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alamarin-jet

INSTALLATION MANUAL

EDITION 2006

alamarin-jet water jet propulsion unit

INSTALLATION INSTRUCTIONS

Alamarin-Jet Oy has published this manual in order to guide the person or company installing an ***alamarin-jet*** water jet propulsion unit.

Alamarin-Jet Oy has published other manuals separately for technical designers, mechanics and repair men.

From here on in this manual the ***alamarin-jet*** water jet propulsion unit will be referred to as ”jet”. This term refers exclusively to a propulsion unit manufactured by Alamarin-Jet Oy.

The instruction covers the following jet propulsion models:

AJ 160 AJ 180 AJ 185 AJ 230

If the given information is type specific, this will be expressed in the text.

In this manual, clarifying figures will be used.

The symbols used in the Installation manual:


ARROW DESCRIBING MOTION


INDICATOR ARROW

PART MARKING


HINT - the text includes useful additional information or a hint which facilitates the work performance or procedure


NOTE - the text includes a warning of a slight danger or a possibility of minor damage to equipment

GUARANTEE MATTER - the text includes a guarantee clause


WARNING - the text includes a warning of a danger that can lead to personal injury, breaking down of equipment or serious malfunction of equipment

SERIOUS DANGER - the text includes a warning of danger to life

APPENDIXES

1. Attaching a Mounting Template to the Shell of the Boat

Installation of the Alamarin-Jet water jet propulsion unit to the boat is done with a mounting template. Fitting the mounting template to the boat can be done in various ways.

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

The first stage of installation is attaching the mounting template to the shell.

1.1. Mounting Template

A mounting template will be delivered with the jet propulsion unit on request. The mounting template is made of aluminium or fibreglass depending on the type of the shell. The mounting template consists of an intake duct and an installation surface for the jet propulsion unit.

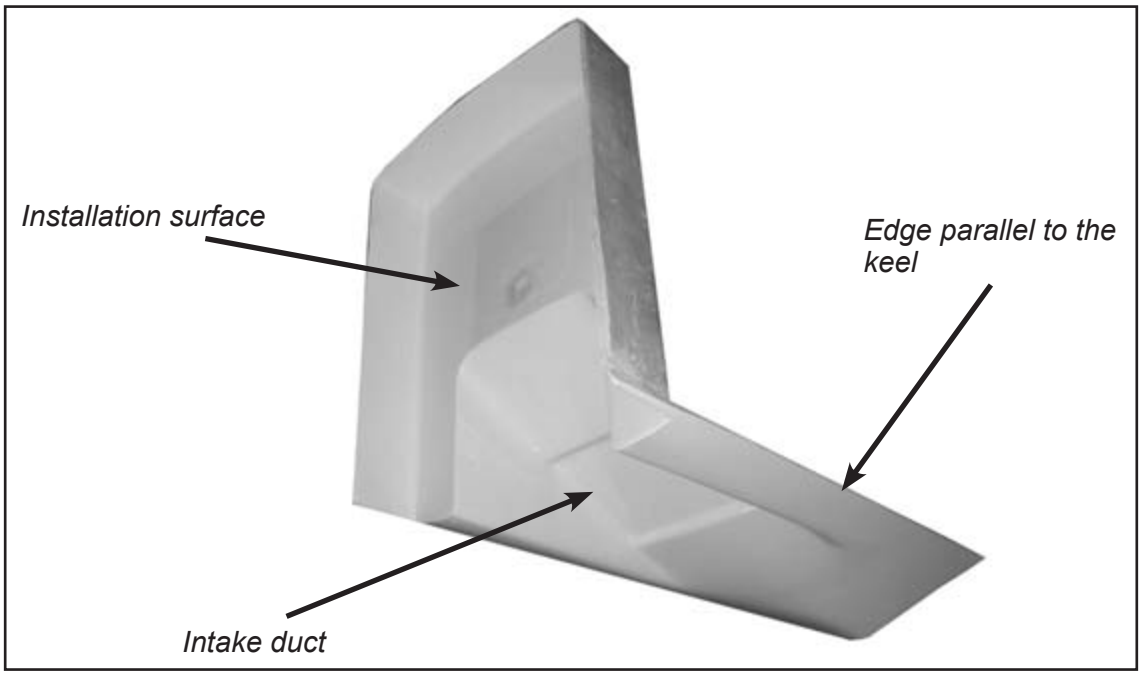


Figure 1.1-1

The mounting template determines the propulsion angle of the jet propulsion unit. The angle between the installation surface and the edge parallel to the keel is 4º over the right angle. The main shaft of the jet propulsion unit then slants 4º downwards compared to the keel. This propulsion angle quarantees the best possible performance with the majority of boats. A description of the propulsion angle is given on page 9, in figure 1.2.1.1-6.

1.2. Installation Methods

1.2.1. ”Repowering”

In accordance with its name, the ”repowering” installation method is used in a modification installation of the propulsion system. In addition, it is an appropriate installation method for prototype or ”one-off” boats. In aluminium boats, the jet propulsion unit is always installed using the ”repowering” principle.

General Description

For the attachment of the mounting template, a hole of appropriate size is cut in the stern and the bottom of the boat, in which the mounting template is either laminated or welded. The following sections go through ”repowering” installation both for reinforced plastic as well as aluminium boats.

1.2.1.1. Reinforced Plastic

Preparations

If the installation is done on a boat that has had some other rear propulsion unit, make sure that the old engine’s installation supports do not impede laminating. There must be at least 150 mm free shell surface on all sides of the mounting template, on which the mounting template can be laminated.

Figure 1.2.1.1-1

If the boat is new, same instructions apply as above, except that in a new boat there is usually plenty of free shell surface and no engine supports have been installed.

Shell and stern laminate must be dry and clean.

Attaching the Mounting Template in Phases

1. Prepare the mounting template by cutting it to the right size at the front. The v-angle of the mounting template is alterable, and the mounting template is cut to suit the v-angle of the boat

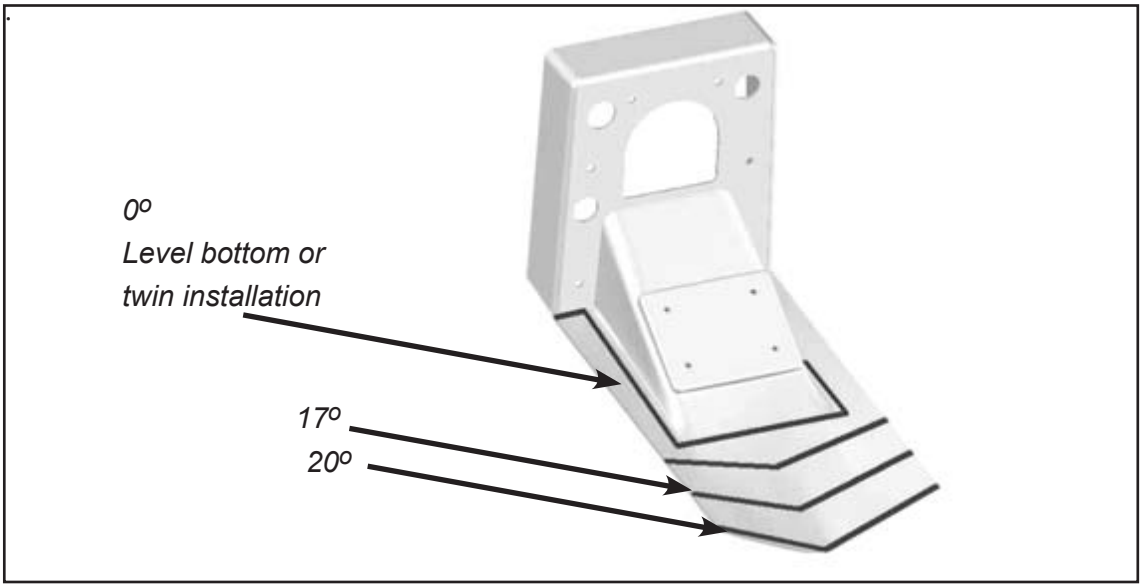


Figure 1.2.1.1-2

NOTE! The angles and distances in the picture are illustrative and indicative. They do not correspond to reality.

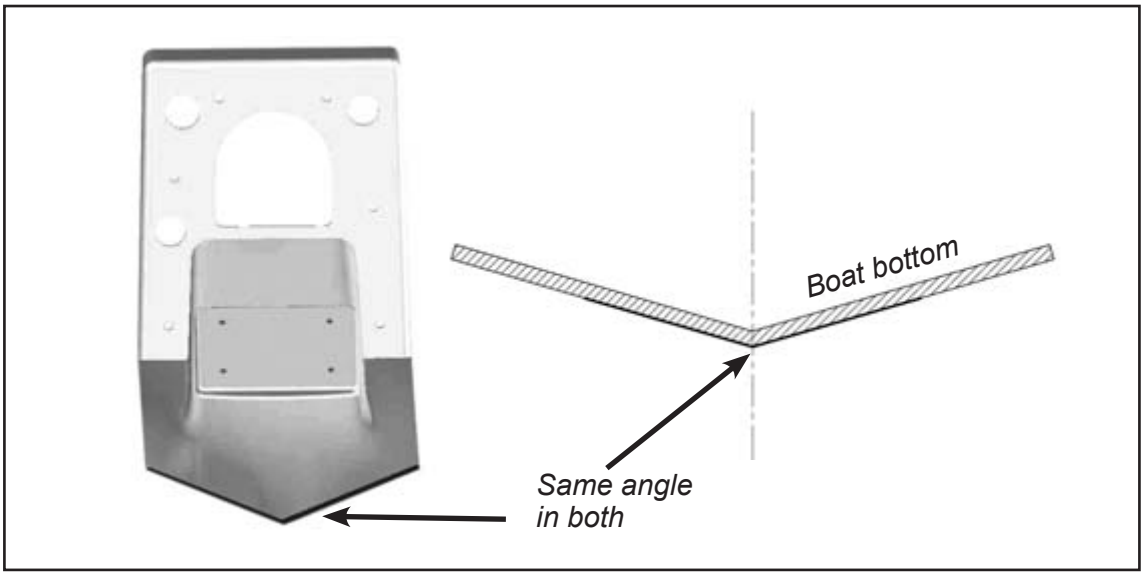


Figure 1.2.1.1-3

Besides the v angle, the right cutting point depends on the roundness of the keel. This is why the cutting point must be determined during installation.

2. Cut a hole of appropriate size for the mounting template in the stern and the bottom of the boat. The hole should be cut so that the mounting template is as far back as possible.

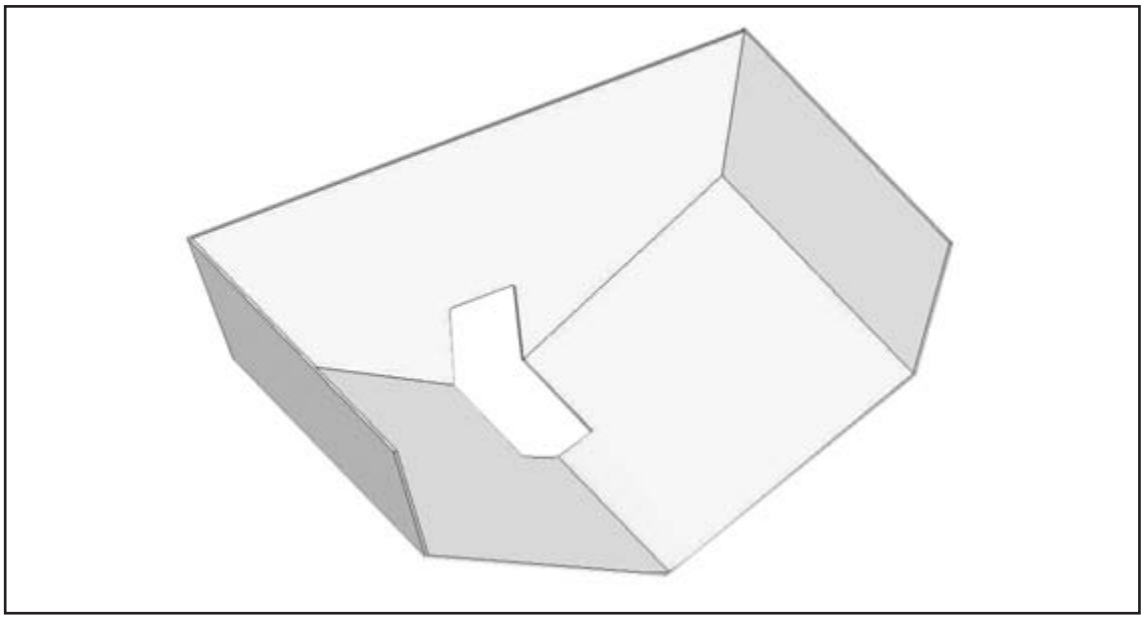


Figure 1.2.1.1-4

The mounting template must be on the same level with the bottom of the boat. The gap between the mounting template and the shell should be fitted as small as possible. A gap of 2-5mm is acceptable.

