source of issue: incorrect installation, damage caused by outside affect, vessel overloading, misuse, abnormal wear and tear, accident, improper application, improper transportation or storage, natural calamity, unsuitable water conditions, lack of maintenance or neglecting correct procedures described in Alamarin-Jet manuals.

Any Alamarin-Jet product that is serviced, repaired or altered in any way by anyone other than party certified by Alamarin-Jet will not be covered by the warranty terms. Modifying or repairing Alamarin-Jet products with any other than original Alamarin-Jet parts will lead immediate invalidation of Alamarin-Jet product warranty.

Alamarin-Jet Warranty terms excludes indirect costs: Crane rent, docking, warping, towing, assistance of yard crew and services, loss of profit, travel, hotel charges, daily allowances and waiting time, expenses of unauthorized repair work of Alamarin-Jet products, expenses caused by failure of the jet to other components inside or outside the vessel, damages to any third parties, injuries, or any other inconveniences.

In order for warranty decision, Alamarin-Jet must receive defected parts with comprehensive failure description attached and transportation charges covered by the purchaser to Alamarin-Jet for inspection. Based on given details and inspected product, Alamarin-Jet reserves rights to define whether the case is under warranty. After inspection Alamarin-Jet will provide documented description for the customer regarding the case.

In case replacement parts are needed before Alamarin-Jet has analyzed the returned parts, purchaser buys new replacement parts. After confirming potential warranty decision, Alamarin-Jet will provide credit note covering the parts under warranty. All products and parts removed or replaced under the Warranty shall become property of Alamarin-Jet.

Alamarin-Jet reserves exclusive right for Alamarin-Jet warranty terms and no other person or distributor is authorized to modify this Warranty or give any other Warranty on behalf of Alamarin-Jet.

Alamarin-Jet Oy reserves its right to change, amend, add or delete any of the Terms and Conditions without prior notice. Any disputes are to be settled according to Finnish law by arbitration in Helsinki, Finland according to the rules of the International Chamber of Commerce and in accordance with Finnish legislation of Arbitration.

2017/5/10

*GO WITH THE FLOW*

# 1. Introduction

This is the installation manual for Alamarin-Jet's AJ 245 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
	<b>WARRANTY</b> The warranty is voided if the procedure is carried out incorrectly.
	<b>NOTE</b> Important notice or fact.
	<b>TIP</b> Additional information that facilitates the performance of work or a procedure.
	<b>CARRIED OUT BY ONE PERSON</b> One person can carry out the procedure.
	<b>CARRIED OUT BY TWO PERSONS</b> Two persons must carry out the procedure.
	<b>INDICATOR ARROW</b>
	<b>ARROW DESCRIBING MOTION</b>

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. Attach the mounting template to the boat's hull (section 3. *Installation Methods*, page 5).
2. Attach the propulsion unit to the mounting template (section 4. *Attaching the propulsion unit*, page 17).
3. Install the control system (section 5. *Installing the control system*, page 41).
4. Install the engine (section 6. *Engine installation*, page 51).
5. Paint the propulsion unit with antifouling paint (section 7. *Antifouling*, page 53).

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





### 3. Installation Methods

The Alamarin-Jet water jet propulsion unit is installed on the boat using a mounting template. Several mounting templates are available, depending on the installation methods and materials used.

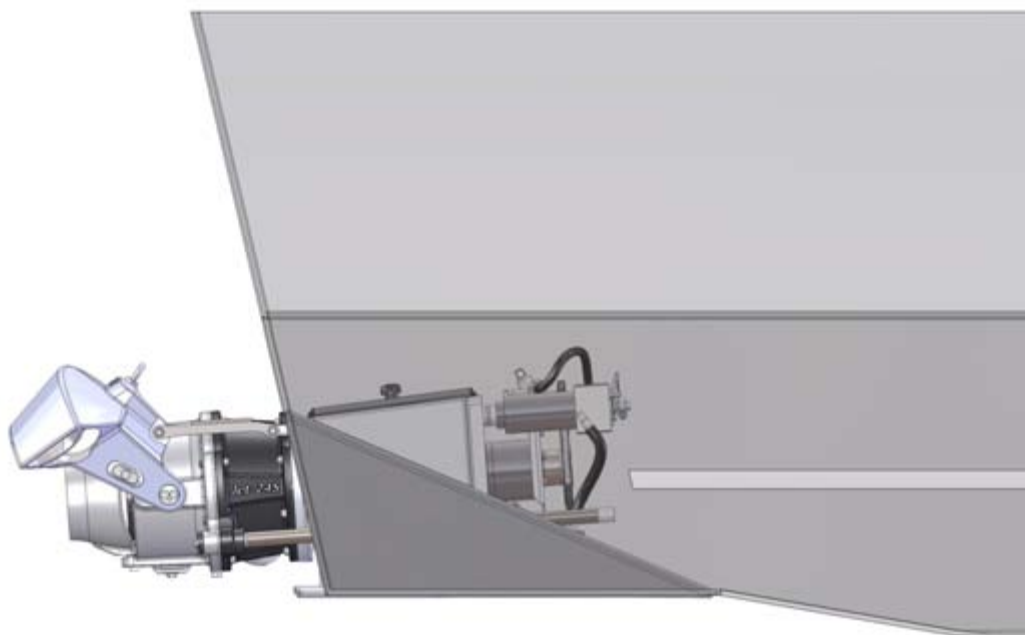
For combi-frames, there are two primary installation methods available:

- a) "short tail", which minimises the installation length outside the stern
- b) "long tail", which minimises the installation length inside the stern

Both methods have their advantages, and it is up to the boat designer to decide which method is best suited for each boat.

#### *Short tail installation*

This installation method minimises the installation length of the jet outside the boat. At the same time, the jet's inspection hatch ends up inside the boat, which makes it safer to clean the intake duct in rough seas.



**Figure 1. Short tail installation**

#### *Long tail installation*

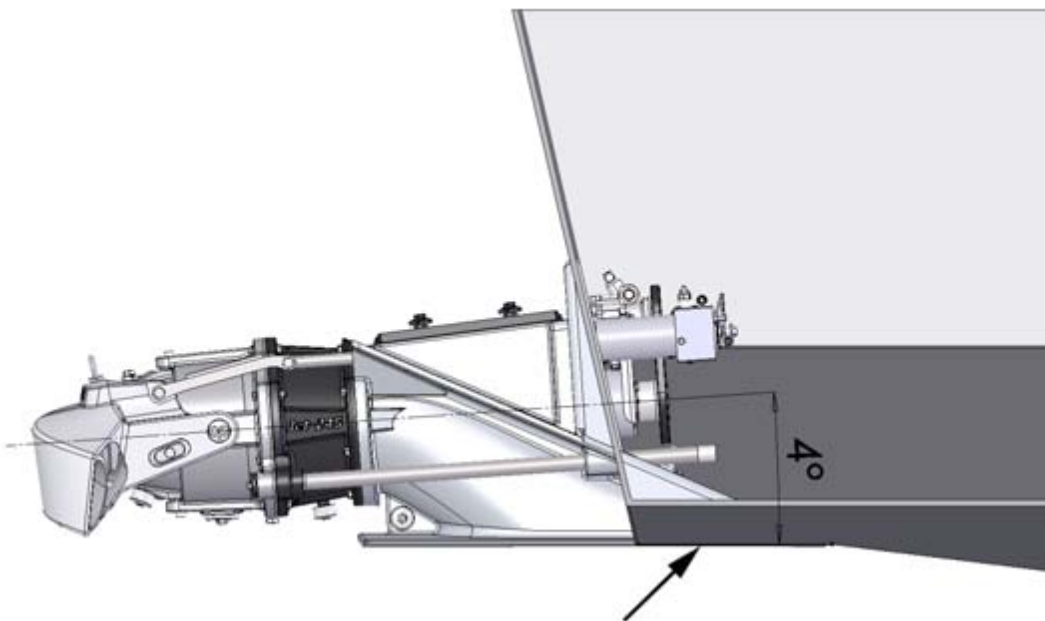
This installation method minimises the installation length of the jet inside the boat so the engine can be installed closer to the stern of the boat. The jet's inspection hatch ends up outside the boat, which reduces the risk of sinking due to a water leak.



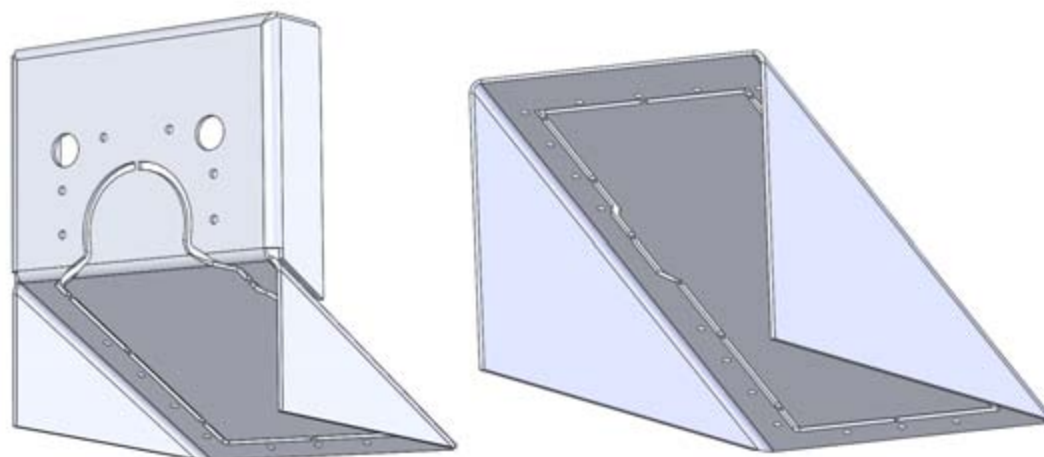
**Figure 2. Long tail installation**

The mounting template can be installed into a hole at the bottom and the stern of the boat, or the shape of the mounting template can be added to the boat's template (GRP boats).

The correct positioning of the mounting template is crucial since it determines the position of the jet. In the example shaft in figure 3 shows the edge parallel to the keel. When the edge is correctly aligned parallel to the keel, the jet pushes the boat forward with the optimal thrust angle (4 degrees). The main shaft of the propulsion unit then slants 4° downwards by reference 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.



**Figure 3. Thrust angle**



**Figure 4. Aluminium mounting templates**

### **3.1. Repowering installation**

The repowering installation method is used in the propulsion system's modification installation. In addition, it is an appropriate installation method for prototype or one-off boats. In aluminium boats, the propulsion unit is always installed using the repowering principle.

For attaching the mounting template, a hole of an appropriate size is cut in the stern and the bottom of the boat, in which the mounting template is either laminated or welded.

#### **3.1.1. Reinforced plastic mounting template**



If the installation is done on a boat that has previously had some other type of rear propulsion unit, make sure that the engine's installation supports do not impede laminating. There must be at least 150 mm free hull surface on all sides of the mounting template, on which the mounting template can be laminated (figure 5). The same 150 mm requirement applies to all boats, including new ones.



**Figure 5. Repowering installation**

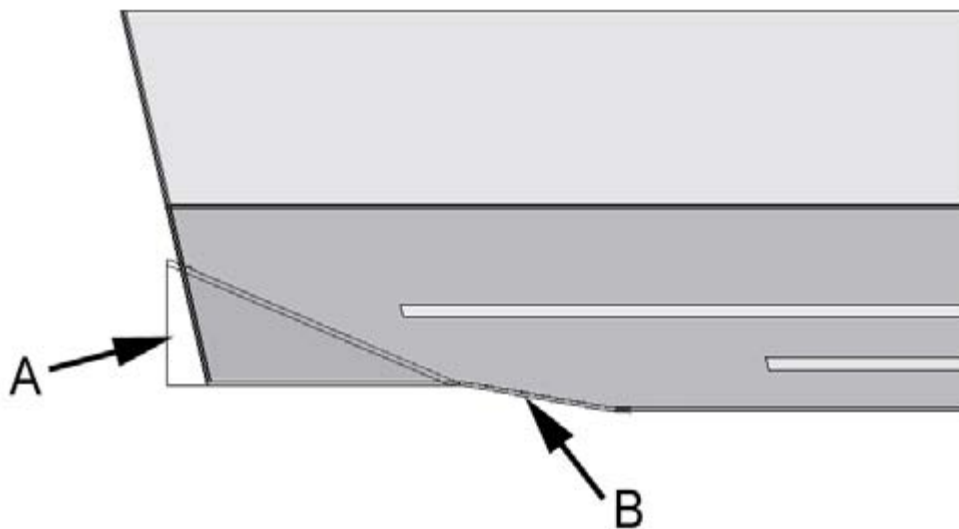
Hull and stern laminate must be dry and clean before work can be commenced.

*Cutting and attaching the mounting template:*

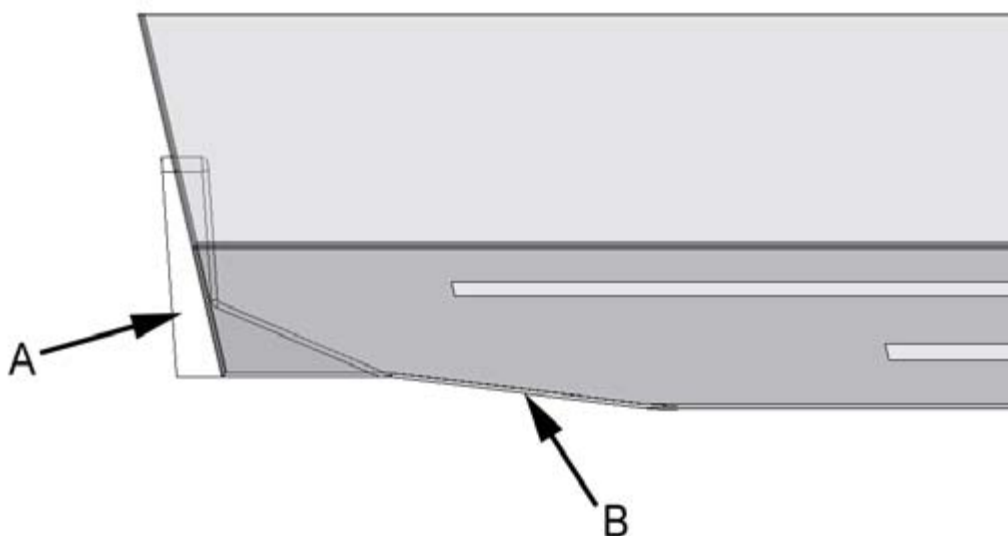
1. Make a hole at the bottom and the stern of the boat for the mounting template. The mounting template should be positioned slightly over the stern of the boat. The excess part can be cut away after installation (figures 6 and 7, point A).

The gap between the mounting template and the hull should be fitted so that it is as small as possible.

2. The front of the mounting template is fitted to a v-bottom boat with the use of a triangular plate having a length of approximately 600 mm from the keel.