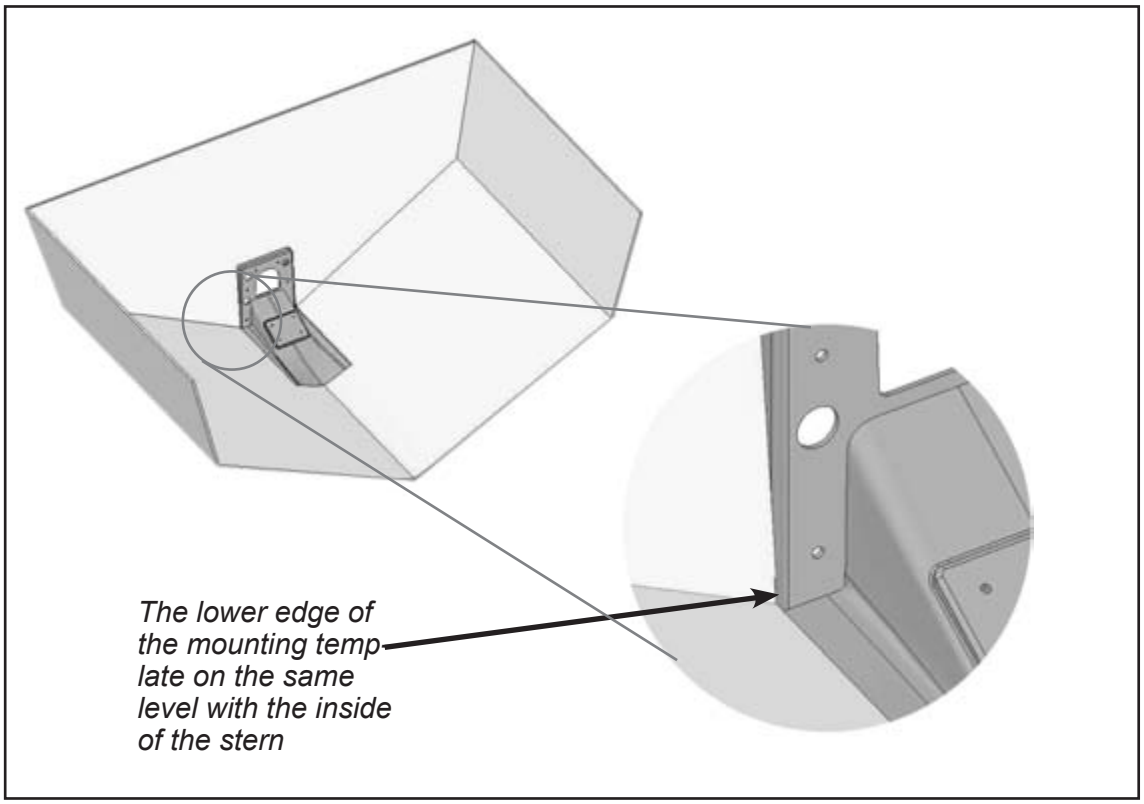


Figure 1.2.1.1-5

3. Chamfer the edges of the hole all around. The chamfered part must be 100 mm and the hole edge thickness 3 mm. Chamfer the edges of the mounting template as well, however the chamfered part does not have to be as long as on the shell.

If the boat's shell is made of sandwich laminate, first remove 100 mm of core material around the hole and then chamfer the core material and the exterior surface about 100 mm. The exterior surface is also chamfered slightly.

4. Fit the mounting template in place.

NOTE! The mounting template must be on the same level with the bottom of the boat.

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 JET PROPULSION UNIT THRUSTS THE BOAT IN THE WRONG ANGLE AND PERFORMANCE WILL BE POOR.

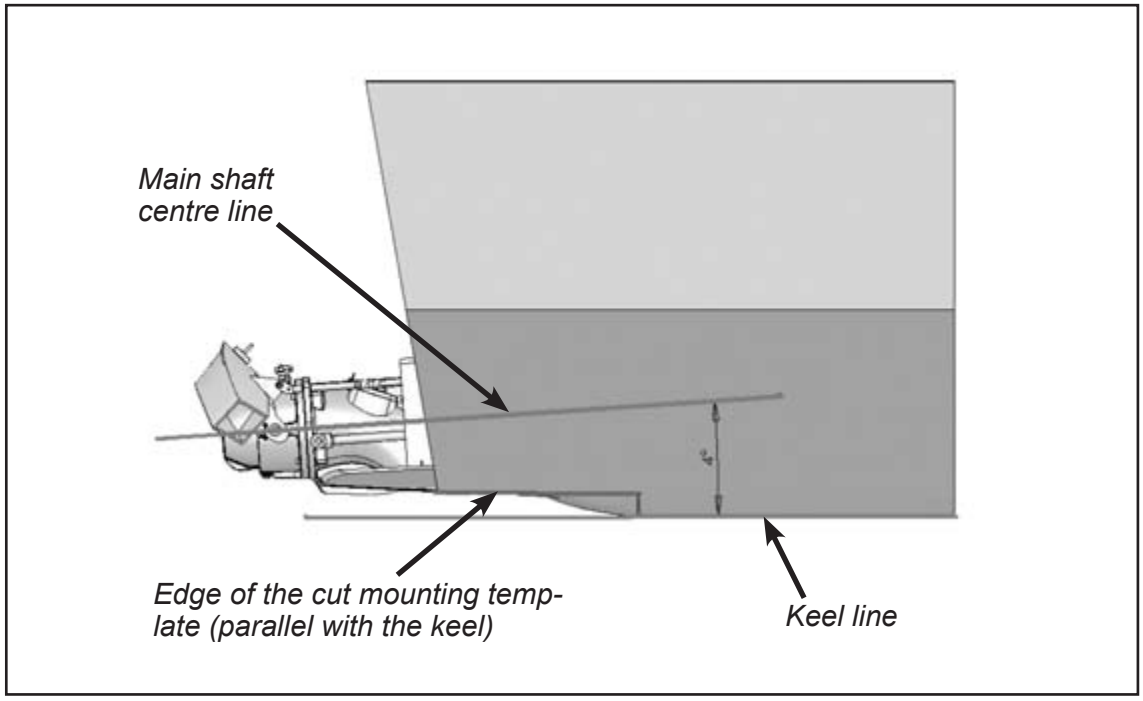


Figure 1.2.1.1-6

5. Fit the mounting template and support it in place from the outside. Close the seam with tape.

6. Spill gelcoat paint on the seam from above so that it becomes 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, 12-14 mm, is reached.

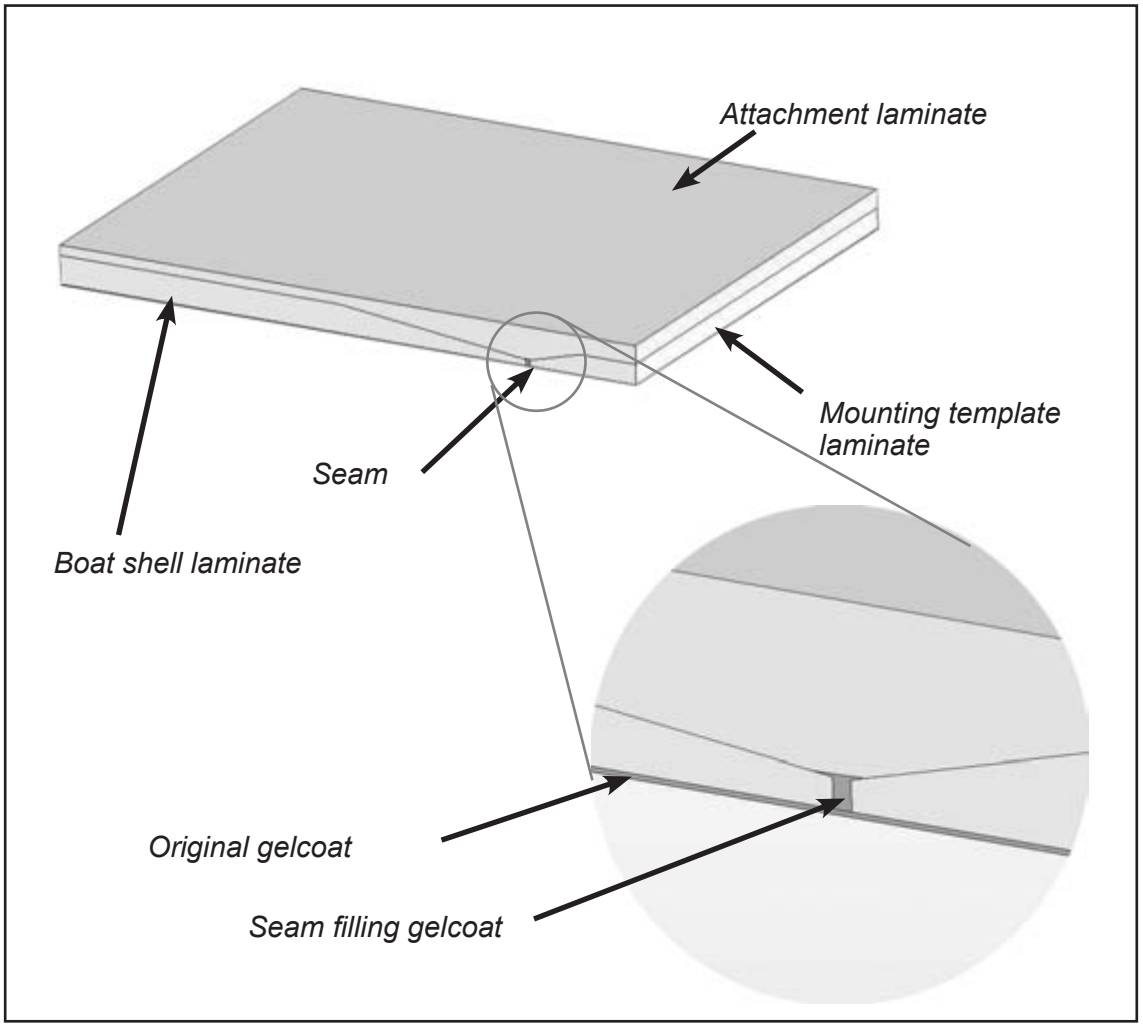


Figure 1.2.1.1-7

9. Fit engine supports and possible bracings.

10. Cut off the excess collar on the mounting template outside the stern.

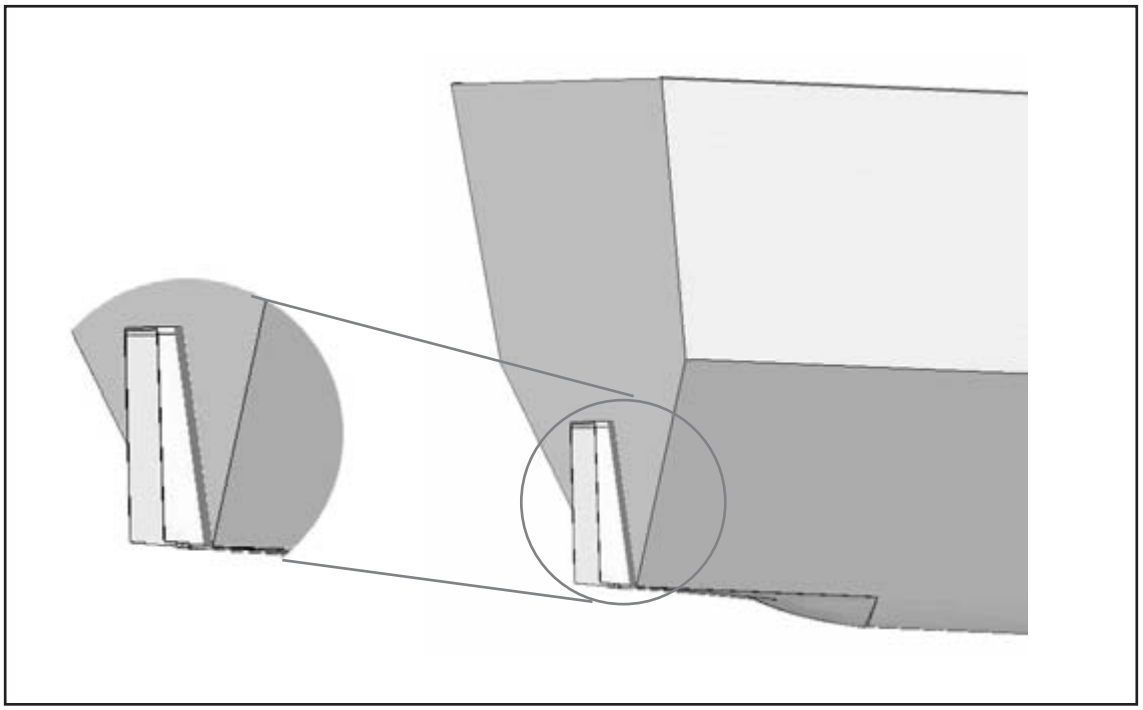


Figure 1.2.1.1-8

11. Smooth the seams and paint visible reinforced plastic surfaces with topcoat paint. Uncovered laminate absorbs water.

1.2.1.2. Aluminium

Installation of an aluminium mounting template does not differ from installation of a reinforced plastic mounting template, except for the free shell surface and the chamfering. Free shell surface is required only as much as is needed for the welding. The seam edges are chamfered in accordance with general welding standards**.**

Attaching the Mounting Template in Phases

1. First read sections 1, 2 and 4 in the installation instructions for a reinforced plastic mounting template. This has been dealt with in the previous section.

2**.** Cut the mounting template the same way as a reinforced plastic one.

3. Cut a hole of appropriate size in the bottom and the stern of the boat. The hole should be cut so that the mounting template is as far back as possible. The gap between the mounting template and the shell should be fitted as small as possible.

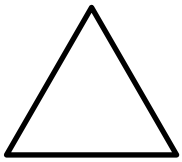
4. Chamfer the plate edges as required by general welding standards.

5. Fit the mounting template in place. Read section 4 in the instructions for the installation of a reinforced plastic mounting template.

6. Weld the mounting template in place both on the inside and the outside and make the seam watertight.

7. 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.

8. The mounting template is painted with two-component paint suitable for painting aluminium. Follow the paint manufacturer's instructions.



NOTE! Painting is important, because the intake duct is cast aluminium. The structure of cast aluminium is porous and it can absorb water. This can accelerate the corrosion process.

The material of the cast section of the aluminium mounting template is AlSi7Mg. The material of the plate section is AlMg3. AlMg5 is used as filler material for welding.

1.2.2. Mounting Template Directly Out of the Mould

1.2.2.1. Removable Mounting Templates

If you want to produce one boat with several different jet propulsion unit options, it is possible to make a mould of the mounting template, which is fitted to the standard shell mould. This speeds up installation of the jet propulsion unit without adding to mould expenses.

The mould for the mounting template is made from an mounting template provided by Alamarin-Jet Oy. In twin installations two moulds have to be made, on both sides of the shell**.**

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

Make a negative (mould) of the mounting template.

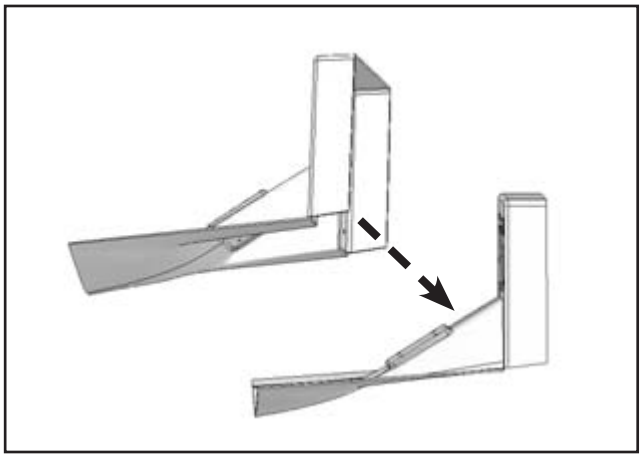


Figure 1.2.2.1-1

I The following things are to be taken into account in moulding the negative:

1. For twin installation, excess fibreglass must be cut off the mould of the mounting template. See cutting instructions in appendix 1.

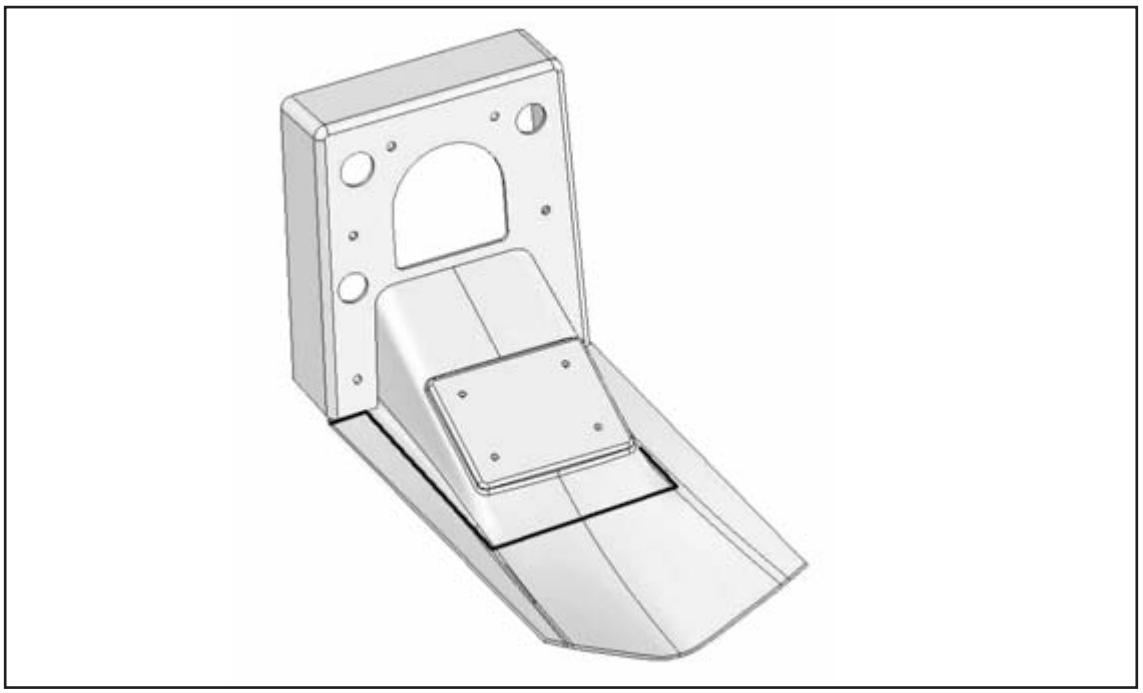


Figure 1.2.2.1-2

2. The collar of the mounting template must be cut in accordance with the stern of the mould. In twin installations, this means cutting according to figure 1.2.2.1-3 when the stern is not vertical.

If the collar is not cut correctly, the consequence is that the intake duct position is wrong.

The edge of the intake duct must be parallel with the keel.

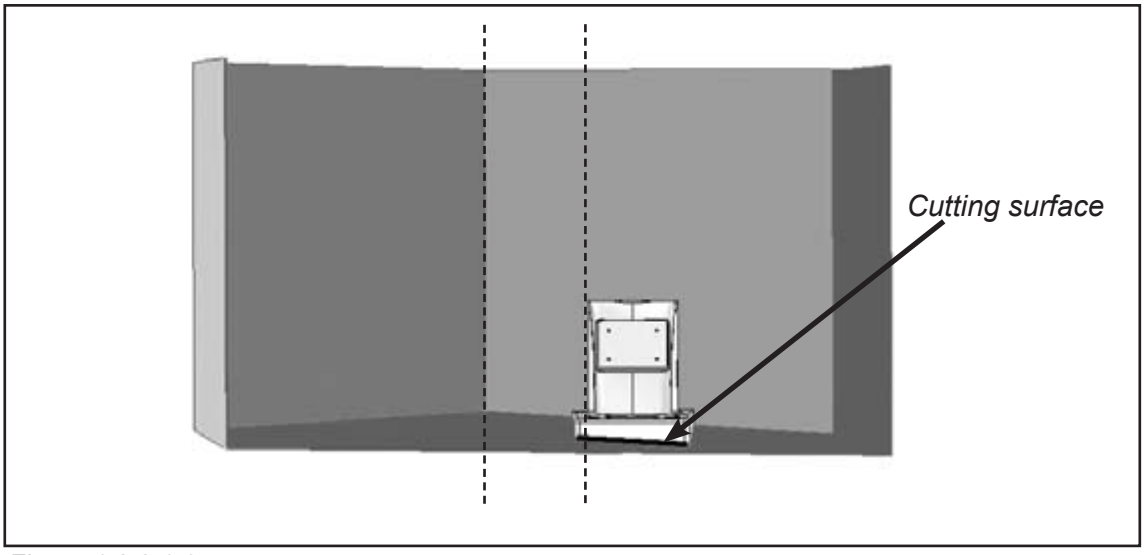


Figure 1.2.2.1-3

3. Sharpen the front edge and the sides of the intake duct negative, so that no thick edge is left between the boat mould and the negative. See figure 1.2.2.1-4. (If this is not done, the thick edge is copied to the final boat and the boat's performance may suffer.)

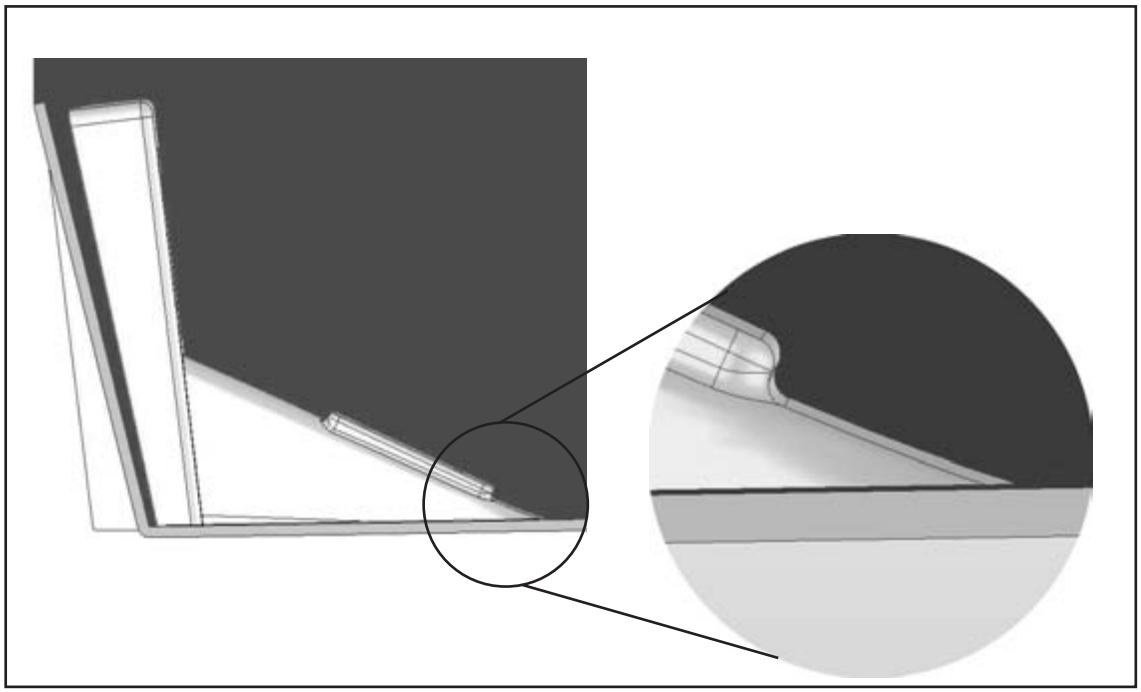


Figure 1.2.2.1-4

4. Reinforce the collar of the mounting template negative with a wooden frame, a plywood plate or for example with urethane foam.

This way the collar is not allowed to bend inward during laminating. See figure 1.2.2.1-5.

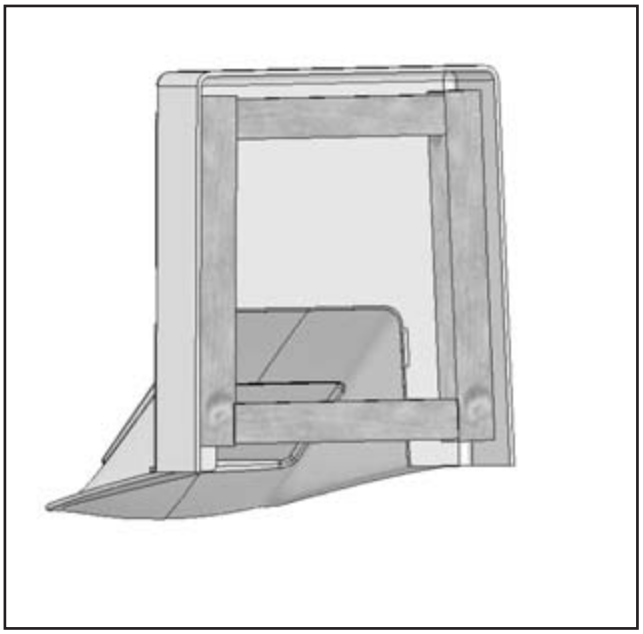


Figure 1.2.2.1-5

II Fit the mounting template negative in the mould. The following instructions apply both to single and twin installations:

1. Set the mounting template negative in the boat mould so that the intake duct is parallel with the keel.

2. Ensure the alignment of the mounting template with the engine so that they are in line with each other. See figure 1.2.2.1-6.

It is advisable to mark the place of the mounting template on the boat's mould after first installation. This makes fitting the mounting template fast and easy the next time.