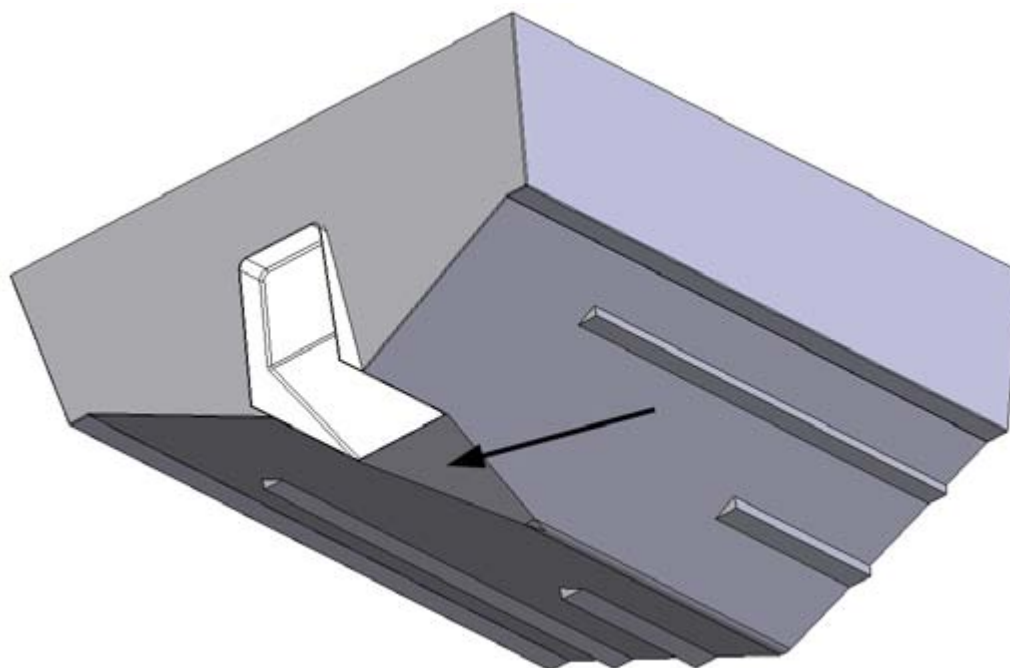
**Figure 6. Positioning of the mounting template, "short tail"**



**Figure 7. Positioning of the mounting template, "long tail"**

A Collar to be cut off

B V-bottom adaptor plate



**Figure 8. V-bottom adaptor plate**

3. Chamfer the edges of the hole on the bottom and stern of the boat.

The chamfered part must be 150 mm wide and the hole edge thickness must be 3 mm.

If the boat's hull is made of sandwich laminate, first remove 100 mm of core material round the hole and then chamfer the core material as well as about 100 mm of the exterior surface. Slightly chamfer the inner envelope.

4. Fit the mounting template in place and support it from the outside.

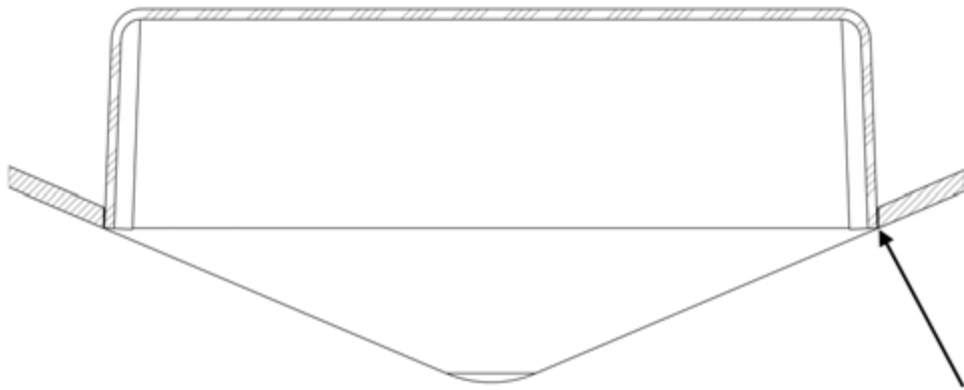


**NOTE!**

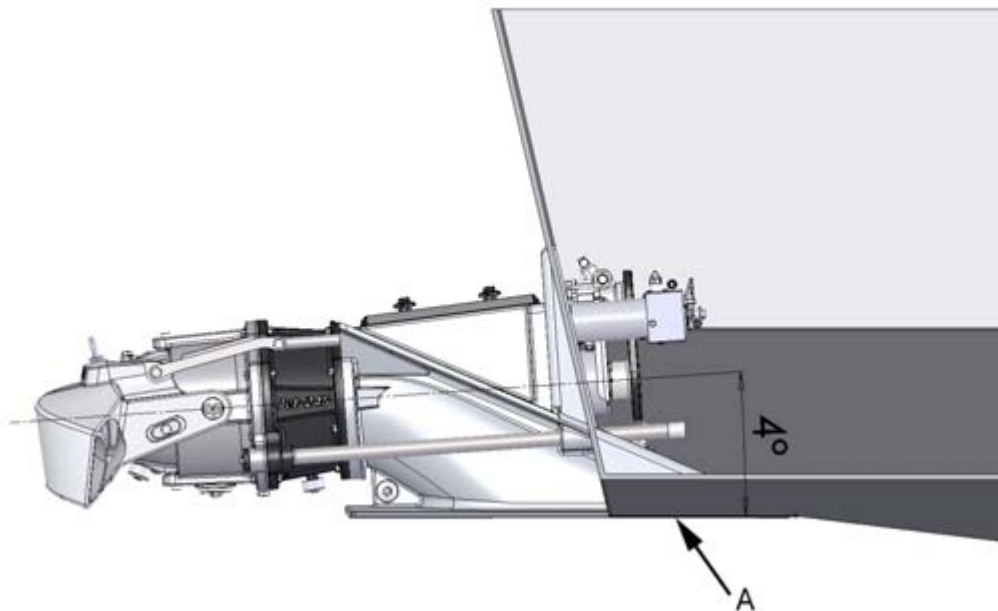
The lower surface of the mounting template must be level with the bottom of the boat (figure 9).

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

If this is not the case, the propulsion unit thrusts the boat in the wrong angle and performance is lowered.



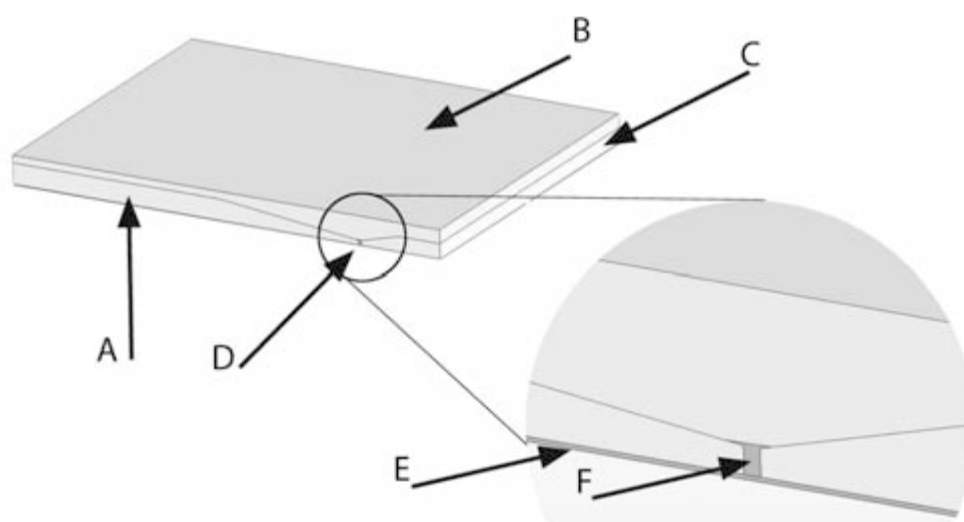
**Figure 9. Cross-section of the mounting template**



**Figure 10. Mounting template alignment**

A The edge of the mounting template parallel to the keel

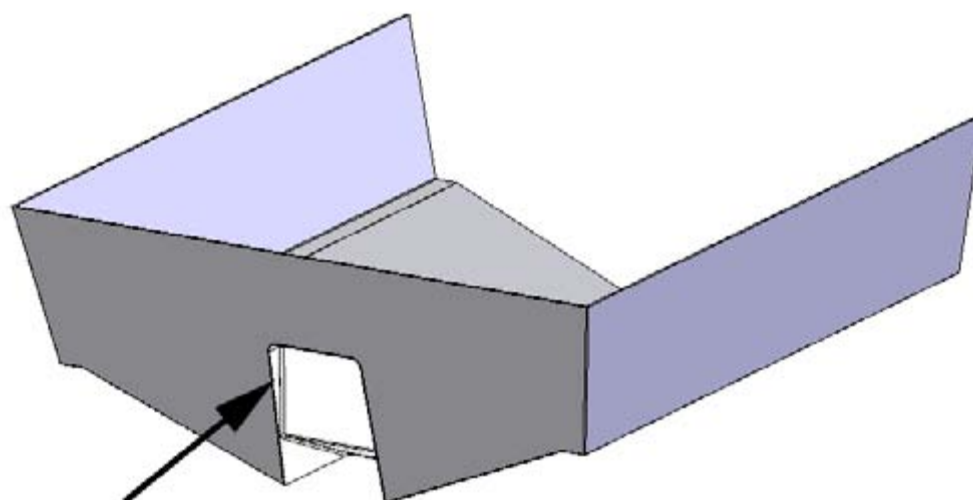
5. Close the seam with tape from the outside.
6. Run gelcoat paint onto the seam from above until it is filled.
7. Laminate 100 mm-wide carpet strips on the seam.
8. Continue laminating over the whole mounting template and the chamfers until the final thickness of 15 mm is reached.



**Figure 11. Laminating**

- A Boat hull laminate
- B Attachment laminate
- C Mounting template laminate
- D Seam
- E Original gelcoat
- F Seam-filling gelcoat

9. Fit engine supports and possible bracings.
10. Cut off the excess collar on the mounting template outside the stern (figure 12).



**Figure 12. Excess collar**

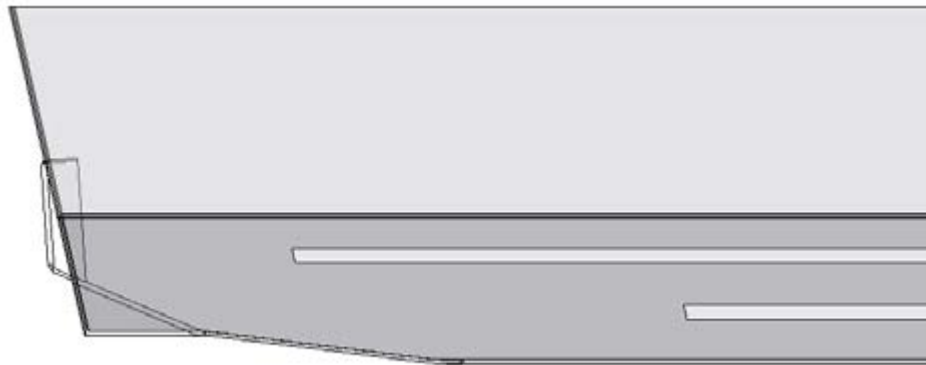
11. Smooth the seams and paint the visible reinforced plastic surfaces with topcoat paint.

This is important because an uncovered laminate absorbs water.

### 3.1.2. Aluminium mounting template

1. Cut a hole of appropriate size in the bottom and the stern of the boat.

In a long tail installation, the collar of the mounting template covers the inner surface of the stern and the excess material must be cut after installation (figure 13). In a short tail installation, the excess collar is outside the stern (figure 6)



**Figure 13. Long tail aluminium mounting template**

The gap between the mounting template and the hull should be fitted so that it is as small as possible.

2. Chamfer the plate edges as required by general welding standards.
3. Fit the mounting template in place.  
Support the mounting template during welding so that the width does not change.

4. Weld the mounting template in place both on the inside and the outside, and make the seam watertight.
5. Abrade the welded seams so that they are smooth at the bottom area.  
Any uneven spots at the bottom must be trimmed by caulking, for example.
6. Paint the mounting template with paint that is suitable for painting aluminium.

Follow the paint manufacturer's instructions.

The material of the plate section: AlMg3

Welding filler metal: AlMg5

## 3.2. Installation out of the mould





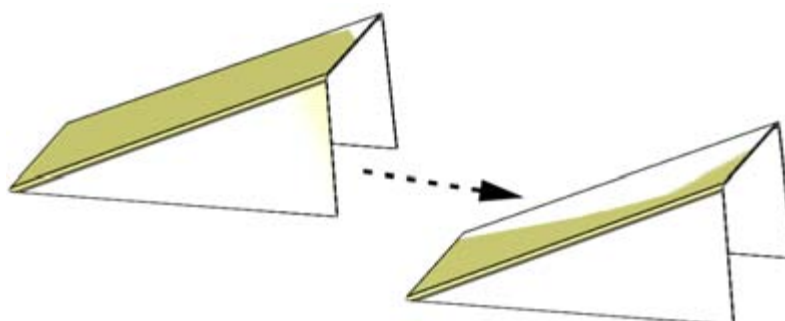
If you want to produce one type of boat with several varying propulsion unit options, it is possible to make a mould of the mounting template and fit it to the standard hull mould (figure 14). This speeds up installation of the propulsion unit without adding to mould expenses.

The mould for the mounting template is made from a mounting template provided by Alamarin-Jet Oy. In twin installations, two moulds must be made, one for each side of the hull.



#### **CAUTION!**

Prepare the mounting template to fit exactly in the boat's mould. This must be done carefully, as inaccuracies (bulges) are copied to the final boat and result in deterioration of boat performance.



**Figure 14. Making a negative of the mounting template**

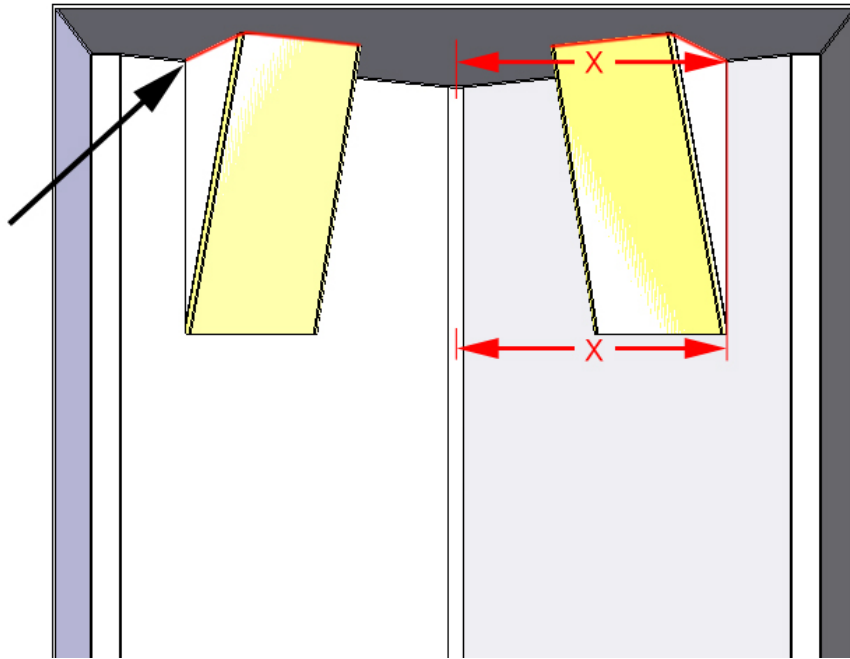
### **3.2.1. Removable mounting template mould**

If you use a removable mounting template mould, you can use the boat's hull mould in both jet installation and rear propulsion unit installation. There are three stages in preparing and installing a removable mounting template:

1. Make a negative (mould) of the mounting template.
2. Process the mould to fit the boat mould exactly.
3. Install the negative onto the boat's mould.

Follow these instructions:

Fitting the mounting template onto the stern of the boat requires care. In twin installations in particular, the angled cutting of the slanted stern requires precision.



**Figure 15. Cutting the collar (twin installation)**

The edges of the mounting template must be smoothed so that the end product shows no big notches.

Reinforce the mounting template negative with a wooden frame, plywood plate or, for example, urethane foam. This way the collar will not bend inwards during laminating.

Attach the mounting template mould on to the boat's mould using tape, for example, so that it stays in place during lamination.



**TIP!**

It is advisable to mark the location of the mounting template on the boat mould after the first installation. This makes fitting the mounting template faster and easier the next time.



**CAUTION!**

Twin installation!

After the boat has been laminated and is ready to be removed from the mould, the mounting template negatives detach with the boat. The mounting templates are removed from the boat for the next installation.

### 3.2.2. Fixed mounting template

The mounting template can also be fixed to the mould. In this case, the boat's hull mould can only be used in jet installation. In twin installation, the boat's mould must be in two pieces in order to make separating the mounting templates possible. A two-piece mould is not necessarily needed for single installation.