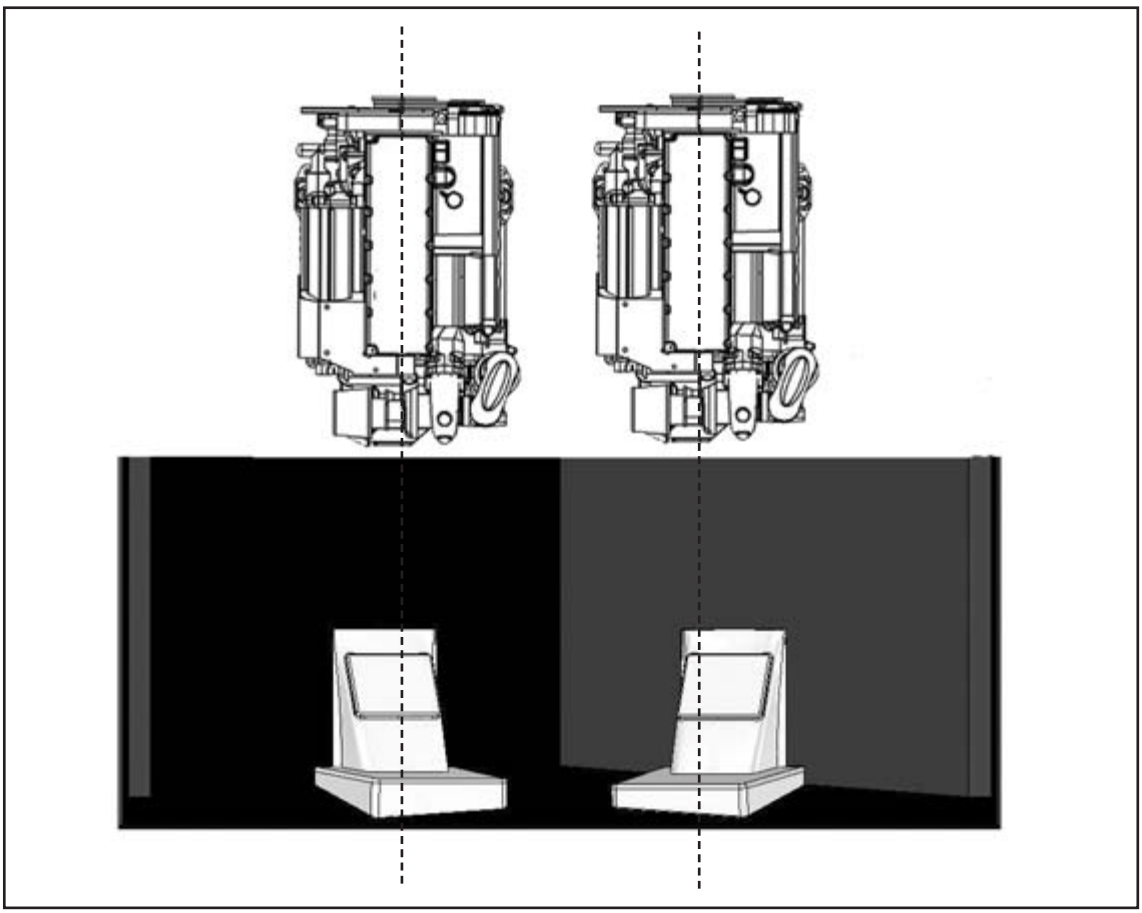
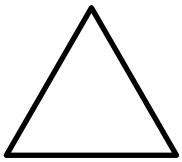


Figure 1.2.2.1-6

It is imperative for the durability of the jet's bearing that the installation has been carried out correctly considering the centre line of the engine. The intermediate shaft that is being used and the angles that it allows must be taken into account in the alignment.

3. Fix the mounting template negative on the boat's mould with tape or other temporary method. Make sure that there are no big notches in the seams of the negative and the boat's mould. A notch caused by tape is not detrimental.

For the part of the jet's mounting template, the boat's mould is now ready for laminating. When laminating the boat, the paint that is spread first (gelcoat) solidifies the mounting template in place.



NOTE - Twin installation! After the boat has been laminated and it is ready to be removed from the mould, the mounting template negatives come off with the boat. The mounting templates are removed from the boat for the next installation..

1.2.2.2. Fixed Mounting Templates

The mounting template(s) can also be fixed to the mould. In the case of twin installation the boat's mould must be two-piece to make separation possible. A two-piece mould is not necessarily needed for single installation**.**

Twin installation:

1. First make two negatives of the mounting template.

2. Fit and install the mounting templates on the boat's mould as described in the previous section.

3. Laminate the rear end of the boat in the mould and remove it. Also remove the mounting templates.

4. 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's mould as described in the previous section.

3. Laminate the shell of the boat in the mould and remove it.

4. Make a new mould of the shell

2. Attaching the Jet Propulsion Unit to the Shell

2.1. Preparations

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

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

Set the template against the installation surface so that the texts are visible, and center the hole gauge in relation to the ready drilled centre hole.

Set the template against the installation surface so that the texts are visible, and center the hole gauge in relation to the ready drilled centre hole.

Mark the holes and drill them. The gauge has only a centre hole for big holes, and they are drilled to the right diameter with a hole saw. The name of the bushing and the final diameter have been marked on the templates for clarity.

The mounting template has notches that denote the amount of holes but these must not be used as points for the final locations.

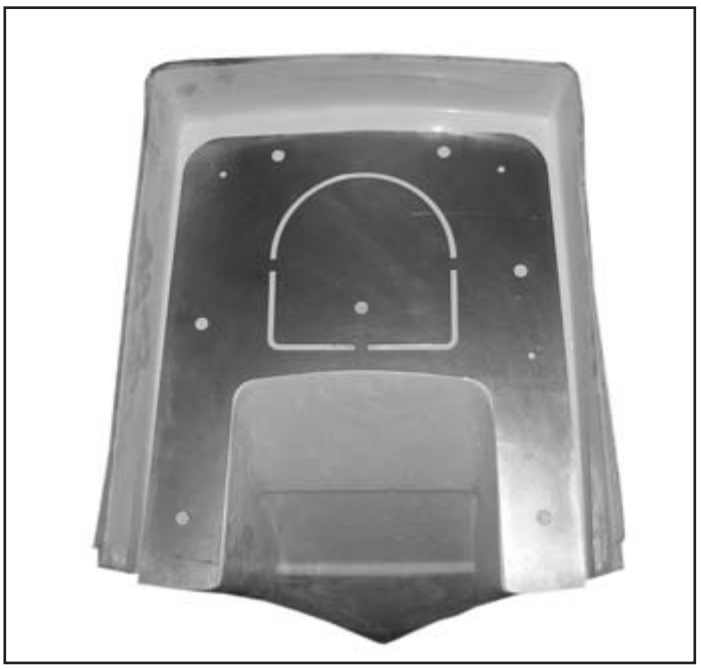


Figure 2.1-1

It is recommended to first make one hole and use it to attach the cutting template to the stern. This way it stays in place when making the other holes..

Before installation the following things should be made sure of:

1. The installation surface is straight and clean.

2. The holes have been drilled/sawn correctly. This is done by trying the jet propulsion unit in place.

3. Stern laminate does not come in the way of the jet propulsion unit and its auxiliaries, which means that the laminate is not too thick.

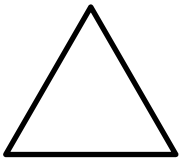
The following parts are removed from the jet propulsion unit before installation:

AJ 230

- hydraulic cylinder
- raw water intake tube
- steering shaft
- cavitation plate
- lubrication hose

AJ 185/180/160

- steering shaft
- control shaft of the reversing deflector
- raw water connector
- cavitation plate
- lubrication hose.



WHEN REMOVING THE HYDRAULIC CYLINDER, CARE MUST BE TAKEN NOT TO ROTATE THE PISTON ROD, BECAUSE THIS CAUSES THE CYLINDER MOVEMENT RANGE TO CHANGE!

The jet propulsion unit can be installed while the stator and the reversing deflector are attached, but removing them makes the installation easier.

2.2. Attaching the Jet Propulsion Unit in Phases

1. Spread sealing compound on the fixing area (a) as indicated in figure 2.2-1. All the holes must be circulated (b), and sealing compound must also be put in the fastening bolt holes (c).

2. Lift the jet propulsion unit in place and push the fastening bolts in the holes. The assistant in the boat fastens the nuts.

3. 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 is 40Nm, which is different from standard due to a softer base.

4. Wipe the burrs of sealing compound off the outer edges, the intake duct and inside around the holes.

The body of the jet propulsion unit is now attached. The accessories will be attached next.

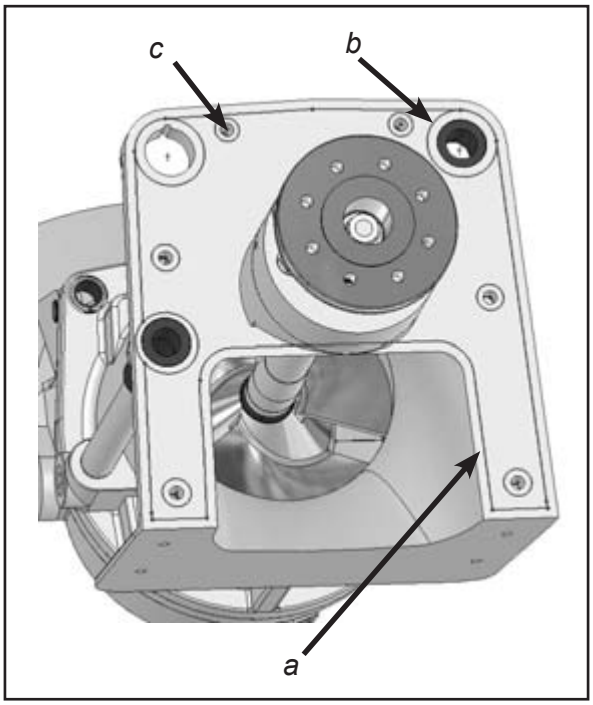


Figure 2.2-1

2.2.1. Cavitation Plate

1. Fit the cavitation plate in place and mark with marker pen the part that is to be cut off, as indicated in figure 2.2.1-1. Cut the blades to the right shape so that they fit in the stern.

In AJ 230 the cavitation plate has separate blades.

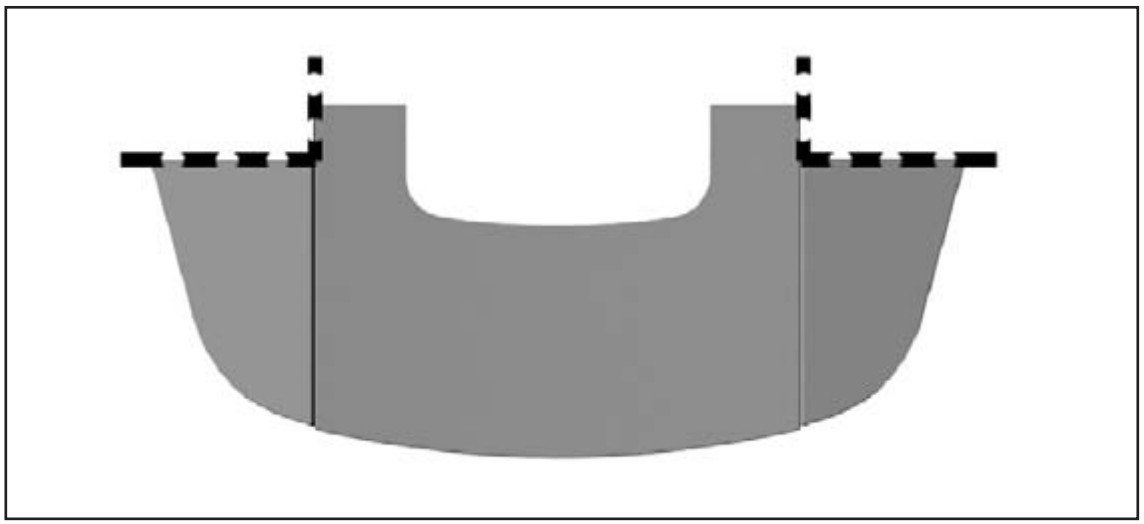


Figure 2.2.1-1

2. Spread sealing compound indicated in points 1-3 in figure 2.2.1-2 and attach the plate. (Tightening torques see appendix 10).

3. Attach both blades to the stern with an angle iron shown in the picture.

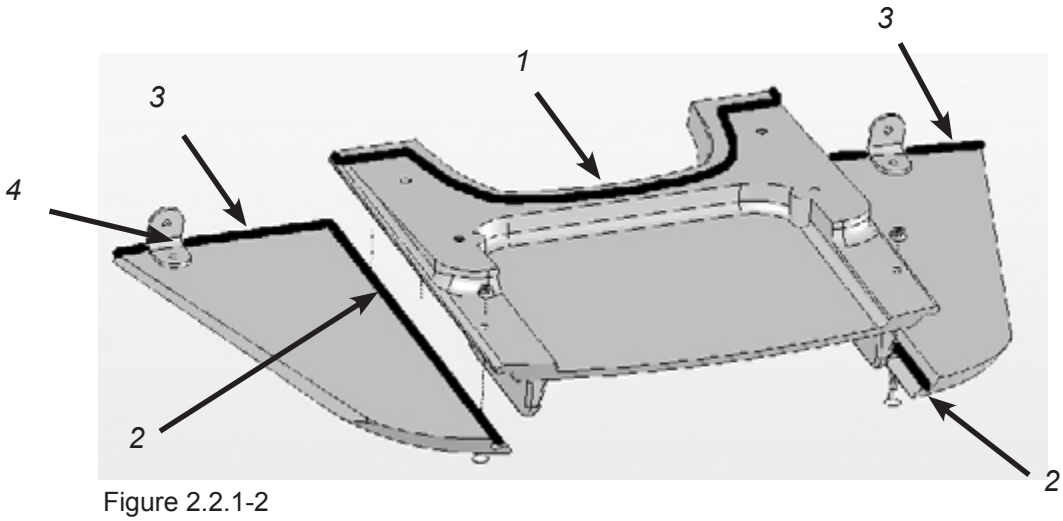


Figure 2.2.1-2

SEALING MUST BE CARRIED OUT CAREFULLY. IF AIR IS ALLOWED TO DRIFT INTO THE INTAKE DUCT, I.E. VENTILATION TAKES PLACE, THE PERFORMANCE OF THE JET PROPULSION UNIT WILL BE SIGNIFICANTLY POORER!

2.2.2. Grass Rake

1. The grass rake is attached in front of the intake opening with two or four screws. The fixing area must be sealed the same way as when installing the jet propulsion unit body.

2. Fit the grass rake in place in the intake duct and tighten the screws in place. (Tightening torques see appendix 10)

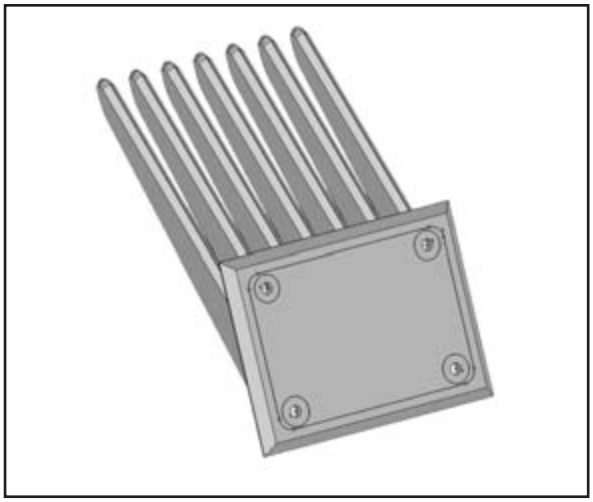


Figure 2.2.2-1

2.2.3. Other Accessories

2.2.3.1. Steering Shafts

The nozzle and the reversing deflector are installed back in place. If the stator, the nozzle and the deflector were removed when installing the body, they must be reinstalled. Grease should be added in the rear bearing, if the stator had been removed.

2.2.3.2. Raw Water Intake Tube

Possible raw water intake tube is installed in place using sealing compound (e.g. Sikaflex 221).

2.2.3.3. Hydraulic Cylinder (AJ 230)

1. Make sure that the cylinder goes into place. Check especially the shoulder indicated in figure 2.2.3.3-1, which may touch the stern, causing a mounting fault.

If the stern is more than 14mm thick, an embedding must be made for the cylinder, in which the shoulder in figure 2.2.3.3-1 fits.

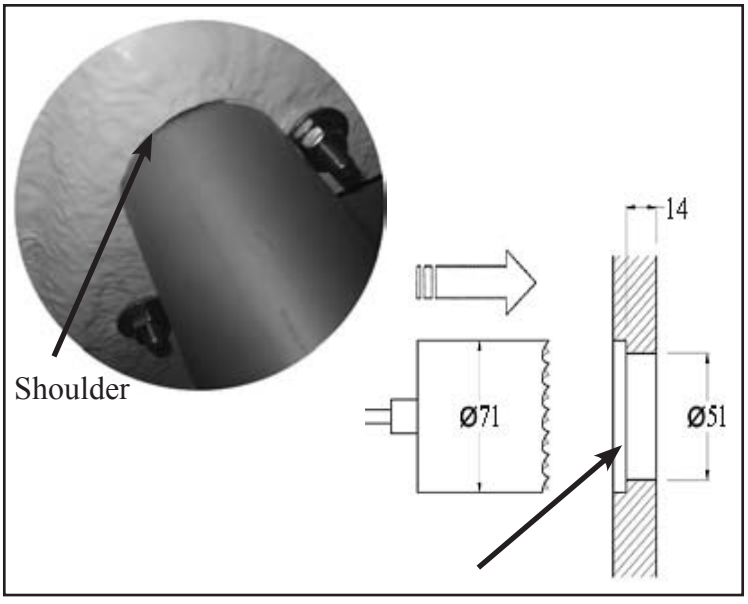


Figure 2.2.3.3-1

2. Spread sealing compound (e.g. Sikaflex 221) on the collar of the hydraulic cylinder and fit the wedge (figure 2.2.3.3-2) in place. Push the cylinder from inside the boat into the appropriate hole. Spread sealing compound also on the outside, on the threading (figure 2.2.3.3-3, A).

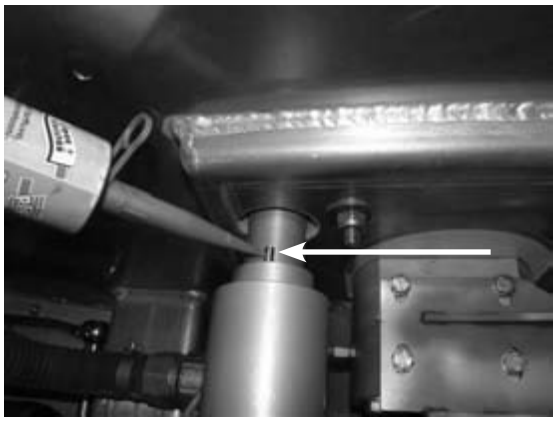


Figure 2.2.3.3-2

The assistant must move the base plate and the tightening nut (figure 2.2.3.3-3, B) farther on the piston rod before the end of the rod can fit into the rearmost hole.

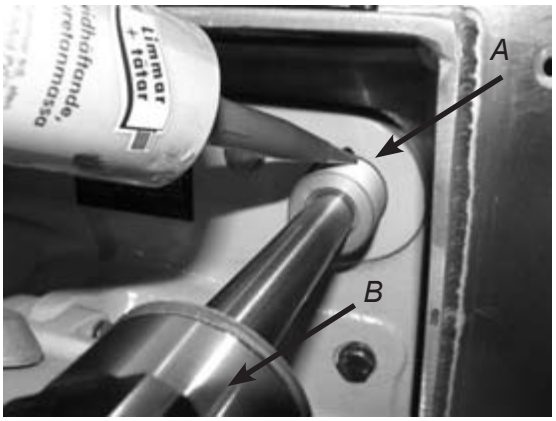


Figure 2.2.3.3-3

3. Tighten the nut. There is a separate wrench for tightening, which is required if the jet propulsion unit is deep in the shell, and the nut cannot be tightened otherwise.

Tightening can also be done with a regular adjustable or fork wrench.

The tightening torque of the nut is 100 Nm.

Figure 2.2.3.3-4

4. Take care that no sealing compound goes on the piston rod. If it does, clean it with acetone for example.

5. Fit the joint between the cylinder and the reversing deflector. Set the cheek plates so that the nuts are on the outer side.

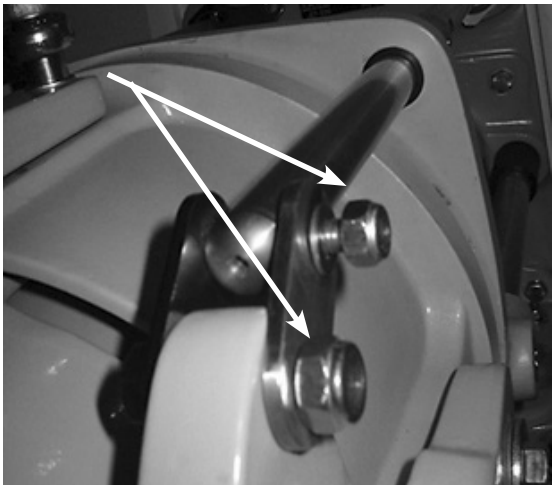


Figure 2.2.3.3-5

2.2.3.4. Oil Pump (AJ 230)

The cylinder that moves the reversing deflector requires a hydraulic pump which is installed on the bearing housing as standard.

1. The bearing housing has four screws. Set the pump with the rack on the bearing housing as indicated in figure 2.2.3.4-1 and screw the screws fingertight.

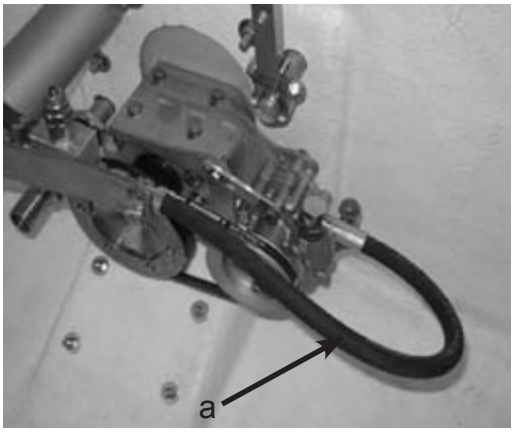


Figure 2.2.3.4-1

2. Loosen slightly the screws with which the pump is attached to the rack (see figure 2.2.3.4.-1). Move the pump as close to the bearing housing as possible. Set the belt in place and align the belt groove on the coupling flange and the belt pulley on the pump carefully. After this, tighten the four screws with which the pump rack is attached to the bearing housing. (Tightening torques see appendix 10)

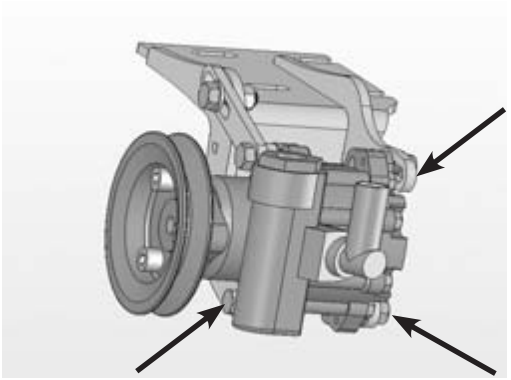


Figure 2.2.3.4-2

3. Tighten the belt by moving the pump away from the bearing housing as indicated in figure 2.2.3.4-2. The screw on the right side is intented for moving the pump.

THE SCREW IS LOCKED IN PLACE, DO NOT TRY TO LOOSEN IT BY FORCE!

When the belt is tight enough, tighten the screw on the left side. Also tighten the other screws with which the pump is attached to the rack. (Tightening torques see appendix 10)

The belt is tight enough if it is possible to turn it 90 degrees at the middle with finger force.

Figure 2.2.3.4-3

4. Fit the pressure hose to the pressure relief valve (’a’ in figure 2.2.3.4-1).

5. A separate oil reservoir is fitted in the boat in a suitable place. However, the lower edge of the reservoir must be clearly above the pump (see figure 2.2.3.4-4). If this is not the case, the pump does not get oil and it breaks down. Fit the hose from the reservoir to the pump so that it goes as straight as possible and does not have ”swan necks”.

6. The oil return hose must be taken to the reservoir through a cooler. A normal heat exchanger intended for oil cooling can be used as a cooler. The exchanger is installed to the engine cooling water line after the filter. The hydraulic return hose is only included in deliveries that include a heat exchanger.

Below is a basic picture of cooler installation.

Things to be taken into account with the return line:

1. The cooler should be installed so that the inlet and outlet connectors point upwards. This advances the exit of air from the system.

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

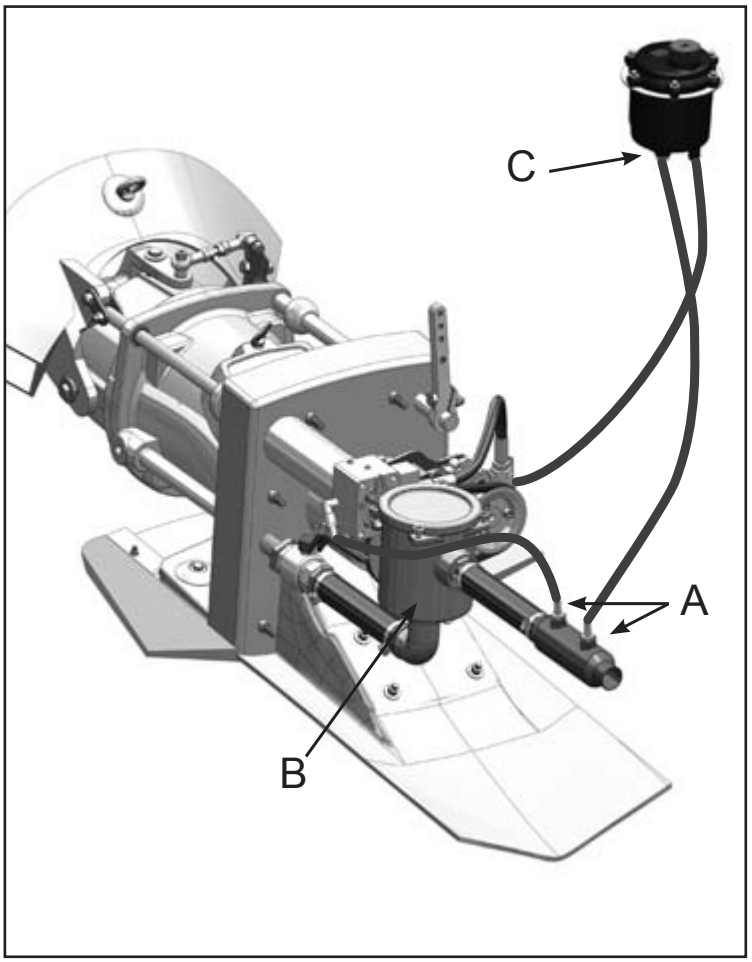


Figure 2.2.3.4-3

A = extra cooler
B = raw water filter
C = oil tank

IF THE CYLINDER OIL IS NOT COOLED, THE WARRANTY DOES NOT COMPENSATE FOR PUMP/CYLINDER FAILURES DUE TO OVERHEATING.

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

2.2.3.5. Raw Water Cooling

Cooling water for the engine can be taken from the pressure face of the jet propulsion unit. The jet propulsion unit has raw water intake as standard for this purpose. Taking cooling water from the jet propulsion unit enables dry running of the system (NB. Observe the manufacturer's instructions on dry running). If the engine's own pump is used for cooling water intake, the water intake of the jet propulsion unit is plugged.