### **Twin installation**

1. Make two negatives of the mounting template.
2. Fit and install the mounting templates on the boat's mould (section 3.2.1. *Removable mounting template mould*, page 13).
3. Laminate the rear end of the boat in the mould and remove it.
4. Remove the mounting templates.
5. Make a separate mould of the rear end.

### **Single installation**

1. Make a negative of the mounting template.
2. Fit and install the mounting template on the boat mould (section 3.2.1. *Removable mounting template mould*, page 13).
3. Laminate the hull of the boat in the mould and remove it.
4. Make a new mould of the hull.



## 4. 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 cylinders
4. hydraulic pump
5. Grass rake
6. Raw water cooling line

### 4.1. Preparations



Holes must be made on the installation surface of the mounting template for attaching the propulsion unit and for the required bushings. An aluminium mounting template is already equipped with the required holes.

Sawing/drilling the holes is carried out with the drilling templates that come with delivery.

*Drilling the holes:*

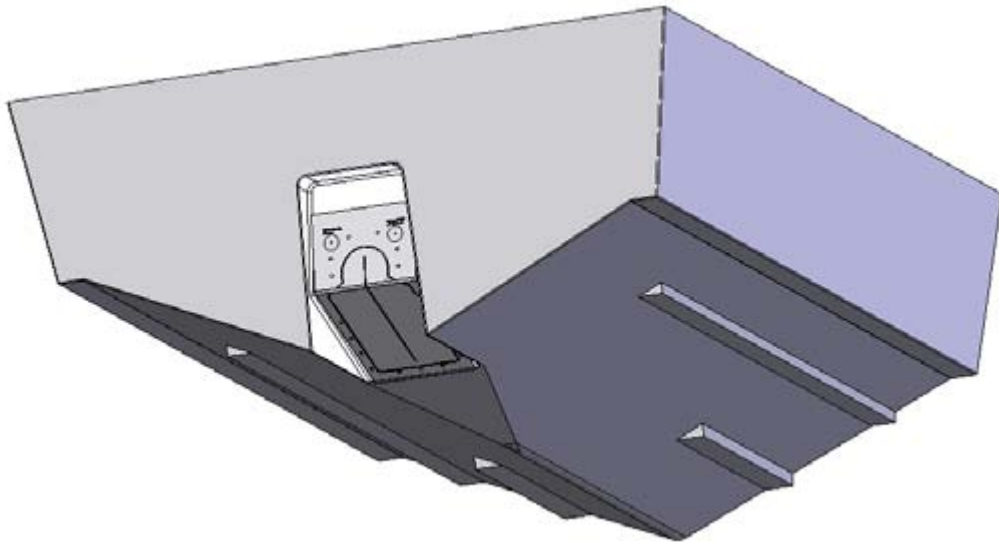
1. Set the template against the installation surface so that the texts are visible, and centre the template in relation to the ready-drilled centre hole.
2. Mark the holes and drill them.

The gauge has only a centre hole for large holes, and they are drilled to the right diameter with a hole saw. The name of the bushing and the final diameter are marked on the template for clarity (figure 16).



#### **TIP!**

It is advisable to first make one hole and use it to attach the drilling template to the transom. This way it stays in place when drilling the other holes.



**Figure 16. Drilling template**

Before installation, make sure that

1. The installation surface is straight and clean.
2. The holes are drilled/sawn correctly.
3. Transom laminate does not get in the way of the propulsion unit and its auxiliaries, which means that the laminate is not too thick.
4. The following parts have been detached from the jet:

*Short tail:*

- raw water intake

*Long tail:*

- raw water intake
- hydraulic cylinders
- hydraulic pump



**WARNING!**

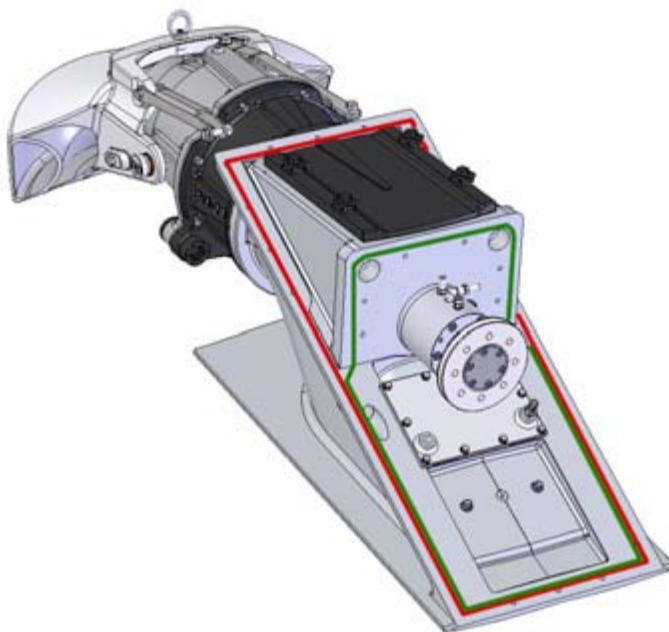
When removing the reversing deflector hydraulic cylinder, the piston rod must not twist 180°. The cylinder will not work properly if that occurs.

## 4.2. Attaching the frame



*Attaching the frame of the propulsion unit to the boat:*

1. Spread sealing compound (such as Sikaflex 221) on the fixing area, depending on which installation method you are using (figure 17, red line = Short Tail, green line = Long Tail).

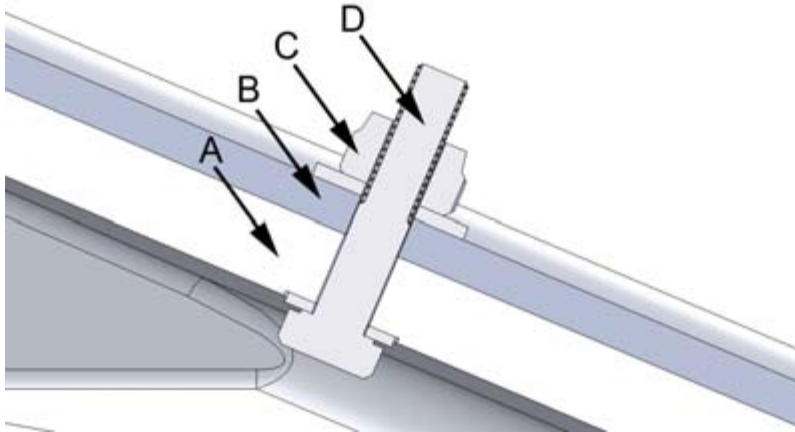


**Figure 17. Surfaces to be sealed**

2. Carefully seal all holes:
3. Lift the jet into place and push the fastening bolts into their holes if you have not already done so.

The fastening screws specific to each installation and their placement are detailed in appendix 6. *Fastening screws 245*, page 60.

The threads of the mounting holes on the frame of the jet are only meant to facilitate installation. The screw attaching the frame of the jet to the mounting template must always be fastened with a nut in accordance with figure 18 .



**Figure 18. Fastening screw (cross-section)**

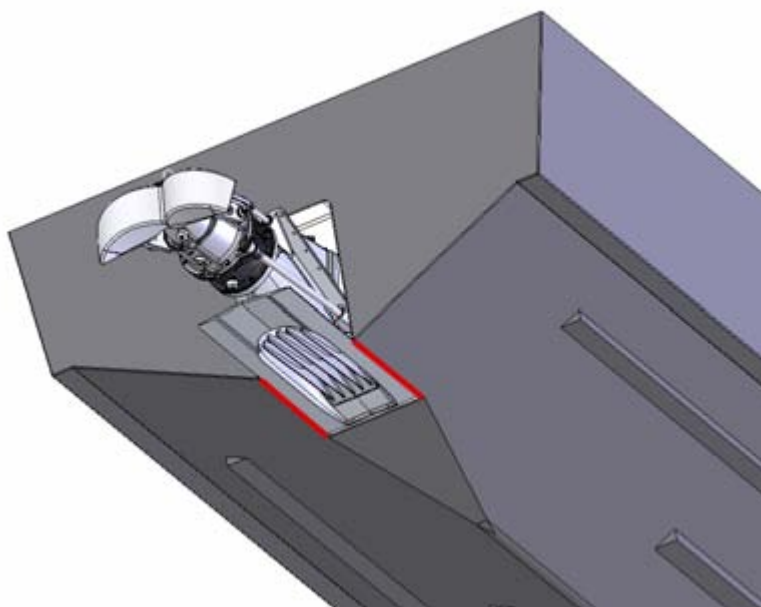
A	Jet frame	C	Nut
B	Mounting template	D	Screw

Some of the screws are already attached during jet manufacture. Ask your assistant in the boat to fasten the nuts.

4. Tighten the nuts evenly on opposite sides and make sure that sealing compound squeezes out slightly on every side.

The tightening torque of the screws in reinforced plastic boats is 20 Nm, which is different from the standard due to its softer base. Standard fastening is used in aluminium boats.

5. Wipe the burrs of sealing compound from the outer edges, intake duct and inside round the holes.
6. Seal the gaps between the bottom plate of the jet and the hull (figure 19).



**Figure 19. Sealing the bottom plate**



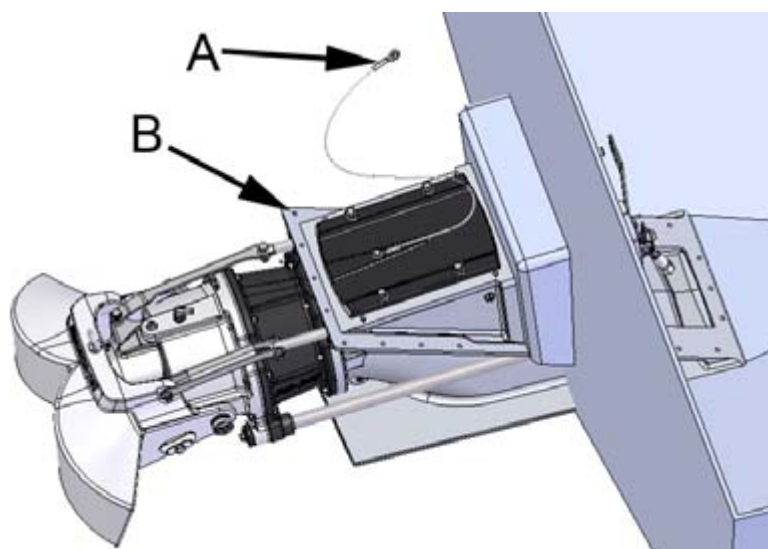


**WARNING!**

If the seam between the bottom plate and the mounting template is not appropriately sealed, ventilation may occur. This will have an adverse effect on the performance of the propulsion unit.

7. Use a screw to attach the inspection hatch wire (figure 20, point A) to one of the fastening holes on the frame of the jet (figure 20, point B, for example).

This way the inspection hatch anode is connected to the frame of the jet, providing the frame with added protection against corrosion.



**Figure 20. Inspection hatch wire**

## **4.3. Installing the lubrication system for the bearing**



### **4.3.1. 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 to the bottom of the reservoir on the drain plug magnet (figure 21, point D).

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.

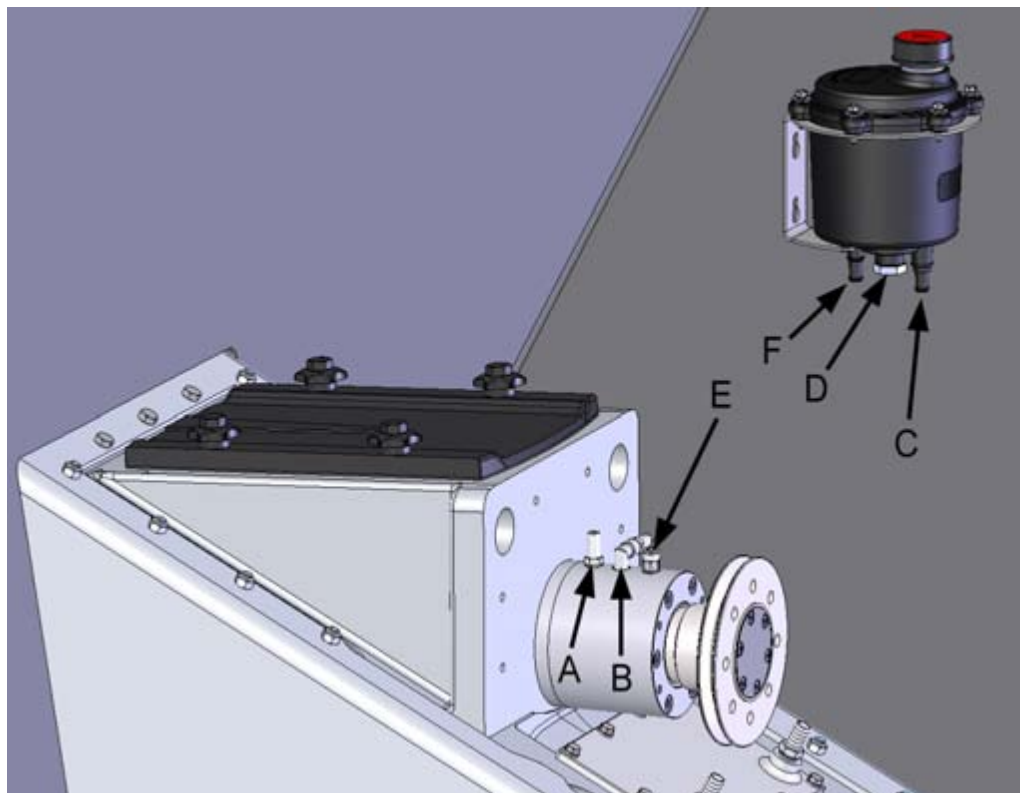
The bearing housing is filled with oil when it is delivered from the factory. The installation must be carefully performed in accordance with the instructions

so that the lubrication functions well from the beginning and as little air as possible escapes into the system.

*Installing the front bearing housing lubrication:*

1. Attach the front bearing lubricating oil reservoir in a suitable place.

The bearing housing connectors are marked as IN and OUT (figure 21, A = IN and B = OUT). The corresponding oil reservoir connectors are marked in the figure below (figure 21, C = OUT and F = IN).



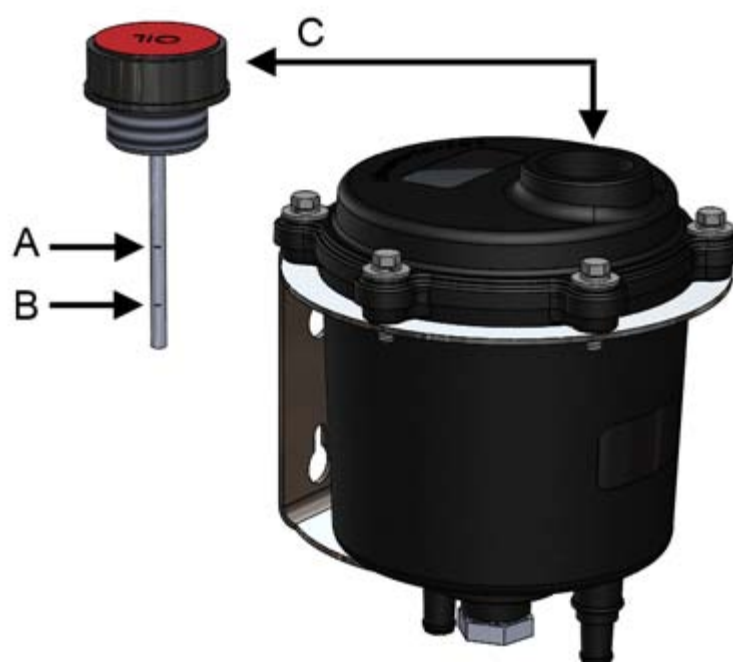
**Figure 21. Bearing housing connectors**

2. Remove the plug from the bearing housing IN connector, push the hose coming from the reservoir into place, and tighten the joint using 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 56.

Keep the hose as straight as possible and shake it occasionally to prevent air pockets from forming.

4. Remove the plug from the OUT connector and push the hose into place. Tighten the joint using pipe straps.
5. Add oil into the reservoir until the oil level is between the markings on the dipstick (figure 22, points A and B).

The system generates slight pressure into the return line and the oil starts to circulate.



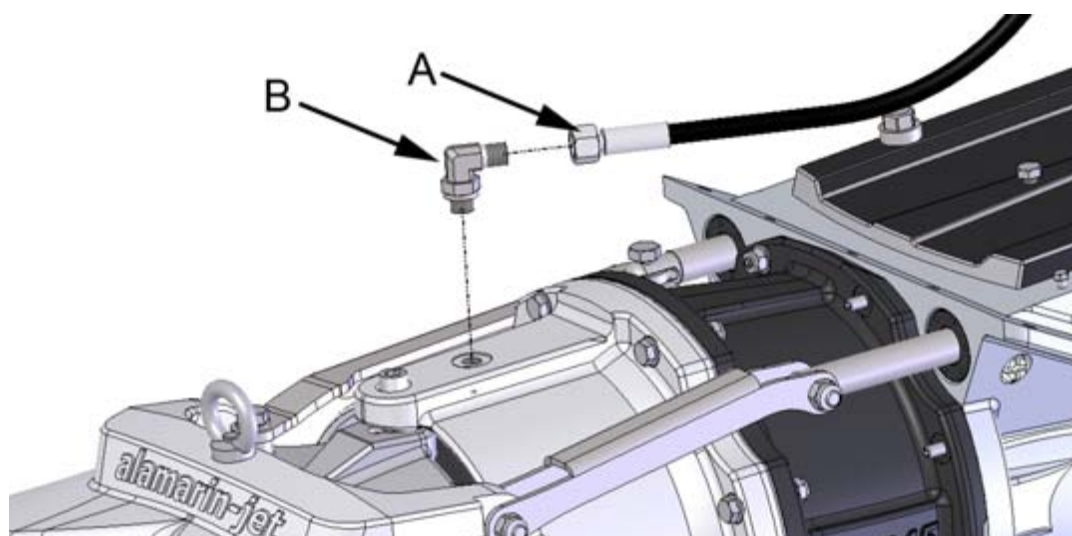
**Figure 22. Oil level in the reservoir**

#### **4.3.2. Rear bearing**

The rear bearing is lubricated by an external lubrication hose.

*Lubrication of the rear bearing with an external hose*

The rear bearing is lubricated by an external lubrication hose that runs through the boat transom (figure 23, point A). The lubrication hose is connected to the stator with an angle fitting (figure 23, point B), through which the lubricant flows into the rear bearing housing.



**Figure 23. Lubrication of the rear bearing with an external hose**

*Installing the external lubrication hose for the rear bearing*

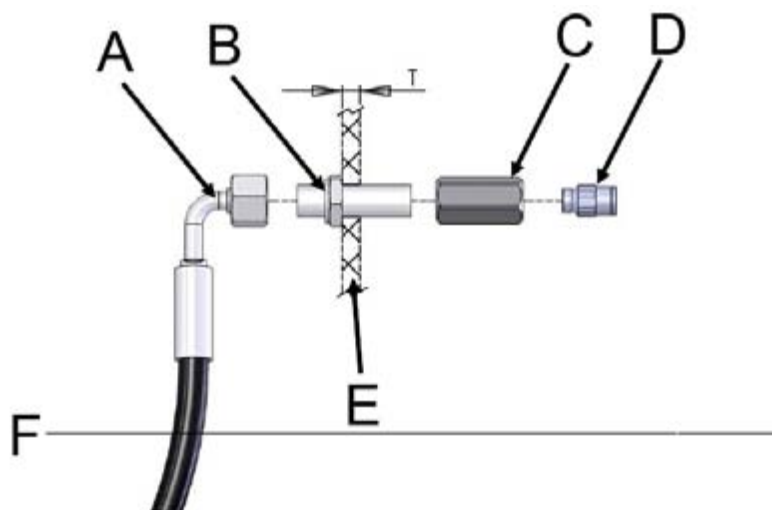
The external lubrication hose for the rear bearing is installed in accordance with figure 24 . Please note that points A and B in figure 24 are located outside the boat, while points C and D are located inside the boat.

1. Choose a suitable location on the boat transom for the lubrication hose lead-in.

The lead-in should be placed above the waterline. The thickness of the transom at the lead-in should be  $T = 5 \dots 20$  mm.

2. Drill a  $\varnothing 13.5$  mm hole in the location chosen for the lead-in.
3. Place the lead-in connector (figure 24, point B) in the drilled hole in accordance with figure 24 and seal it in place with sealing compound (such as Sika291i).
4. Tighten connector C in figure 24 to the lead-in connector.
5. Attach the lubrication hose (figure 24, point A) to the lead-in connector and tighten connector D to connector C in accordance with figure 24 .
6. Use a plastic hose to form a channel from connector D to a grease nipple.

Alternatively, there can be an automatic lubrication unit at the end of the hose.



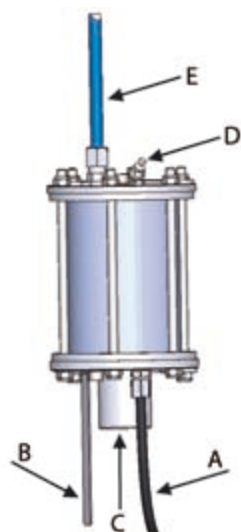
**Figure 24. Installing the external lubrication hose for the rear bearing**

A	Lubrication hose	D	Connector
B	Lead-in connector	E	Transom
C	Connector	F	Waterline

*Automatic lubrication unit*

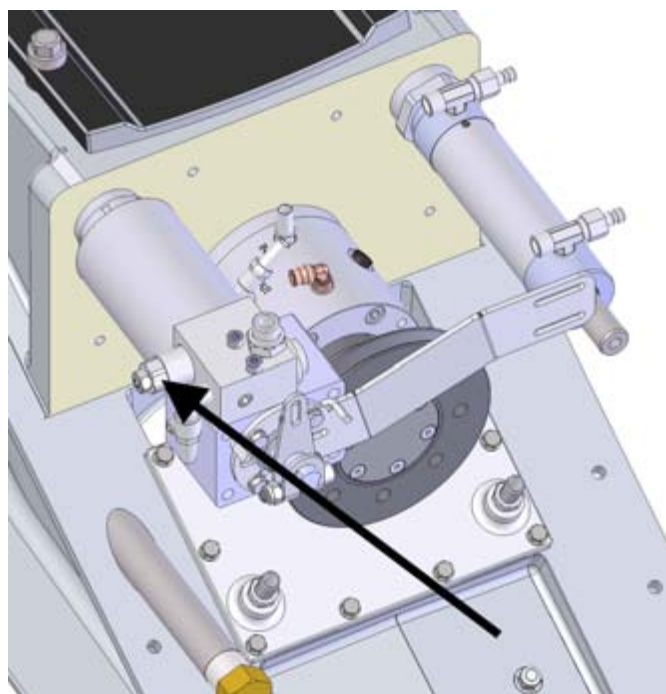
The automatic lubrication unit (figure 25) decreases the need for maintenance because it feeds grease to the rear bearing each time the jet's main shaft rotates. The grease going to the rear bearing lubricates the bearing, and it also prevents water from leaking into the bearing housing. The amount

of grease is adjusted with a screw in the hydraulic cylinder, which tightens the spring (figure 26). When you loosen the screw, the amount of grease decreases.



**Figure 25. Automatic lubrication unit**

A	Oil pressure hose from the hydraulic cylinder	D	Grease nipple
B	Scale	E	Grease hose to the lubrication channel
C	Piston		

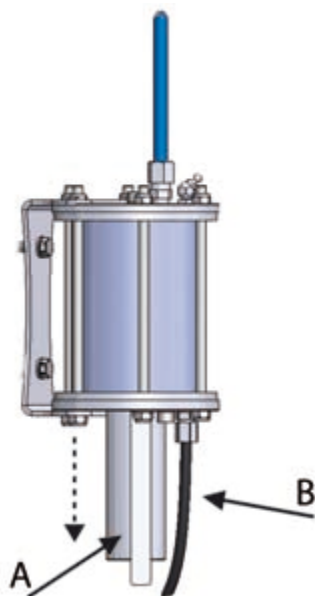


**Figure 26. Adjusting the automatic lubrication unit**

*Installing the automatic lubrication unit:*

1. Choose an appropriate place near the propulsion unit.

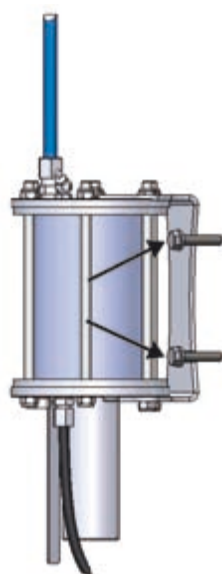
Note the lengths of the oil pressure hose and the grease hose. The oil pressure hose (figure 27, point B) must not be tight. Also make sure that the piston (figure 27, point A) can move freely, as it protrudes the length of the scale when the reservoir fills up.



**Figure 27. Automatic lubrication unit's piston movement range**

2. Use the template delivered with the automatic lubrication unit to make holes for the fastening screws of the rack in a sufficiently sturdy place.
3. Attach the screws delivered with the automatic lubrication unit into place nearly all the way.
4. Put the rack in place.

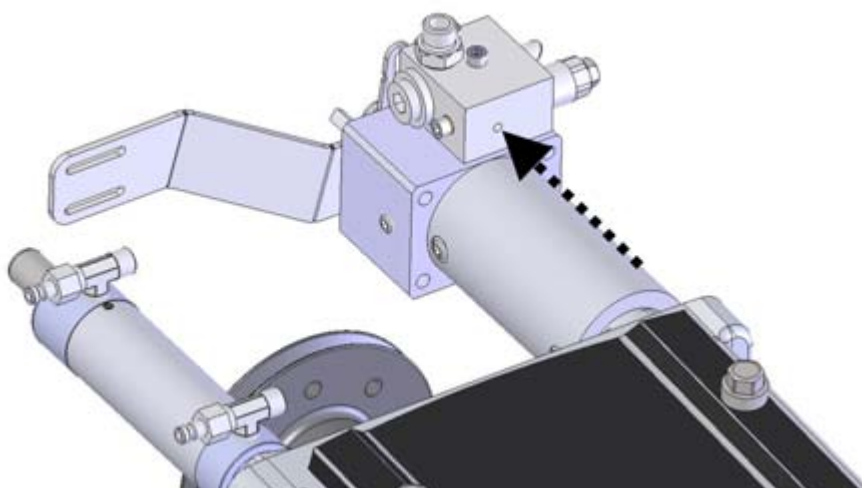
The rack has slots for the screws. Slide the rack under the screws and tighten them (figure 28) with a spanner.



**Figure 28. Automatic lubrication unit's tightening screws**

5. Screw the oil pressure hose into place (figure 29).

Please note that the cylinder must be rotated slightly before the pressure hose can be attached. However, if you want to retain the position of the cable clamp, rotate the plate in accordance with the instructions in section 5.1. *Connecting the reversing deflector to the control system*, page 41 .



**Figure 29. Attaching the oil pressure hose**

6. Attach the grease hose to the connector on the transom of the boat (figure 24, point D).

### **Feeding**

You can adjust the feed as follows:

- If the automatic lubrication unit feeds too much grease (the reservoir empties too soon), reduce the pressure by loosening the adjusting screw (figure 26).
- If the automatic lubrication unit does not feed grease to the rear bearing (cold conditions, thick grease type), increase the pressure by tightening the adjusting screw (figure 26).

The amount of grease fed to the rear bearing must be 0.1 l/100 h (6 cu in/100 h). The grease volume in the unit is 0.3 l (18 cu in). With these settings, the reservoir empties after 300 hours. If you notice that the reservoir empties more quickly or slowly than this, adjust the pressure in the desired direction.

You can fill the reservoir by pushing grease into it with a grease gun through the nipple (figure 25, point D). Then the piston (figure 27, point A) will protrude out of the reservoir.

The properties of the grease to use are described in appendix 1. *Grease recommendations*, page 55.

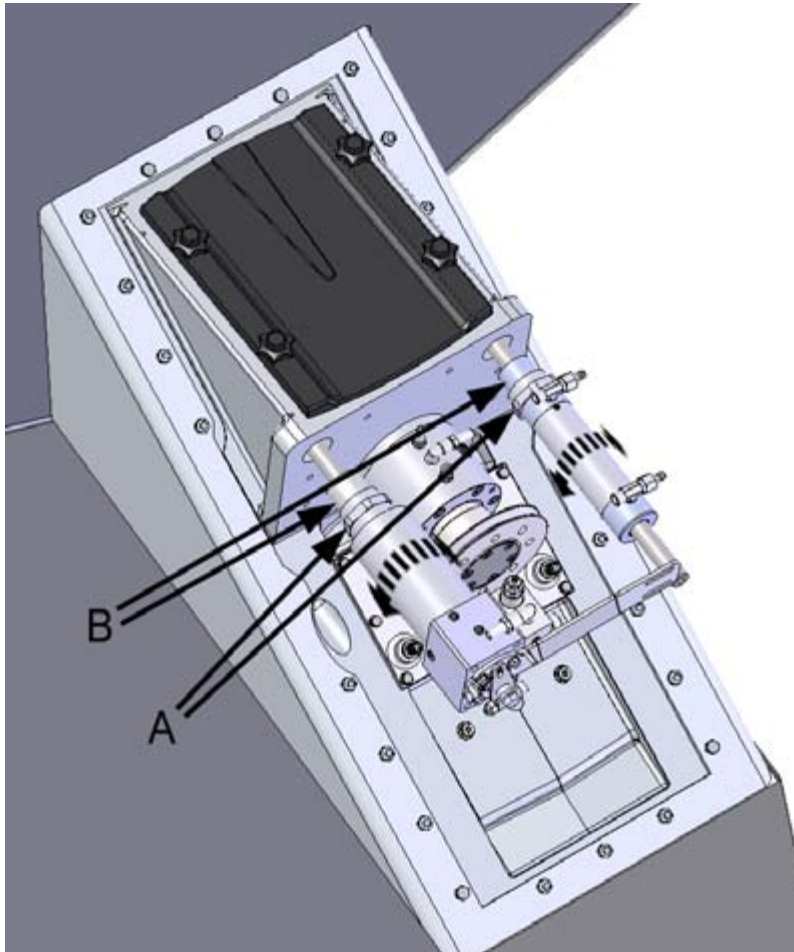
## **4.4. Attaching the hydraulic cylinders**





The AJ 245 has two hydraulic cylinders, one for the reversing deflector and one for the steering nozzle. Both cylinders are installed the same way.