Figure 2.2.3.5-1 below clarifies the operation of the raw water line.

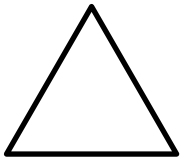
General observations concerning raw water intake:

I There must be a shut-off valve at the beginning of the line so that the line can be cut off if necessary while the boat is in water. If there is no valve, water leaks into the boat when the line is cut off for example for cleaning.

II The filter must be installed to the line before the coolers. The filter must be above waterline. (Water does not flood in when the filter is being cleaned).

III The line empties itself when the boat is in horizontal plane. (E.g. when the boat is hanging on a davit).

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



ALWAYS OBSERVE THE MANUFACTURERS´ OTHER INSTRUCTIONS FOR DRY RUNNING.

Figure 2.2.3.5-1 below illustrates the principle of a line connected to a marine diesel engine.

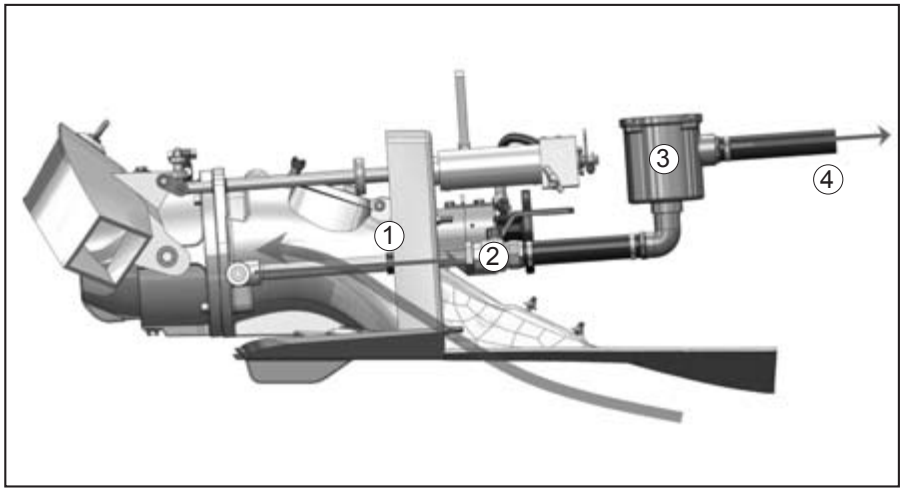


Figure 2.2.3.5-1

1. Raw water connector (G3/4´´ thread)
2. Shut-off valve
3. Raw water filter
4. Cooling water intake in the engine

2.3. 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, for example copper. Because the propulsion unit is made mainly of aluminium, copper forms a highly unfavourable galvanic couple with the propulsion unit. The aluminium starts to corrode because it functions as an anode.

IF COPPER BEARING ANTIFOULING PAINT IS USED FOR PAINTING THE PROPULSION UNIT, THE RESULT WILL BE 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 50mm unpainted area around the propulsion unit in the stern and on the bottom of the boat. See picture 2.3-1.

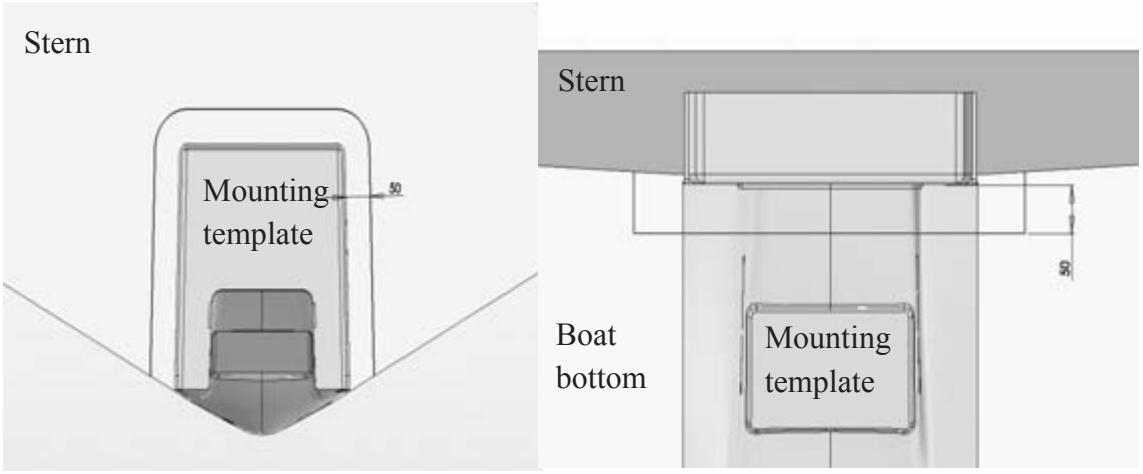


Figure 2.3.-1

3. Control System

This section describes the installation of control systems for the jet propulsion units. Using the correct method when installing the systems is important, because a wrong method may cause the jet propulsion unit to be used wrong and lead to poor performance.

3.1. Installation Options

Because the jet propulsion unit can be used with or without a gearbox, there are various ways of installation. The steering wheel is always used to steer the nozzle but connecting the gearbox, the throttle and the reversing deflector correctly requires the right control system.

1. Between the jet propulsion unit and the engine is the gearbox:

A control with two levers, one of which operates the gear and the throttle and the other the reversing deflector. See appendix 2.

2. Between the jet propulsion unit and the engine there is only the intermediate shaft:

A control with two levers, one of which operates the throttle and the other the reversing deflector. See appendix 1.

3. Two jet propulsion units with gearboxes:

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

.

CONTROLLING THE MOVEMENT OF THE REVERSING DEFLECTOR MUST ALWAYS BE DONE WITH A SEPARATE LEVER. OTHERWISE THE JET PROPULSION UNIT DOES NOT FUNCTION CORRECTLY

3.2. Connecting the Reversing Deflector to the Control System

The control cylinder of the reversing deflector is used with the lever (a) that is at the end of the cylinder. The lever has a cable terminal when the jet propulsion unit is delivered from the works. However, the inlet direction of the cable can be different than the direction of the cable support (b) as standard. The support can be turned to the wanted direction however.

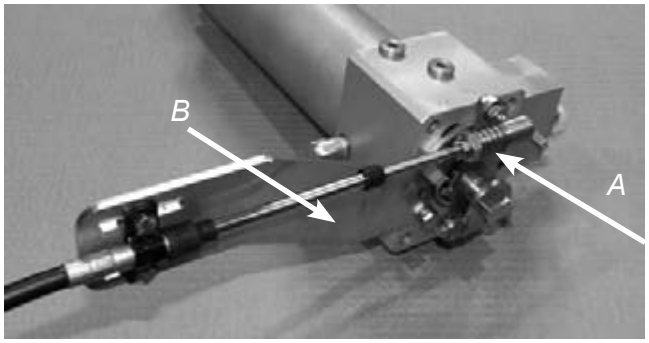


Figure 3.2-1

3.2.1. Turning the Cable Support

In a standard installation, the support plate of the hydraulic cylinder's operating cable points to the starboard side. If necessary, you can turn the plate to a more suitable direction depending on the incoming direction of the cable.

1. If the control cable is attached, detach the end of the cable (figure 3.2.1-1, A) from the cylinder's operating lever and detach the cable fastener from the support plate (figure 3.2.1-1, B).

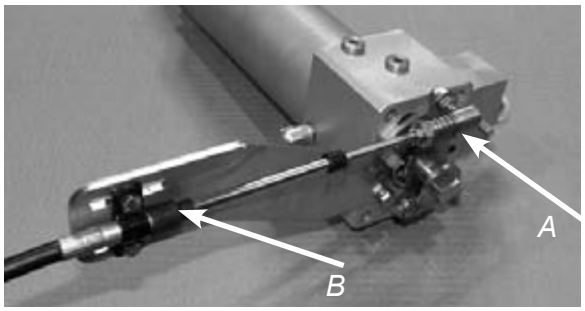


Figure 3.2.1-1

2. Loosen the fastening screws of the operating lever (figure 3.2.1-2, A) and pull the lever off the shaft.

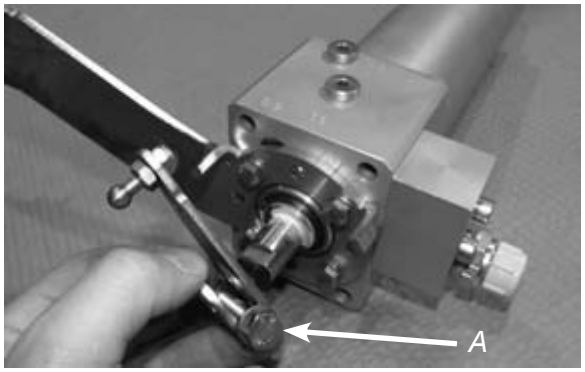


Figure 3.2.1-2

3. Open the fastening screws (four in total, figure 3.2.1-3) which hold the support plate on the cylinder. The same screws attach the valve housing to the cylinder pipe. However, if you are careful the valve housing should remain in the cylinder pipe.

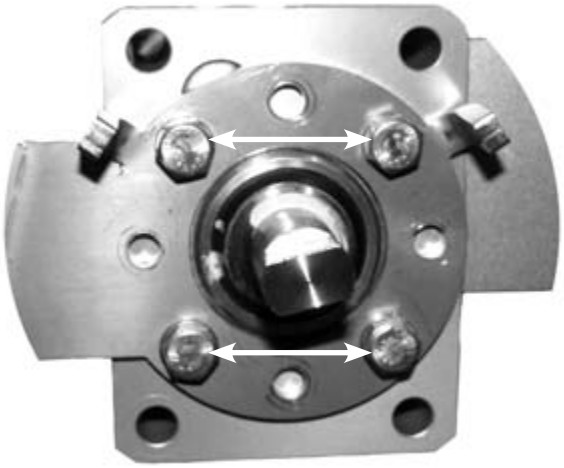


Figure 3.2.1-3

4. Turn the support plate into the desired position and attach it with screws to the valve housing (tightening torque: 10 Nm). The support plate has eight holes, so you can turn the plate at 45° intervals. In figure 3.2.1-4, the plate has been turned 135°.
Check that the support plate or control cable do not interfere with the rotating intermediate shaft, for example.


Figure 3.2.1-4

5. Place the lever (figure 3.2.1-5, A) on the operating shaft so that it lies between the limiters on the support plate (figure 3.2.1-5, B). The tightening torque of the lever screw is an unusual 10 Nm. Attach the control cable with a fastener (figure 3.2.1-5, C) to the support plate and with an angle joint (figure 3.2.1-5, D) to the lever ball screw. See the cylinder adjustment instructions in chapter 3.2.3.

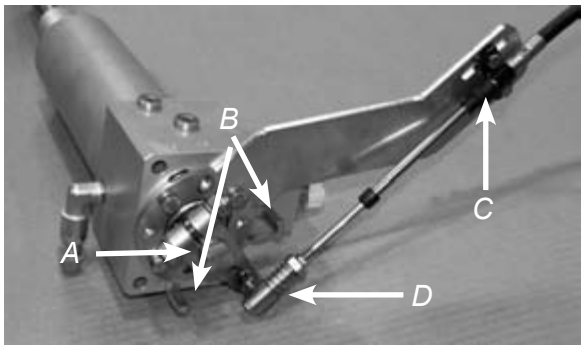


Figure 3.2.1-5

3.2.2. Connecting the Control Cables

The control cables are connected from the control to the reversing deflector as indicated in the pictures.

Idle running: Both levers in the centre.

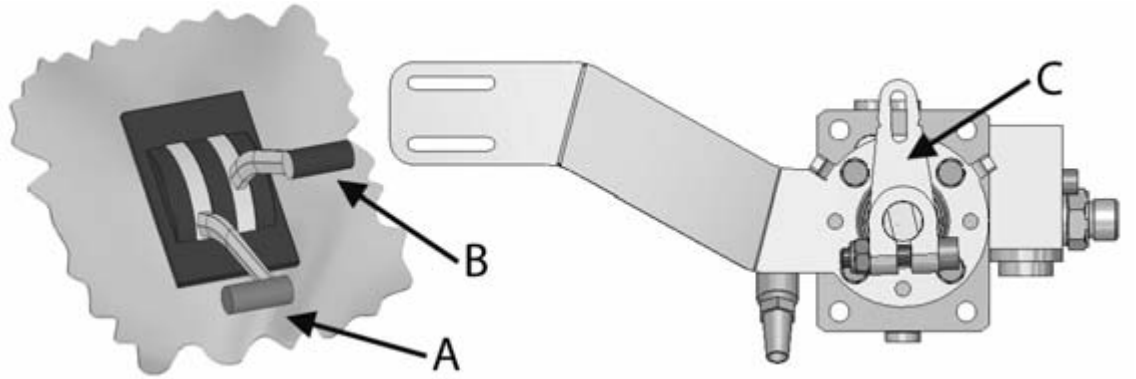


Figure 3.2.2-1

A Throttle
B Reversing deflector
C Cylinder operating lever

Full astern: Reversing deflector down, cylinder operating lever on the left.