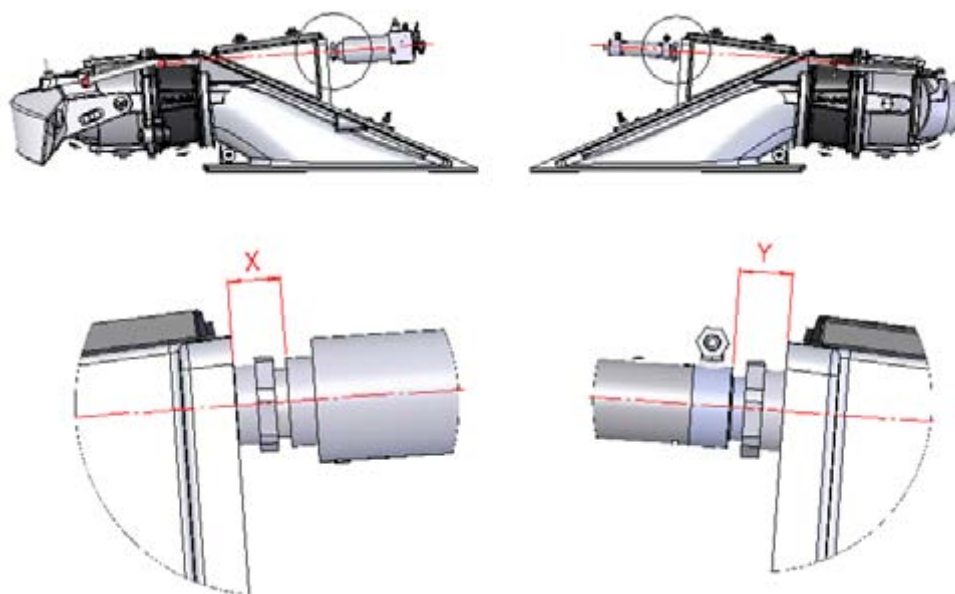
1. Make sure that the cylinders are attached without the sealing compound. The lock nut (figure 30, point A) must go through the stern so it rests against the frame of the jet.
2. With the cylinder detached, screw the lock nut all the way to the bottom.
3. Apply sealing compound to the cylinder retaining threads (figure 30, point B).



**Figure 30. Installing the hydraulic cylinders**

4. Push the cylinder into place and screw it in until the correct distances ( $X \sim 31$  mm and  $Y \sim 29$  mm) are reached (figure 31).
5. Tighten the lock nut.





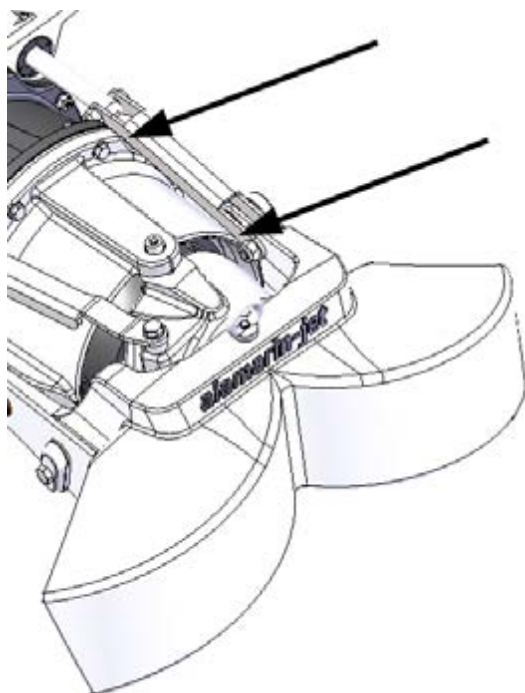
**Figure 31. Dimensions of the hydraulic cylinders**

6. Check that the reversing deflector and the steering nozzle move correctly.

The steering nozzle should move the same distance in both ways.

For the reversing deflector, the determining limit is the deflector's bottom position. Make sure that the deflector's intermediate bar does not come into contact with the cast parts of the jet (figure 32).

If any deviations are observed in the movements of the reversing deflector or the steering nozzle, adjust the cylinders by screwing them in or out.

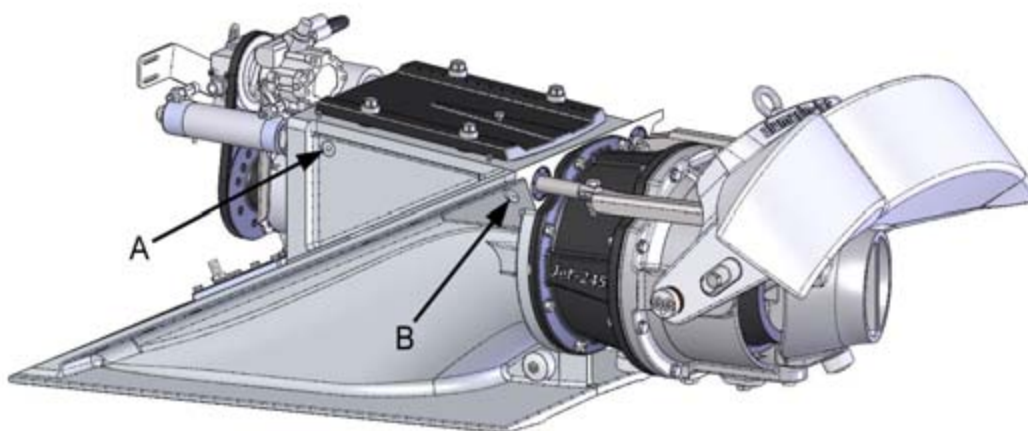


**Figure 32. Reversing deflector intermediate bar**

#### **4.4.1. Filling the hydraulic cylinder installation holes with grease**

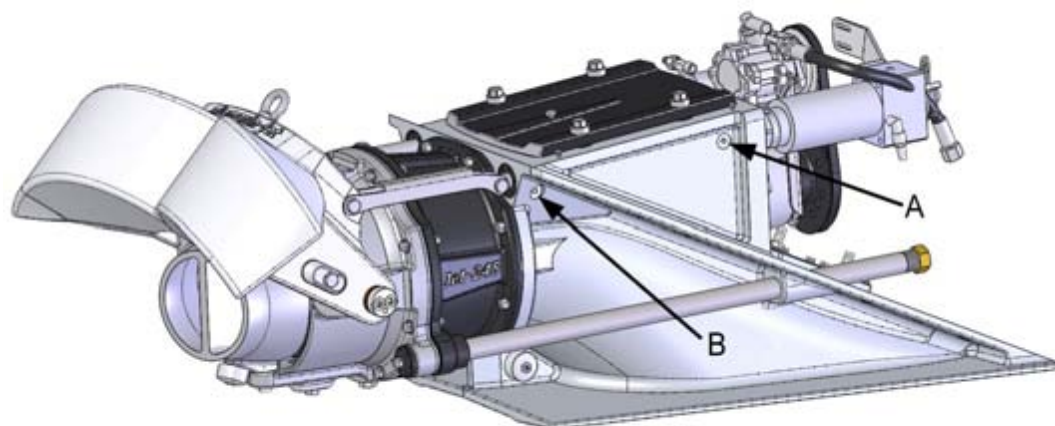
Before the propulsion unit is put into use, the hydraulic cylinder installation holes of the assembled unit should be filled with grease. This procedure prevents corrosion if the rear seal leaks and is not replaced.

Remove the plugs located on the side of the propulsion unit's frame (2 pcs) and screw a grease nipple into the hole closer to the bow (figure 33, point A). Use a grease gun to push grease through the grease nipple until grease starts to squeeze out of the hole closer to the propulsion unit's nozzle (figure 33, point B).



**Figure 33. Filling the hydraulic cylinder installation holes with grease, steering side**

To finish up, remove the grease nipple and screw the plugs back into place. Carry out the same procedure on the hydraulic cylinder installation hole located on the other side of the propulsion unit's frame. Make sure that the plugs' o-rings are in place (figure 35).



**Figure 34. Filling the hydraulic cylinder installation holes with grease, deflector side**



**Figure 35. Plug o-ring**

## **4.5. Attaching the hydraulic pump**

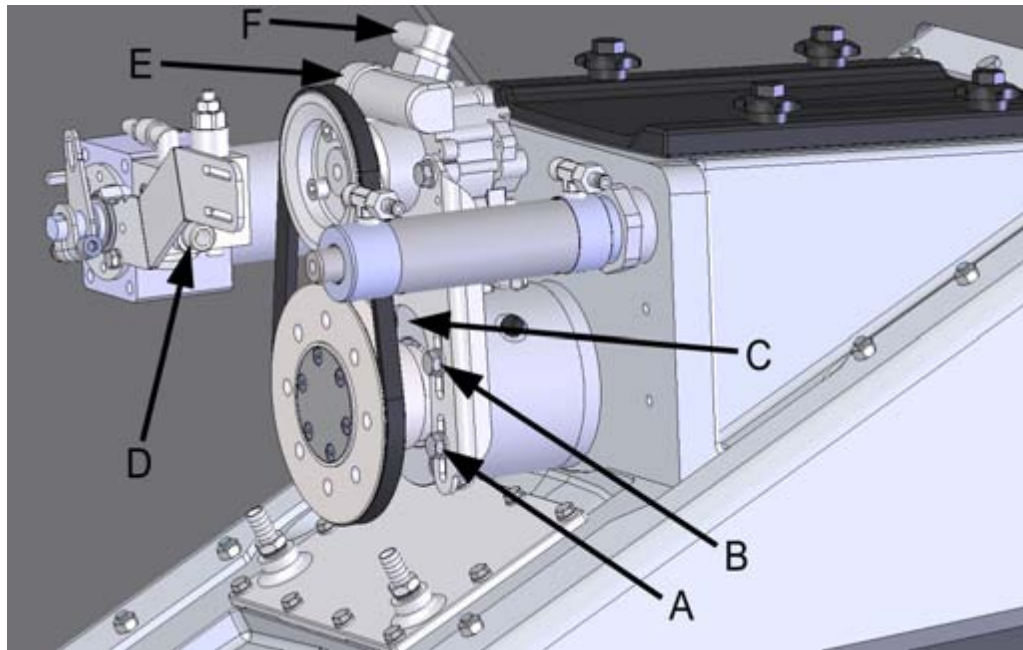


*Attaching the hydraulic pump:*

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 36, points A and B).



**Figure 36. Attaching the hydraulic pump**

2. Fit the belt in place.
3. Lift the rack by cranking it from point C indicated in figure 36 .
4. Tighten the screws.

The tightening torque is 46 Nm.

5. Install the pressure hose to connectors D and E (figure 36).
6. Install the reservoir hose to connector F (figure 36).
7. Install the oil reservoir and its rack to a suitable place above the pump.

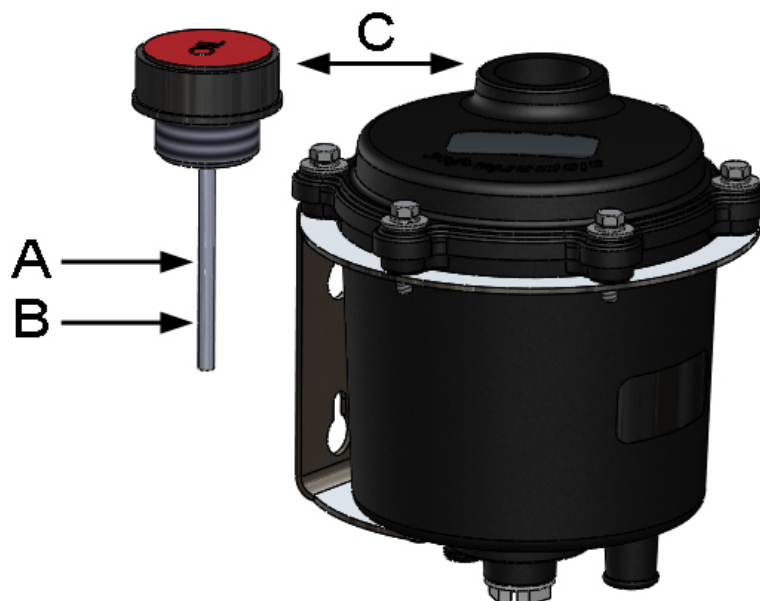


**Figure 37. Oil reservoir and rack**

In figure 37 , 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 38, point C). There is a dipstick on the reservoir cap with markings for maximum and minimum oil levels (figure 38). The type of oil to use is described in appendix 2. *Oil recommendations*, page 56 .



**Figure 38. Checking the oil level**

- A Maximum level
- B Minimum level
- C Cap

*Amount of oil in the hydraulic system and the front bearing*

Hydraulics:	1-1.5 L
Front bearing:	0.8-1 L

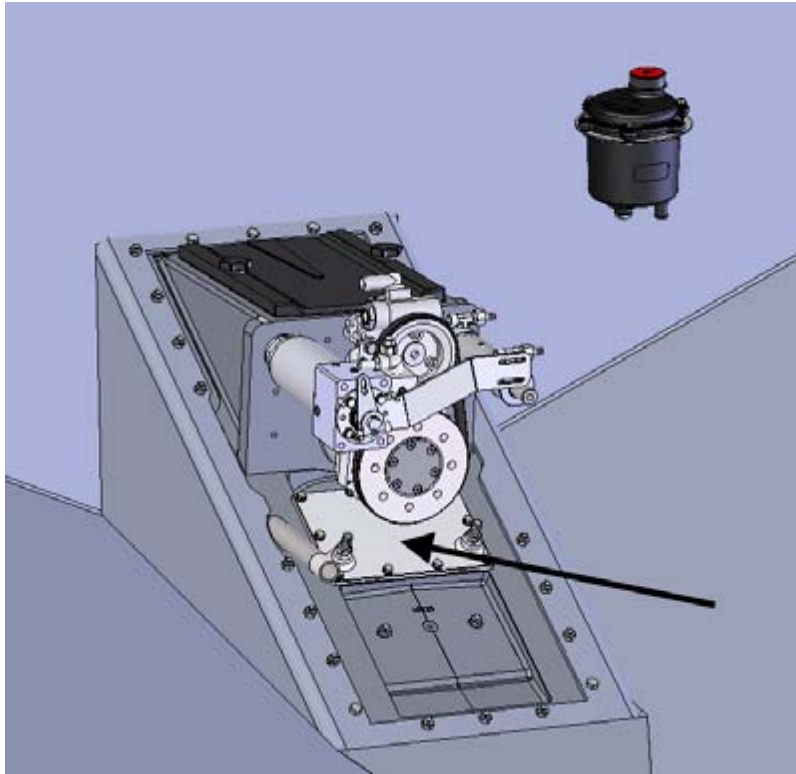
## 4.6. Oil cooling



The oil circulating in the system must be cooled down in order to prevent excessive heating. This is done with a heat exchanger, which is integrated into the frame of the propulsion unit (figure 39). The oil circulation direction through the heat exchanger can be chosen freely.

**WARRANTY!**

If the oil in the system is not cooled, the manufacturer is not responsible for possible damages which derive directly or indirectly from the oil overheating.



**Figure 39. Cooling system**

**WARNING!**

The system's pressure is high during operation, max. 7 MPa (max. 70 bar).

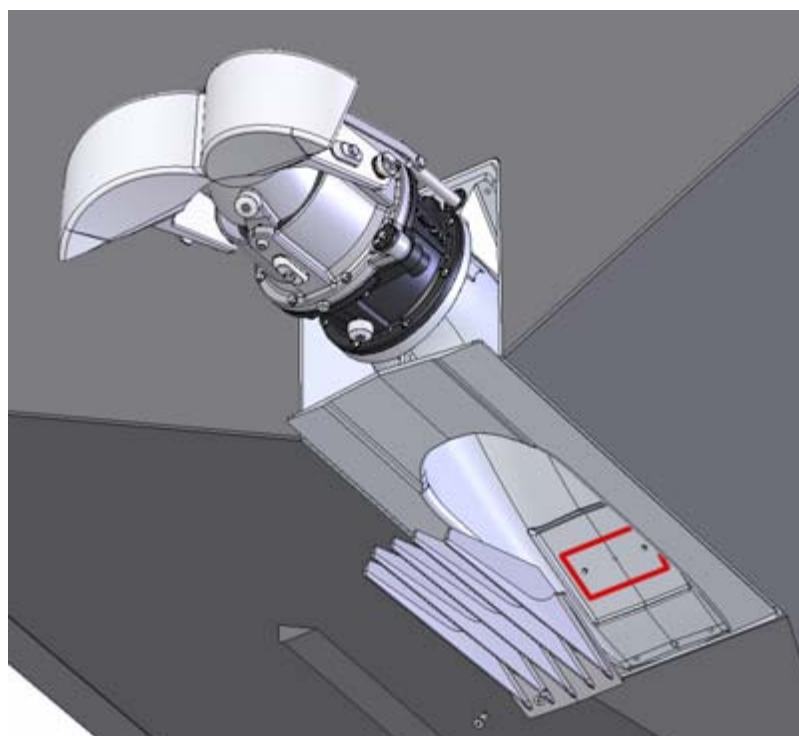
Make sure that the hoses do not rub against sharp edges. The bursting of a pressure hose can cause serious danger.