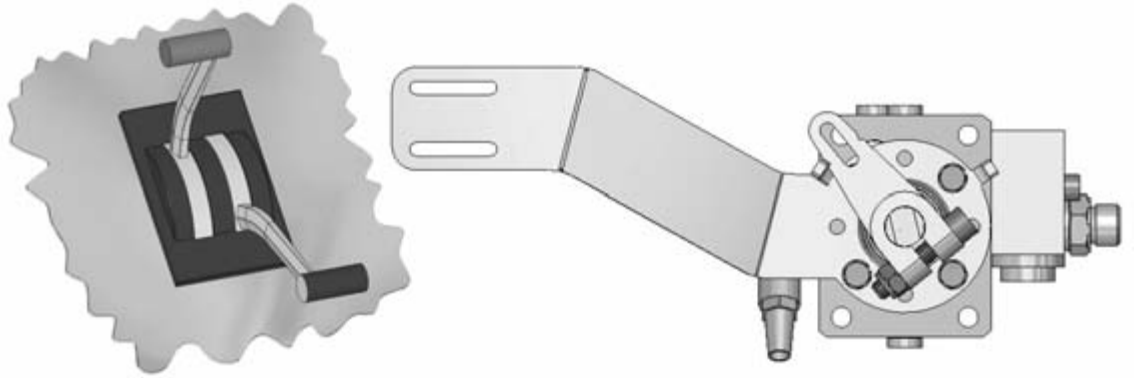


Figure 3.2.2-2

Full ahead: Reversing deflector up, cylinder operating lever on the right.

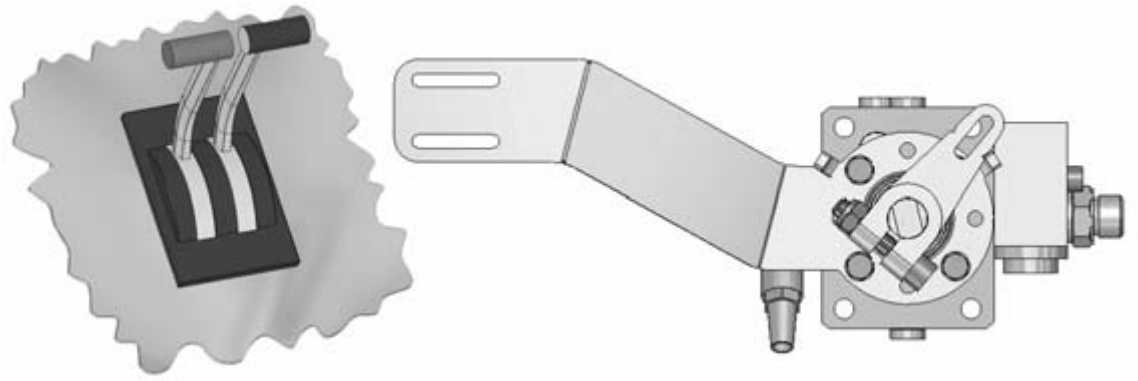


Figure 3.2.2-3

3.2.3. Adjusting the Cylinder

1. Detach the control cable from the end of the cylinder operating lever (figure 3.2.3-1, A).
2. Loosen the operating lever screw (figure 3.2.3-1, B) but do not pull the lever off the shaft.
3. Place the lever against the limiter on the shaft (figure 3.2.3-2, A).
4. Using a wrench, turn the operating shaft (figure 3.2.3-2, B) 13 mm 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.
5. Attach the operating lever with a screw to the shaft. Tighten the screw to a torque of 10 Nm. Do not tighten the screw too much!
6. Attach the control cable to the screw at the end of the operating lever (figure 3.2.3-1, A).
7. Use the control system in the cabin to check that the deflector can move to the up and down positions. The positions are illustrated in figures 3.2.3-3−3.2.3-6.

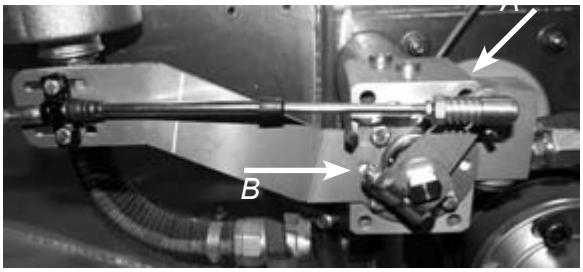


Figure 3.2.3-1

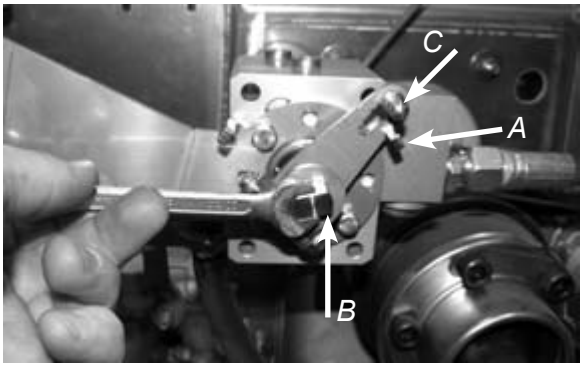


Figure 3.2.3-2

Tube-type reversing deflector

The down position is correct when the entire jet flow enters the deflector (figure 3.2.3-4, A). When viewed from the outside, the steering nozzle and the reversing deflector must be level (figure 3.2.3-2, B).

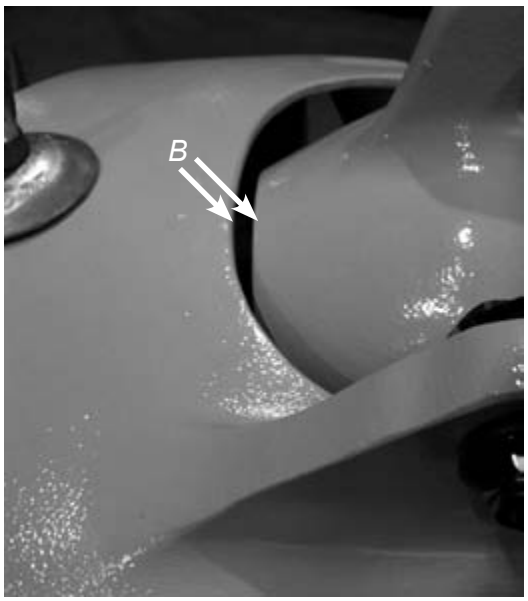


Figure 3.2.3-3

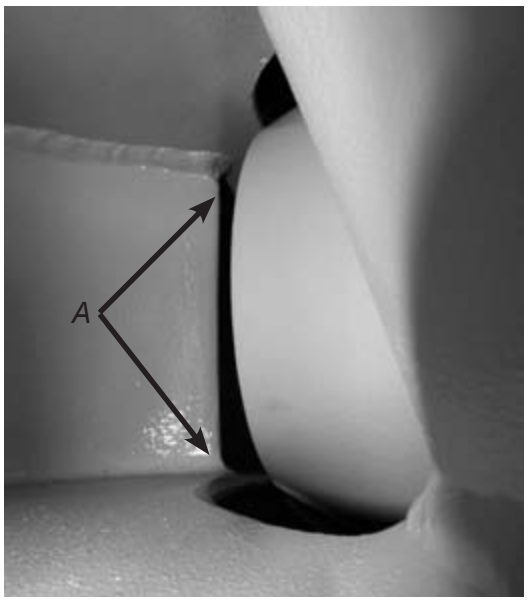


Figure 3.2.3-4

Round-type reversing deflector

The top of the deflector must be almost on the same level as the steering nozzle (figure 3.2.3-5, A) for the deflector to turn the water flow efficiently (figure 3.2.3-6).

If necessary, adjust the ball screw height on the control lever (figure 3.2.3-2, C) so that the entire movement range of the lever is in use.

Figure 3.2.3-5

Figure 3.2.3-6

3.3. Connecting the Steering Nozzle to the Control System

There is a lever for the operating device at the end of the nozzle control shaft. 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.

IF THE MOVEMENT RANGE OF THE NOZZLE OPERATING DEVICE IS TOO LONG, THE JET PROPULSION UNIT'S SYSTEM CAN BREAK DOWN DUE TO OVERLOAD!

The control lever has holes ready at different heights so that different operating devices can be connected to it. See drawings in appendixes 6 and 7.

A connecting rod for the levers is available for twin installation. The connecting rod is delivered so that its length is alterable, i.e. the other end of the rod is free. If necessary, the rod is shortened to a suitable size, and after that an end plate and a hex screw are welded at the end of the rod (figure 3.3-1).

The end plate and the hex screw are welded together. The materials to be welded are acid-proof steel, so the filler metal has to be chosen correctly.

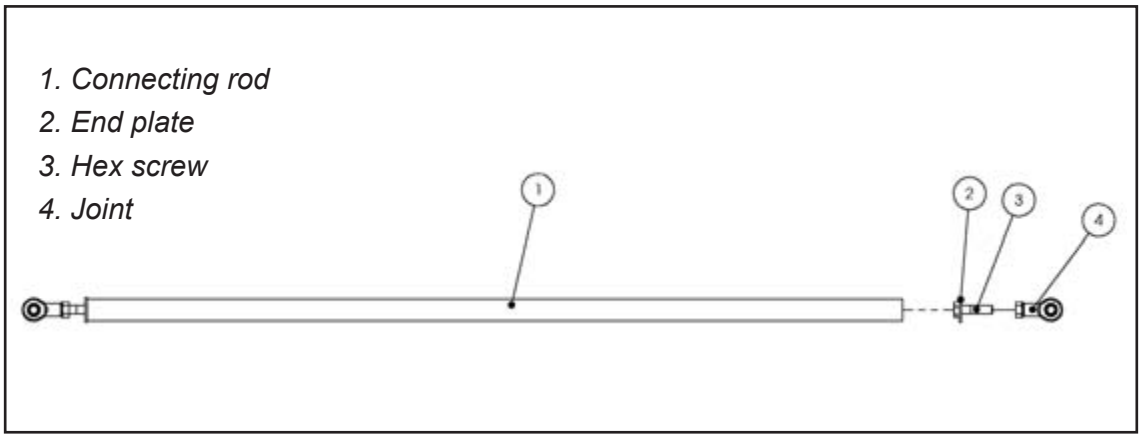


Figure 3.3-1

3.4. Installing an Electronic Reversing Deflector Control System

An electronic reversing deflector control system is available for smaller models (AJ 160 and AJ 180/185).

The system consists of the following main components:

#1 control lever (potentiometer)

#3 electronic unit

#4 spindle motor.

See drawing SE-01 in appendix 1.

3.4.1. Installation Instructions

1. The control system has been preadjusted as in drawing SE-01 (appendix 8).

2. When the water jet unit has been installed on the boat, the installation of the reversing deflector control system can begin.
   - 2.1. Set the reversing deflector in centre position so that lever 5 (figure SE-01) points up perpendicularly.
   - 2.2. Fix the spindle motor (part 4) in place implementing the setting dimension of 413 mm (figure SE-01). The spindle motor can point perpendicularly either to the right or left. Note that the *spindle motor is locked with steel wire* to prevent the spindle from rotating.
   - 2.3. Make sure that the dimension of 100 mm is implemented as indicated in figure SE-01.
   - 2.4. Attach the control box (part 3, figure SE-01) as close to the spindle motor as possible in vertical position with connection cables down.
   - 2.5. Fix the control lever (part 1) in place, connect the control cable to the connection box (part 2), and then to the control cable (part 3.1).
   - 2.6. Connect the power supply cable to the connection box (part 3.3, not incl. in the delivery). The size of the power supply cable must be 2 x 4 mm^2. Fuse 16 A.

3. Make sure that the control lever is in centre position and switch on the current to the equipment.

4. Move the control lever carefully and at the same time observe the course of the reversing deflector.

5. If the course of the deflector is different than desired, the course can be altered in accordance with the accompanying adjustment instructions.

6. If you start to adjust the course of the deflector, familiarize yourself with the adjustment instructions first.

WARRANTY CLAUSE: The warranty is valid only if instructions for installation and adjustment have been followed!

3.4.2. Adjustment Instructions

PREPARATION

- Set the STICK to middle position.
- Adjust the AREA trim completely counterclockwise 25 cycles or until the trim starts to “snap”, after which adjust about 4 cycles back.
- Adjust the ZERO trim completely counterclockwise 25 cycles or until the trim starts to “snap”, after which adjust about 8 cycles back.
- Adjust the start speed, current limit and accuracy trims to middle position.

ADJUSTMENT

-Switch on the system.

-Adjust the spindle motor (deflector) to centre position with the ZERO trim.

-Test the suitability of the area with the STICK.

Area too wide:

- STICK in middle position,
- adjust the AREA trim slightly clockwise (for example 1 cycle),
- adjust the spindle motor back to centre position with the ZERO trim.
- Test the suitability of the area again with the STICK.

If the area is still too wide, repeat the procedure above. Instead, if the area is too small, repeat the procedure above with the difference that you adjust the AREA trim counterclockwise.

TIPS:

- operating direction of the STICK is wrong:

Switch the places of the brown and the white wire on the STICK.

- Spindle movement is slow or jerky

Check that the CURRENT LIMIT has not been adjusted too low, i.e. the red LED is on or flashes continuously when the spindle moves.

Before increasing the current limit, check that the system is not mechanically jammed.

- Spindle does not stop, instead it quivers back and forth:

ACCURACY or START SPEED is too high.

- Spindle does not move:

Check the fuse and operating voltage.

- Spindle runs to the other end and moving the STICK does not have effect

Check the wiring and/or carry out preparation anew.