## 4.7. Attaching the grass rake



The grass rake (figure 40) is attached in front of the intake opening with two screws.





**Figure 40. Grass rake**

*Attaching the grass rake:*

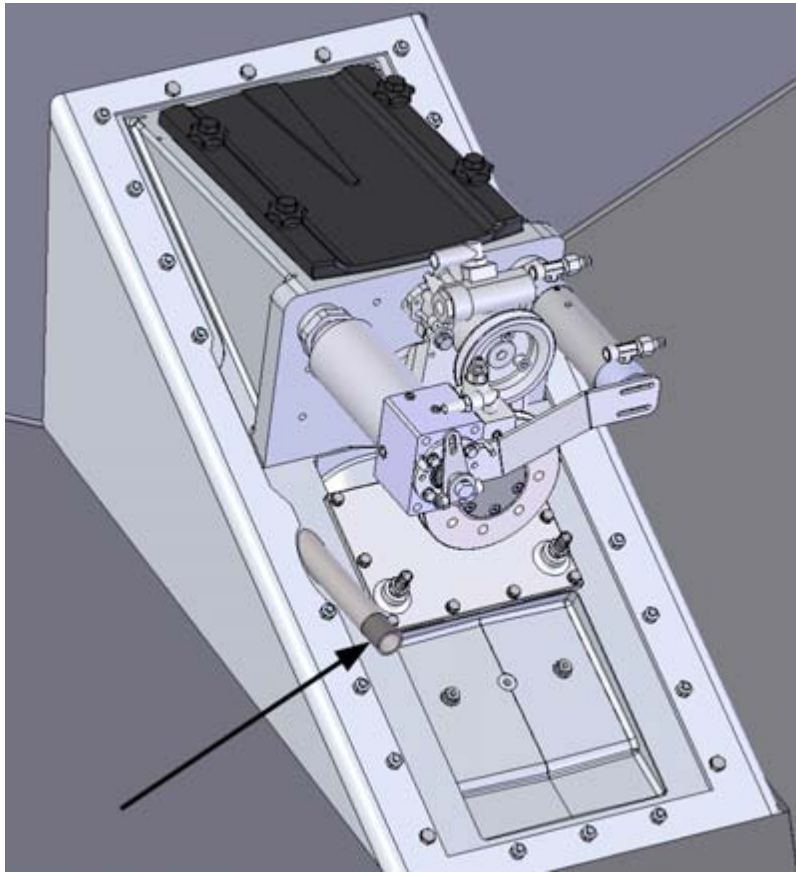
1. Seal the fixing area in the same manner as when installing the propulsion unit frame.
2. Fit the grass rake in place in the intake duct and tighten the screws in place.

The normal tightening torque for an M8 screw is 23 Nm (17 lb ft). The tightening torque of the screws in reinforced plastic boats is only 20 Nm (15 lb ft).

## 4.8. Installing the raw water cooling line



Cooling water for the engine can be taken from the pressure face of the propulsion unit. The propulsion unit has one raw water intake as standard for this purpose. It is located on the starboard side of the bearing housing (figure 41).



**Figure 41. Raw water intake**

The intake has a G3/4" external thread (3/4" BSP). The line to the engine can be constructed using normal pipe parts or can be plugged into the engine using the plugs delivered with the propulsion unit. The raw water intake can also be used for other purposes that require pressure water.

The design pressure of the line is 10 bar, but the actual pressure depends on the impeller type, running speed and the line structure.

When constructing the raw water cooling line

- Note the engine manufacturer's recommendations regarding the cooling water feed.
- If necessary, throttle the line sufficiently before the engine and remove the throttles after the engine.

Line pressure should be measured before the engine, and the pressure should be adjusted in accordance with the engine manufacturer's instructions.

The hose joints must be durable enough. If the hose breaks or the joint comes off, the engine room may fill with water, the engine may break, or the boat may even sink.

Dry running of the jet (when the boat is not in water) can be performed without restriction.





### **WARNING!**

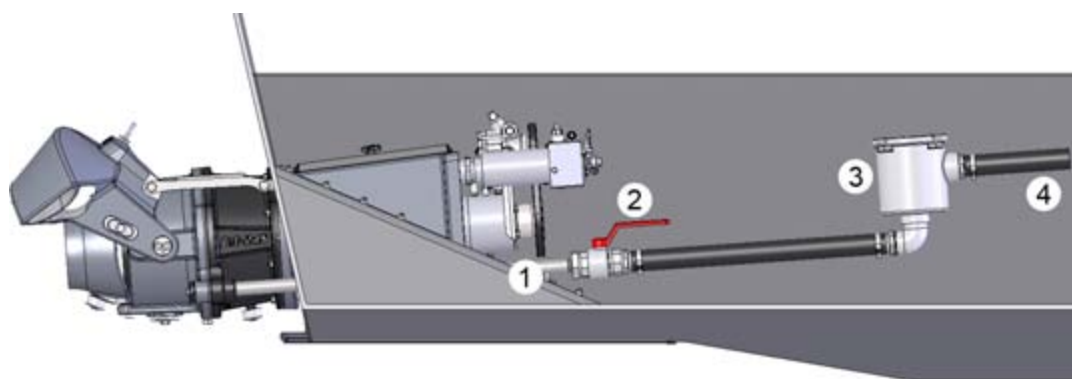
If you wish to run the jet dry, be sure take the type of rear bearing into consideration: if the jet's rear bearing is grease-lubricated, dry-running is possible. Conversely, a water-lubricated rear bearing requires a constant water supply in order to ensure adequate lubrication during operation. Dry running a water-lubricated rear bearing may quickly damage the bearing. The engine must always be supplied with cooling water.



### **CAUTION!**

Always observe the manufacturers' other instructions for dry running.

The operation of the raw water line is depicted in figure 42.



**Figure 42. Raw water cooling**

- 1 Raw water connector
- 2 Tap
- 3 Filter
- 4 Input for the engine

Note the following when installing the raw water cooling line:

- There must be a shut-off valve at the beginning of the line so that the line can be cut off when the boat is in water. If there is no valve, water will leak into the boat when the line is opened for cleaning, for example.
- The filter must be installed on the line before the coolers are installed. The filter must be above the waterline. (This way water does not flood in when the filter is being cleaned.)
- The line empties itself when the boat is on a horizontal plane (e.g. when the boat is hanging on a davit).

**WARNING!**

If the raw water line is not used at all, the line must be closed off carefully by means of the plug delivered with the jet. Ensure that the plug is watertight by applying thread sealant on its thread (such as Loctite 5776).

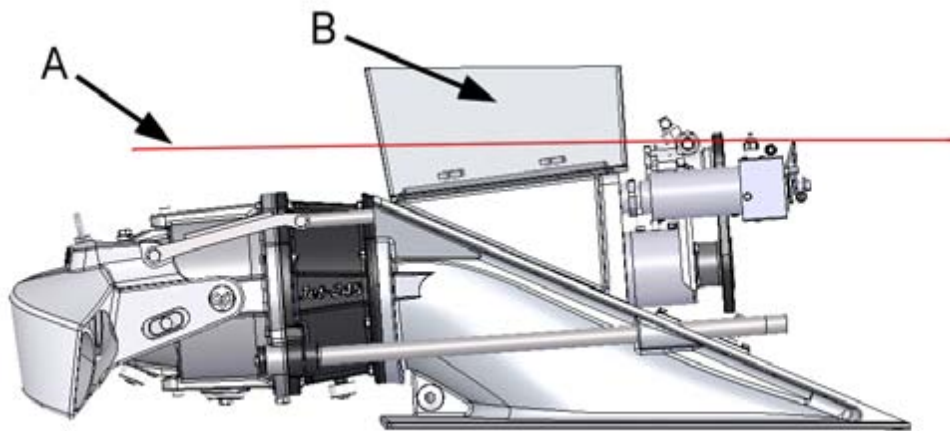
If the line is not plugged, the engine room will fill with water.

## 4.9. Installing the inspection hatch elevation collar

In a short tail installation, the inspection hatch is located inside the boat. If the static waterline (figure 43, point A) ends up higher than the inspection hatch (figure 43, point B), the inspection hatch must be equipped with an elevation collar (figure 43, point B). This way, when the inspection hatch is opened, water rises inside the elevation collar but does not spill out into the engine compartment.

**WARNING!**

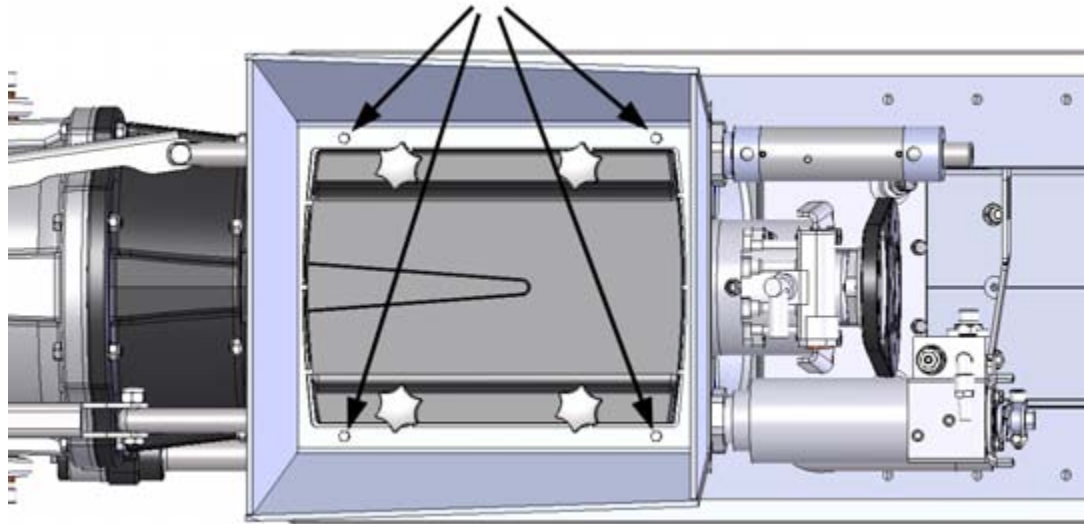
Not using an elevation collar when the static waterline is above the inspection hatch will result in a water leak in the engine compartment, which will in turn result in immediate risk of sinking!



**Figure 43. Inspection hatch elevation collar**

The elevation collar is an accessory that is available to order when required.

The collar is installed using four M5 screws (figure 44), and the coupling is sealed using a sealing compound.



**Figure 44. Installing the elevation collar.**



## 5. 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.



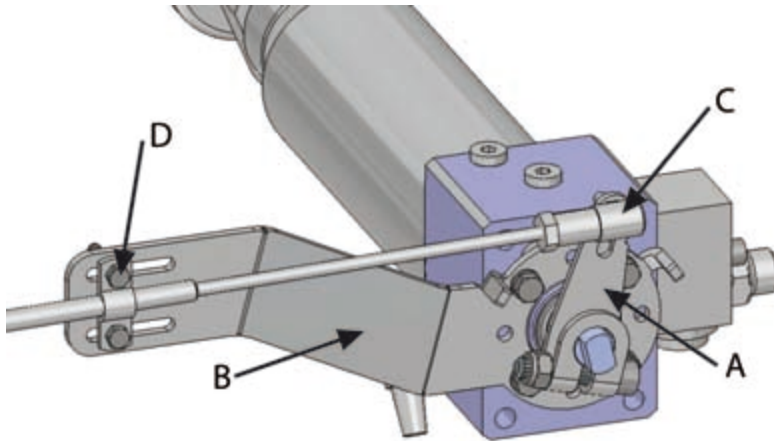
### WARNING!

The movement of the reversing deflector must always be controlled with a separate lever. Otherwise the propulsion unit does not function correctly.

### 5.1. Connecting the reversing deflector to the control system



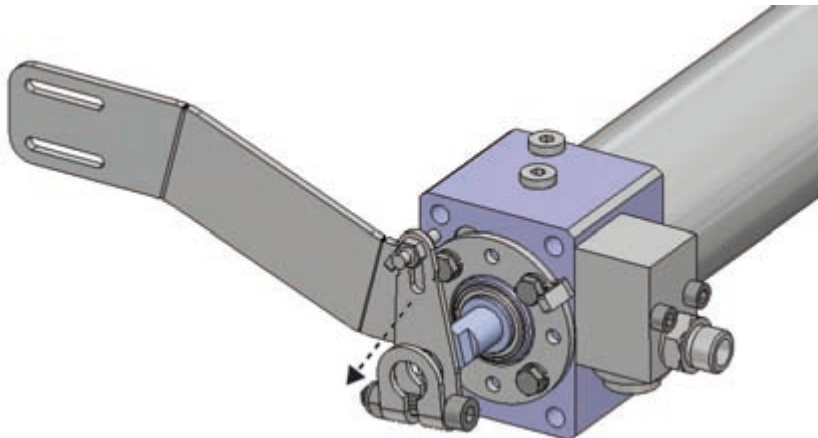
The control cylinder of the reversing deflector is used with the lever (figure 45, point A) that is at the end of the cylinder. The lever has a cable terminal when it is delivered from the factory. However, the cable's inlet direction can be different than the standard direction of the cable support (figure 45, point B). You can turn the cable support plate to point in the desired direction in accordance with the cable's inlet direction.



**Figure 45. Hydraulic cylinder**

*Changing the position of the cable support:*

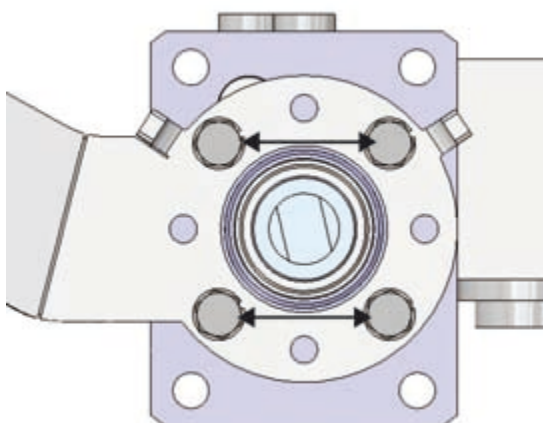
1. If the control cable is attached, detach the end of the cable (figure 45, point C) from the cylinder's operating lever and detach the cable fastener from the support plate (figure 45, point D).
2. Loosen the operating lever's fastening screw and pull the lever off the shaft (figure 46).



**Figure 46. Removing the operating lever**

3. Open the fastening screws (four in total, figure 47) 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.

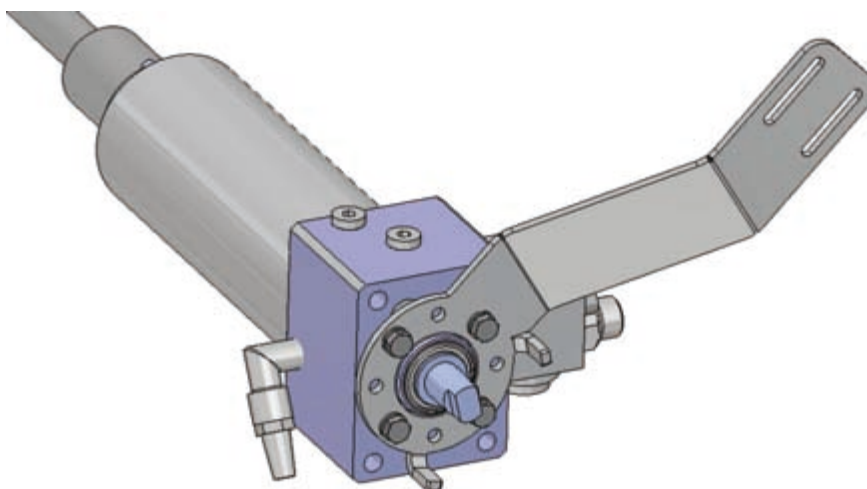


**Figure 47. Support plate fastening screws**

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.

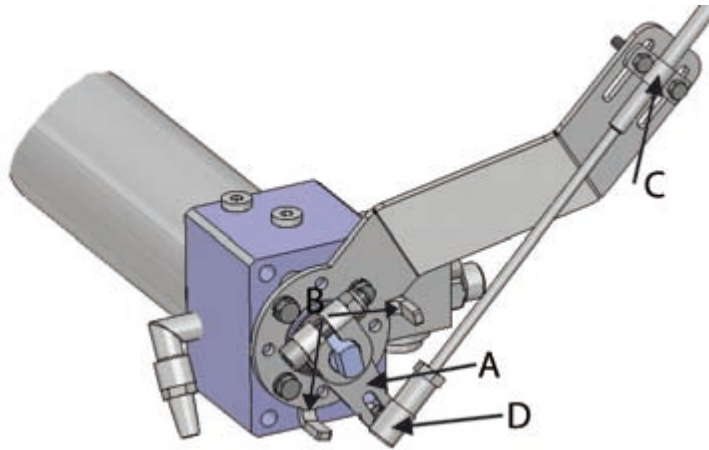
The support plate has eight holes, so you can turn the plate at 45° intervals. In figure 48 the plate has been turned 135°.



**Figure 48. Turned support plate**

5. Place the lever (figure 49, point A) on the operating shaft so that it lies between the limiters on the support plate (figure 49, point B).

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



**Figure 49. Attaching the operating lever**

6. Attach the control cable with a cable clamp (figure 49, point C) to the support plate and with an angle joint (figure 49, 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.

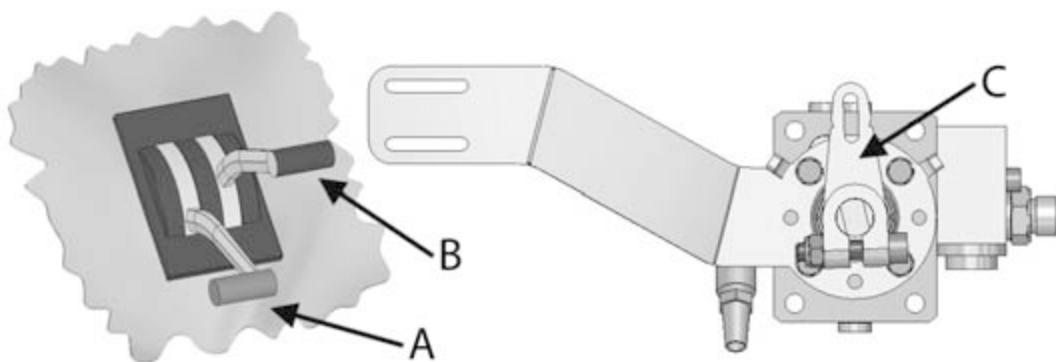
See the cylinder adjustment instructions in section 5.1.2. *Cylinder adjustment*, page 45.

### 5.1.1. Connecting the control cables

The control cables are connected from the control system to the reversing deflector, as indicated in figures 50–52 .

#### *Idle running*

Both levers (B and C) are in the centre (figure 50)



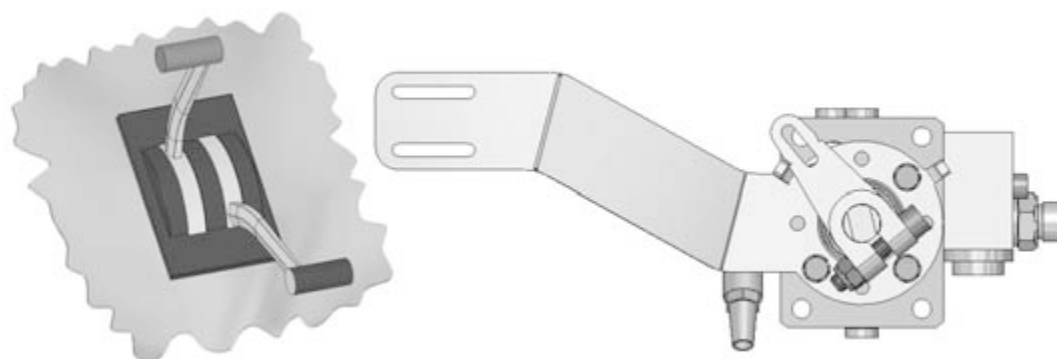
**Figure 50. Idle running**

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



### *Full astern*

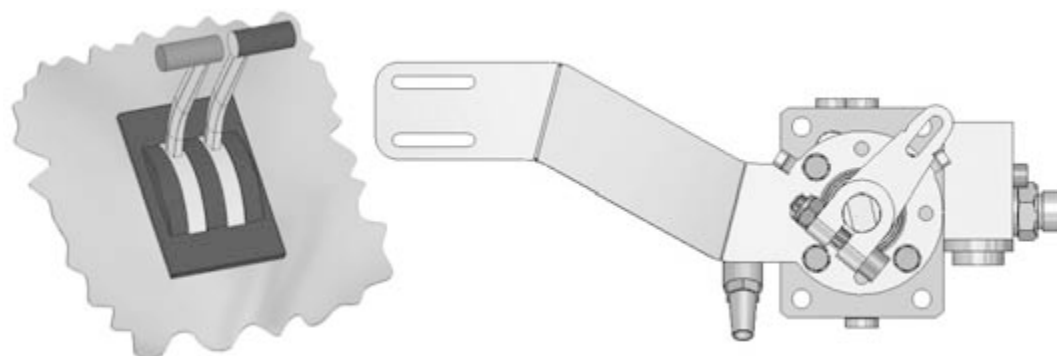
The control lever is down, the cylinder operating lever on the left (figure 51)



**Figure 51. Full astern**

### *Full ahead*

The control lever is up, the cylinder operating lever on the right (figure 52)



**Figure 52. Full ahead**

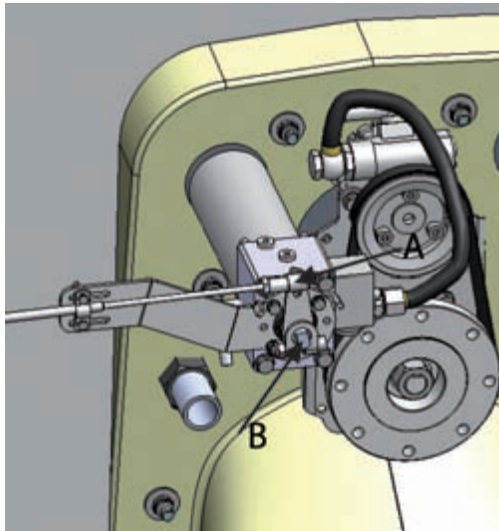
## **5.1.2. Cylinder adjustment**

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 38). Occasionally move the hydraulic cylinder's operating lever back and forth (figure 49, point A) so that the cylinder fills with oil.

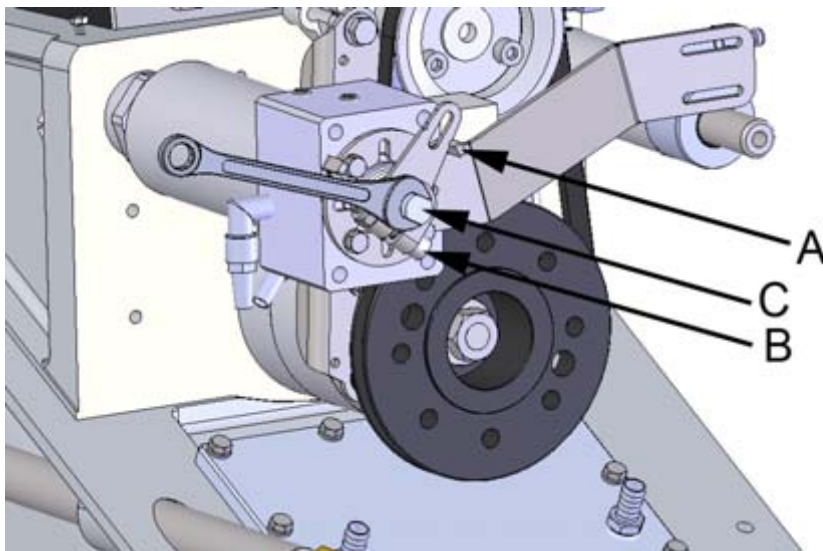
### *Adjusting the cylinder:*

1. Detach the control cable from the end of the cylinder operating lever (figure 53, point A).



**Figure 53. Removing the control cable**

2. Loosen the operating lever screw (figure 54, point B) but do not pull the lever off the shaft yet.
3. Place the lever against the limiter on the shaft (figure 54, point A).



**Figure 54. Operating lever and limiter**

4. Turn on the engine and put it into gear.
5. Using a 13 mm wrench, turn the operating shaft (figure 54, point C) clockwise so that the reversing deflector is in a downwards position, blocking the jet flow.

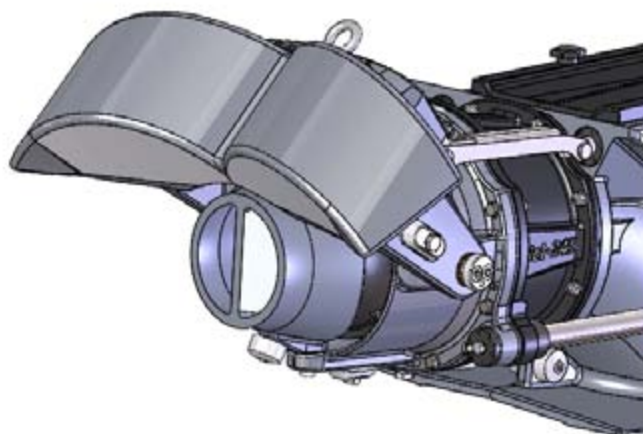
If you turn the shaft too much, it will no longer move smoothly, indicating that the cylinder has reached the end of its movement range. If this happens, turn the shaft back slightly.

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

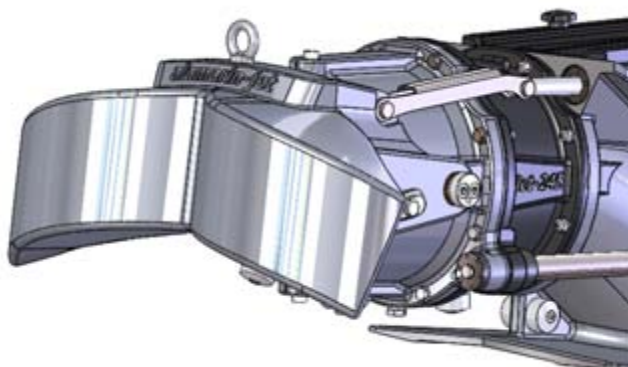
Do not tighten the screw too much!

7. Attach the control cable to the screw at the end of the operating lever (figure 53, 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 55). In the down position, the top of the reversing deflector nearly touches the steering nozzle (figure 56).



**Figure 55. Deflector in the up position**



**Figure 56. Deflector in the down position**

## **5.2. Connecting the steering nozzle to the control system**

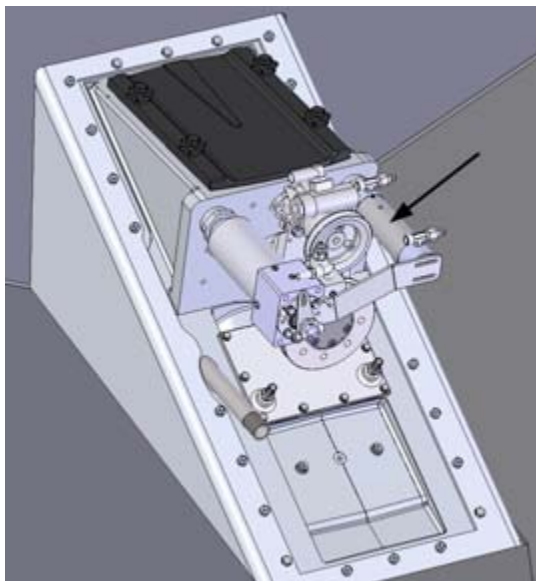


The jet features a compact integrated hydraulic cylinder for steering. The cylinder is easy to use and enables comfortable steering.

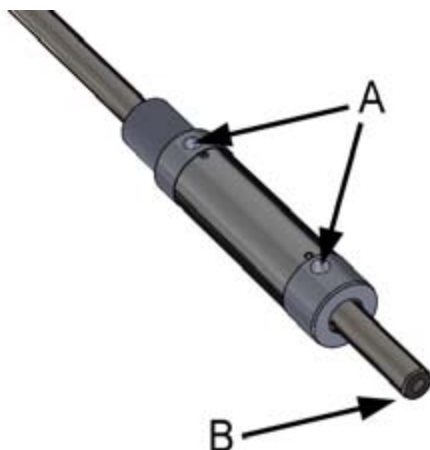
The cylinder is compatible with most steering pumps available on the market. Compatible pumps are also available from Alamarin-Jet as accessories. The hose connector threads of the cylinder are type ¼" NPT. The thread is conical, but the the connector must be sealed using thread sealant (such as Loctite

542). The size of the steering pump should correspond to the cylinder volume, which is 0.1 litres.

The end of the steering cylinder features an additional thread, which can be used to connect an emergency steering system (figure 58, point B).



**Figure 57. Steering nozzle hydraulic cylinder**



**Figure 58. Hydraulic cylinder parts**

- A Bleeding connections
- B Connector for an emergency steering system

*Installation:*

1. Make sure that the cylinder is installed in accordance with instructions (4.4. *Attaching the hydraulic cylinders*, page 27) and that the steering nozzle moves the same distance in both directions.
2. Build a hydraulic line from the steering wheel to the cylinder in accordance with the instructions supplied with the system.

Direct the bleeding connections on the hydraulic cylinder so that bleeding is possible.

3. Fill the system with oil and bleed it carefully in accordance with the instructions.

A free flow valve is available for emergency control as an accessory (appendix 4. *Control system hydraulic line*, page 58). When the valve is opened, the oil flow bypasses the pump and the cylinder can be operated manually.

In a twin installation, the cylinders are installed in series and a tap is installed between them so that the cylinders can be occasionally synchronised.



## 6. 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 AJ 245 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.

Note the direction of the jet's rotation, which usually corresponds to the direction of the engine's rotation (counterclockwise from the rear of the boat).



### CAUTION!

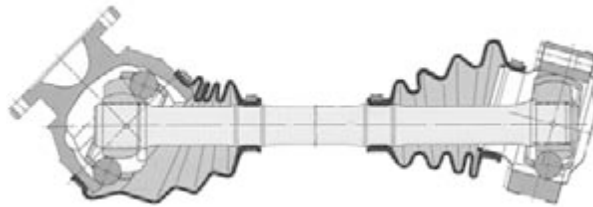
Before installing the engine, make sure that the gear possibly connected to it is correct. The wrong gear ratio decreases the performance of the propulsion unit or can completely prevent its use.

### 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*

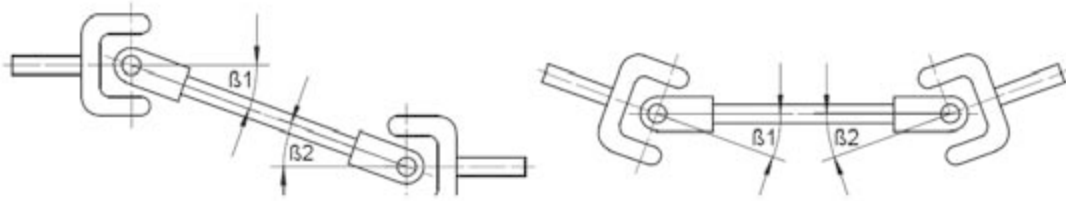
At both ends of the constant speed shaft, there is a joint based on balls rolling on a spherical surface. Amongst the shafts used with propulsion units, an intermediate shaft of this type allows the most freedom in terms of alignment. The joints can be at angles that are different from each other (figure 59).



**Figure 59. 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 60 shows examples of allowed angle configurations.



**Figure 60. 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 61, there is a rubber joint at one end and a constant speed joint at the other.



**Figure 61. 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.



## 7. 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.

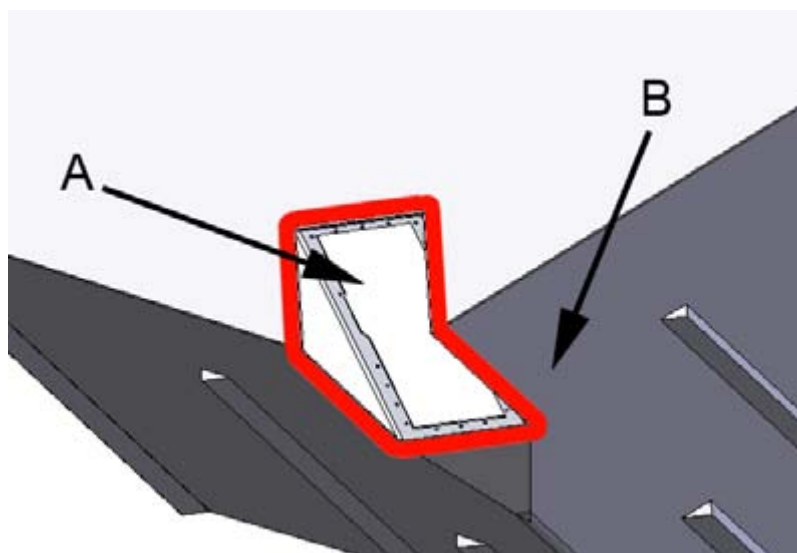


### **WARNING!**

Familiarise yourself with antifouling before painting the propulsion unit with antifouling paint! 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 round the propulsion unit in the stern and on the bottom of the boat (figure 62).



**Figure 62. 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°C	33-36 mm <sup>2</sup> /s
Kinematic viscosity 100°C	7.1-7.7 mm <sup>2</sup> /s
Viscosity index	min. 170
Density 15°C	0.835-0.890 g/cm <sup>3</sup>
Pour point	max. -42 °C
Flashpoint	min. 180 °C

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**

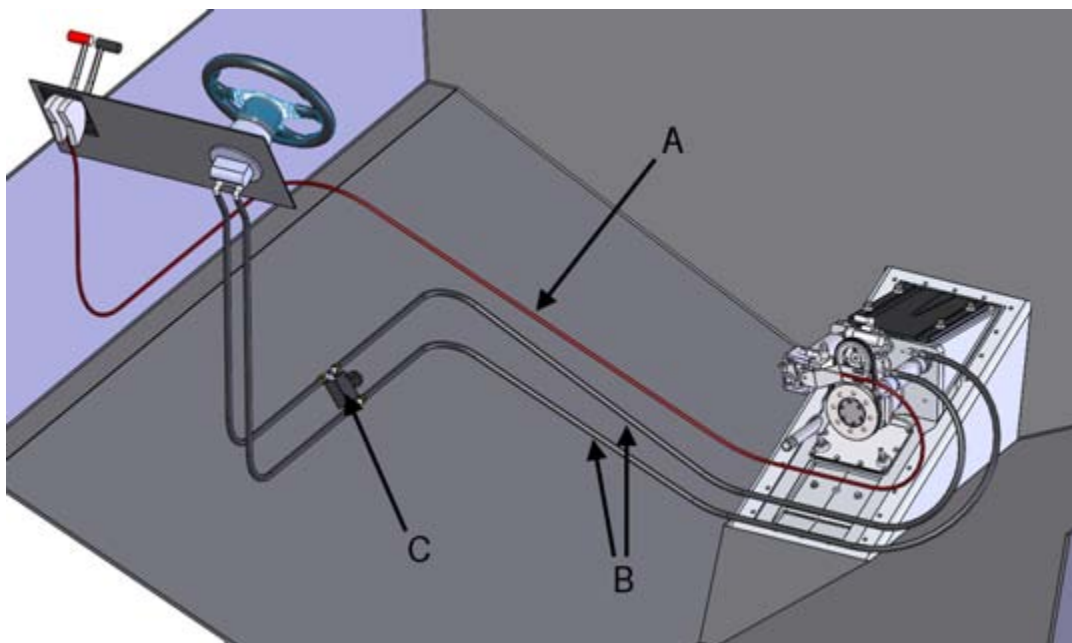
	Strength grade		
	8.8	10.9	12.9
Thread	Tightening torque (Nm) (*)		
M5	5.5 (4)	8.1 (6)	9.5 (7)
M6	9.6 (7)	14 (10)	16 (12)
M8	23 (17)	34 (25)	40 (30)
M10	46 (34)	67 (49)	79 (58)
M12	79 (58)	115 (85)	135 (100)
M16	145 (107)	215 (159)	250 (184)

(\*) 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.

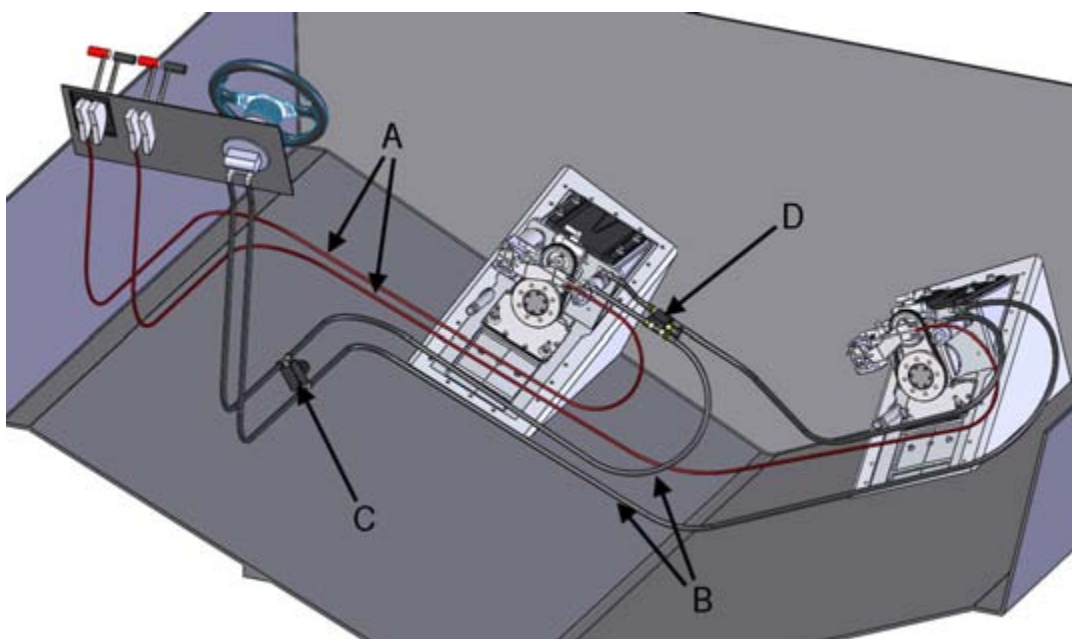
## Appendix 4. Control system hydraulic line

### *Single installation*



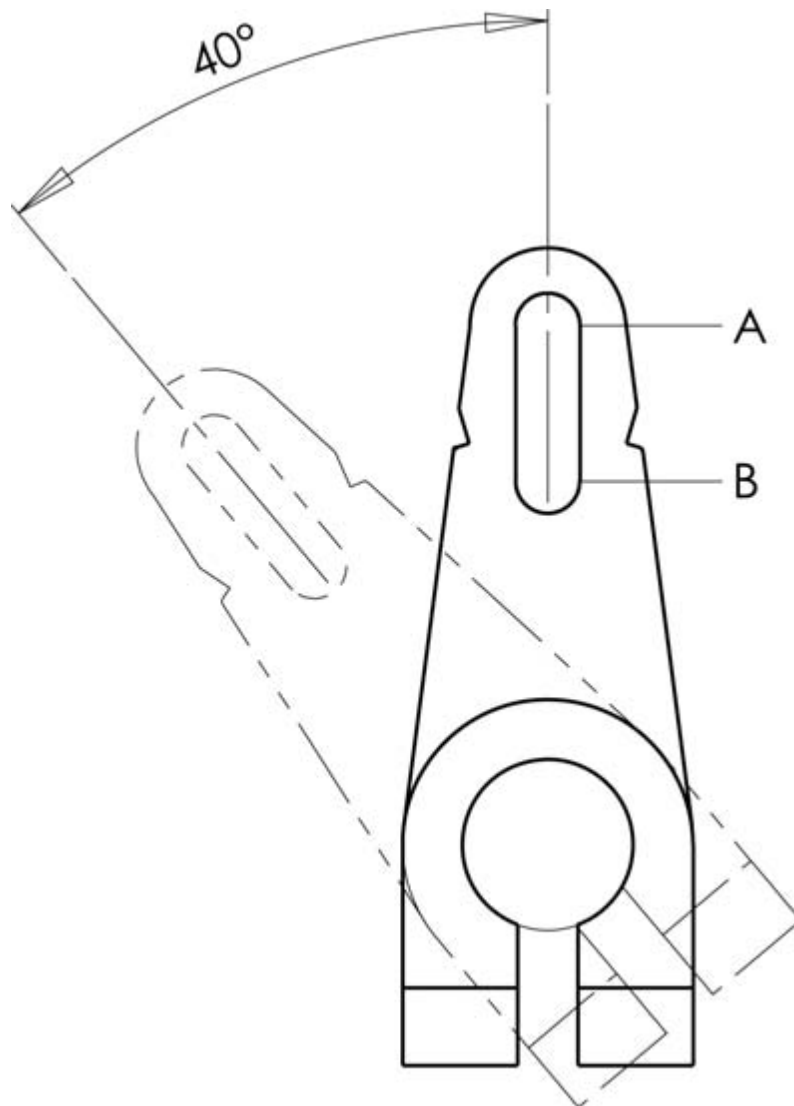
- A Reversing deflector's control cable
- B Hydraulic lines to the control cylinder
- C Free flow valve for emergency control (accessory)

### *Twin installation*



- A Reversing deflector's control cables
- B Hydraulic lines to the control cylinder
- C Free flow valve for emergency control (accessory)
- D Free flow valve for synchronisation

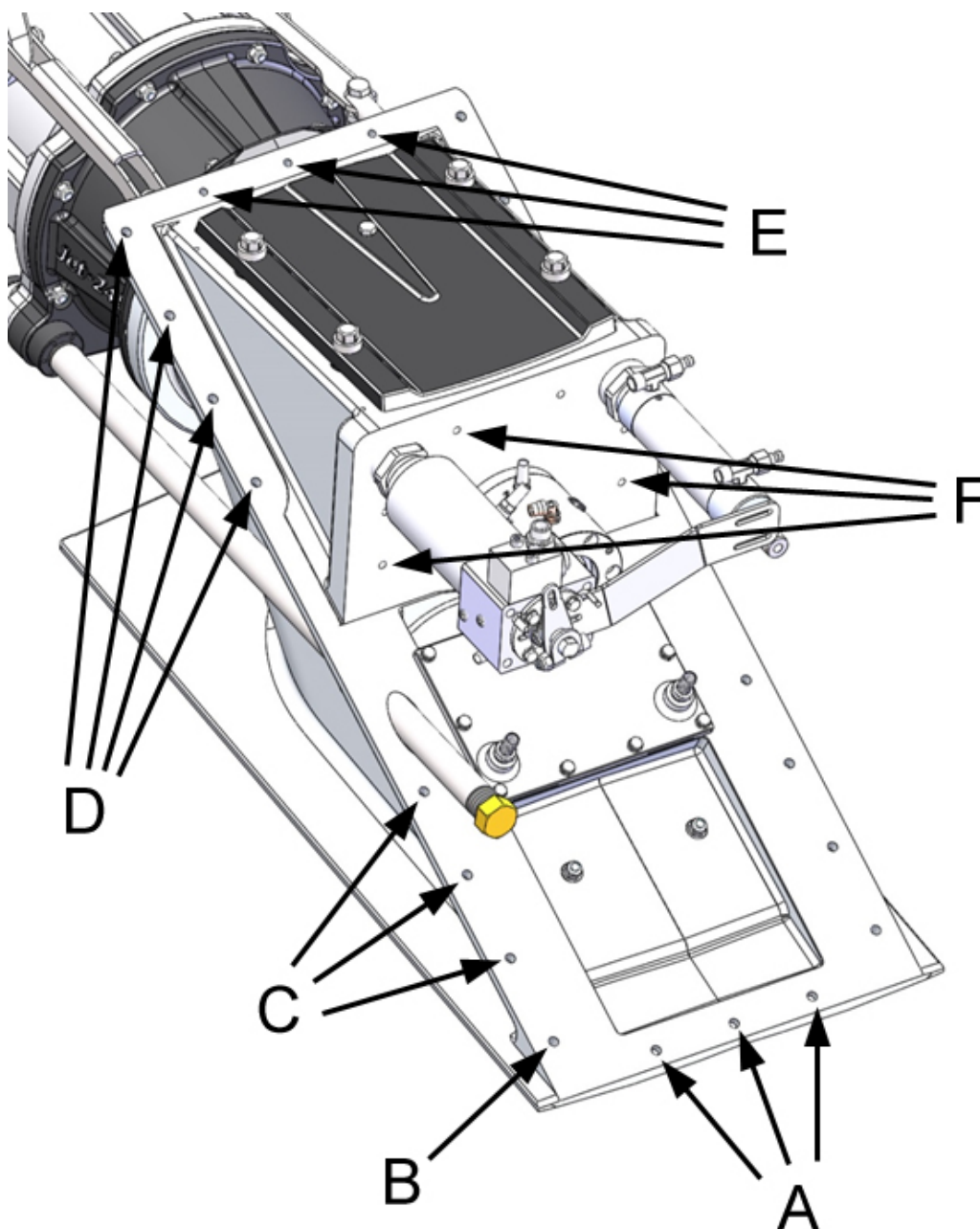
## Appendix 5. Movement range of the hydraulic cylinder control lever



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 6. Fastening screws 245



**Table 3. Fastening screws, aluminium, short tail**

<b>Aluminium</b>			
<b>Short tail</b>	R9901		
<b>Component</b>	<b>Quantity</b>		<b>Position</b>
M8x20 DIN933	5		B, E
M8x30 DIN933	14		C, D
M8x30 DIN7991	3		A
M8 nyloc	17		
M8 body spacer	22		
M8 spacer	14		



**Table 4. Fastening screws, aluminium, long tail**

<b>Aluminium</b>			
<b>Long tail</b>	R9902		
<b>Component</b>		<b>Quantity</b>	<b>Position</b>
M8x20 DIN933		6	C
M8x25 DIN933		8	B, F
M8x30 DIN7991		3	A
M8 nyloc		9	
M8 body spacer		17	
M8 spacer		6	

**Table 5. Fastening screws, GRP, short tail**

<b>GRP</b>			
<b>Short tail</b>	R9903		
<b>Component</b>		<b>Quantity</b>	<b>Position</b>
M8x30 DIN933		16	B, C, D
M8x30 DIN7991		6	A, E
M8 nyloc		17	
M8 body spacer		19	
M8 spacer		14	

**Table 6. Fastening screws, GRP, long tail**

<b>GRP</b>			
<b>Long tail</b>	R9904		
<b>Component</b>		<b>Quantity</b>	<b>Position</b>
M8x30 DIN933		12	C, F
M8x25 DIN933		2	B
M8x30 DIN7991		3	A
M8 nyloc		9	
M8 body spacer		17	
M8 spacer		6	

Holes E and D are plugged in a long tail installation.

Screws C and D are installed with hard locking compound.