4. Engine Installation

This section deals with engine installation in connection with the jet propulsion unit. Otherwise engine installation has to be carried out according to the engine manufacturer's instructions.

4.1. General

Alamarin-Jet propulsion units are used generally with a 1,0:1,0 gearbox or with a direct connection from the engine flywheel adapter.

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).

BEFORE INSTALLING THE ENGINE, MAKE SURE THAT THE POSSIBLE GEARBOX CONNECTED TO IT IS CORRECT! WRONG GEARBOX RATIO LOWERS THE PERFORMANCE OF THE JET PROPULSION UNIT OR ENTIRELY PREVENTS IT FROM BEING USED!

4.2. Aligning the Engine with the Jet Propulsion Unit

Correct sizing and alinging 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.

4.2.1. Intermediate Shafts

THE NEXT SECTION DEMONSTRATES PRINCIPLES OF COMMONLY USED SHAFTS. ALWAYS ASK THE MANUFACTURER OF THE INTERMEDIATE SHAFT FOR INSTALLATION AND OPERATION INSTRUCTIONS!

4.2.1.1. Constant Velocity Shaft

At the both ends of the constant velocity shaft there is a joint based on balls rolling on a spherical surface. Of the shafts used with jet propulsion units, an intermediate shaft like this has the most freedom as regards alignment.

The joints can be in angles that are different from each other (figure 4.2.1.1-1).

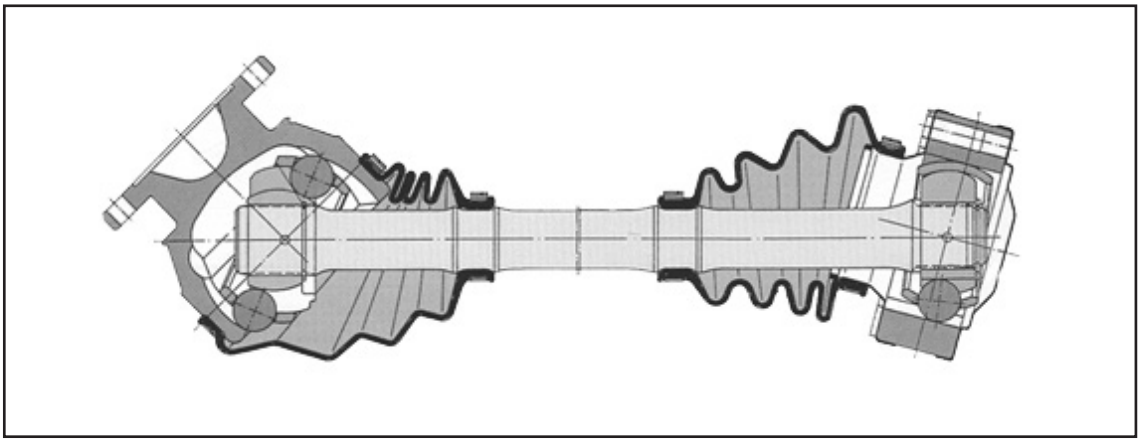


Figure 4.2.1.1-1

4.2.1.2. Cardan Shaft

The cardan shaft joints are diagonal. This is why alignment is more demanding. To get the shaft to rotate without vibration, the joint angles must be of equal size. Figure 4.2.1.2-1 below shows examples of allowed angle configurations.

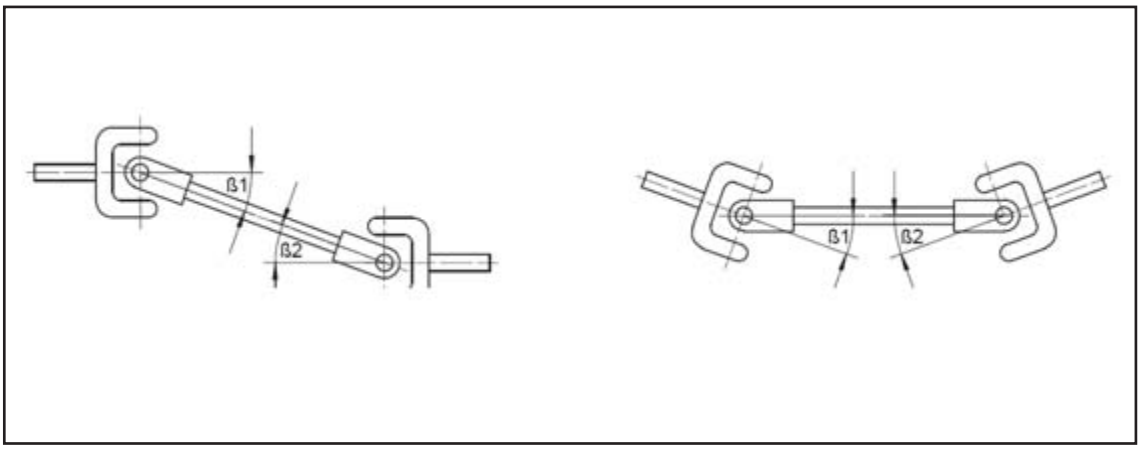


Figure 4.2.1.2-1

4.2.1.3. Intermediate Shaft with Rubber Stop

Shafts with rubber stops effectively prevent vibrations that travel along the shaft to the shell of the boat. This is why they are popular especially in boats with a metal structure. In the example shaft in figure 4.2.1.3-1 there is a rubber joint at the other end and a constant speed joint at the other.

Figure 4.2.1.3-1

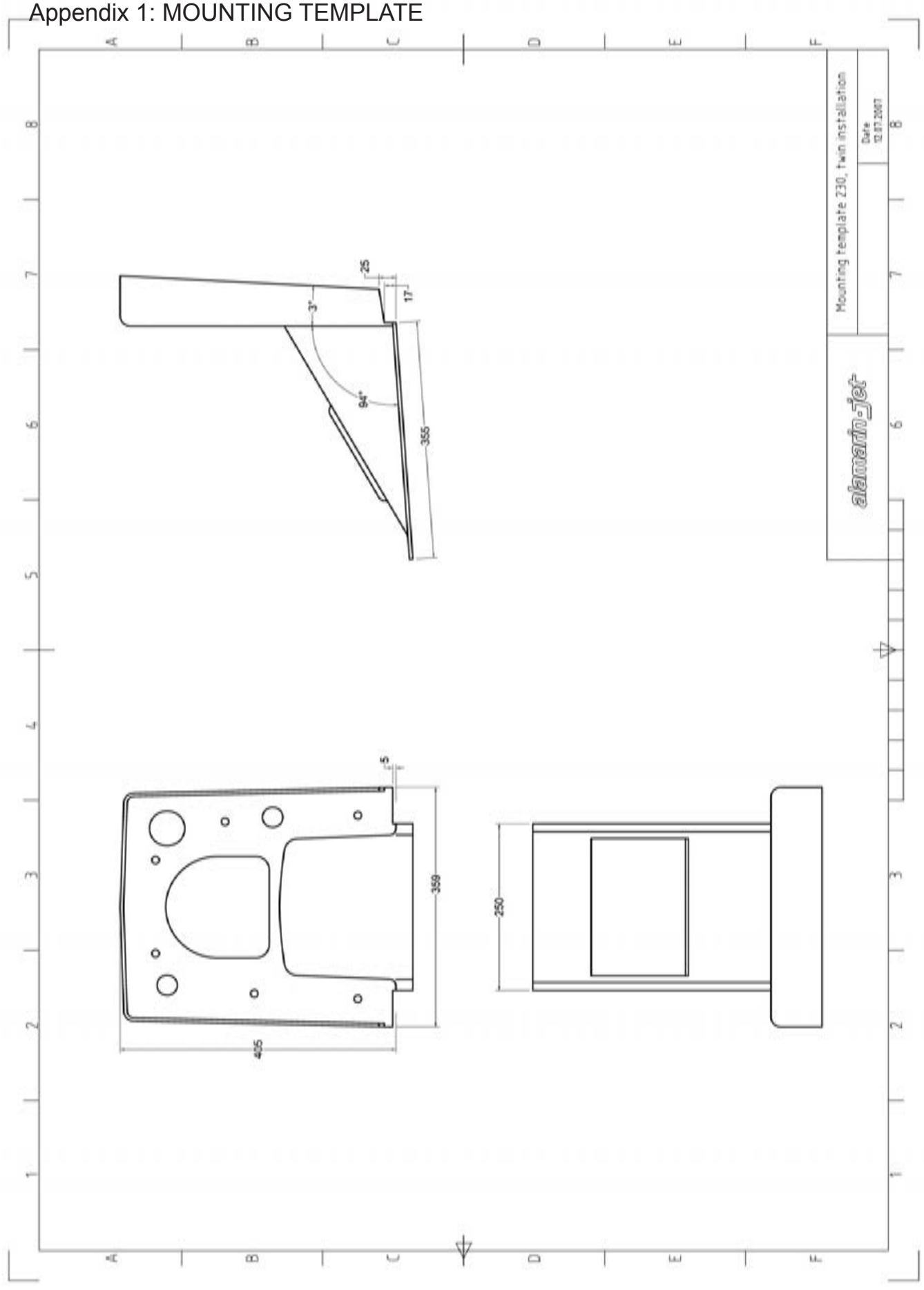
4.2.2 General Instructions Concerning Intermediate Shaft Installation

1. 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.

2. The ends of the shaft must be exactly in place against the flange surface before screws are tightened. Incorrect position leads to wrong joint angle and unbalance. This may cause extensive damage to the system.

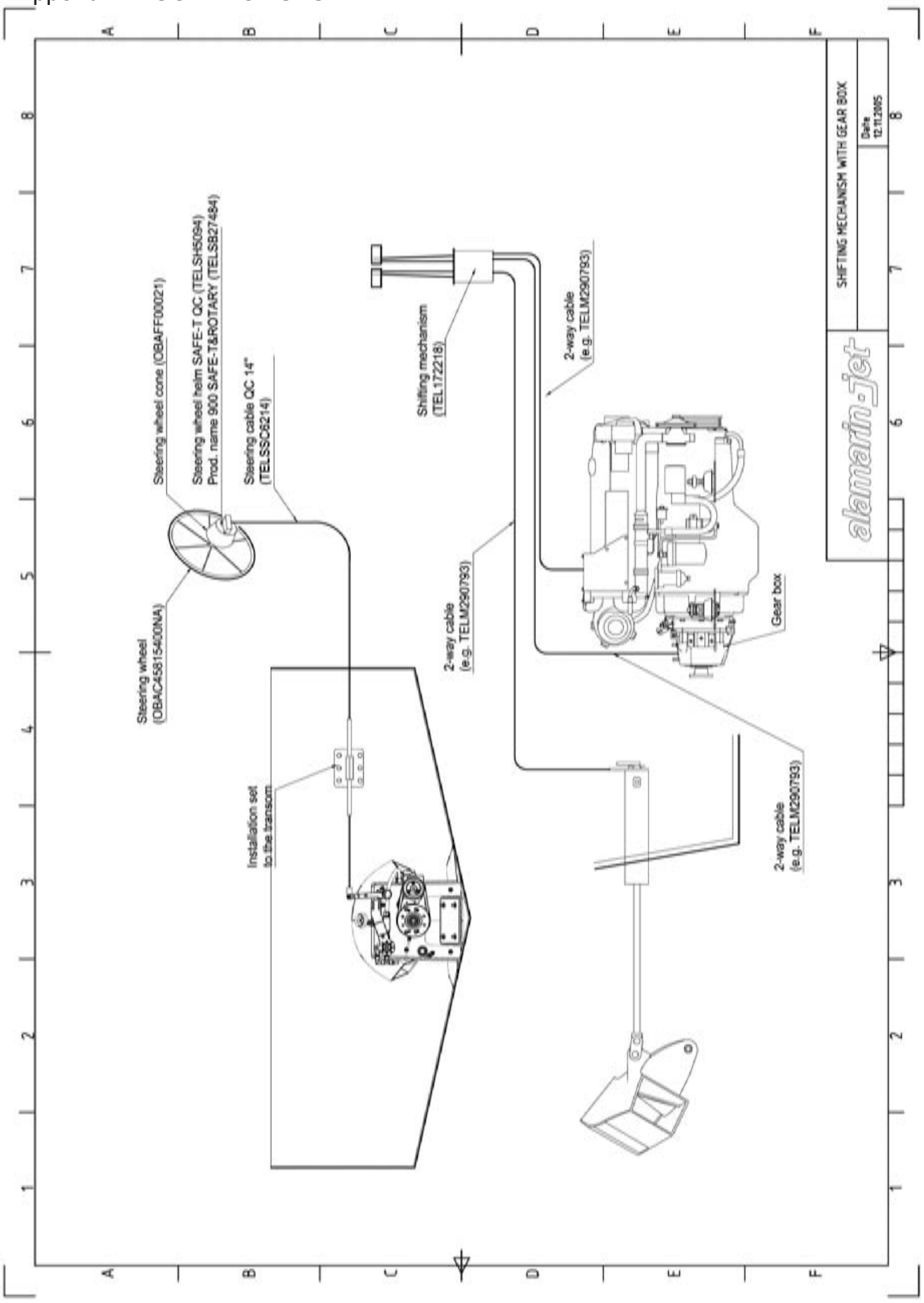
3. The tightening screws of the intermediate shaft are to be tightened a little at a time evenly in a crosswise sequence. Uneven tightening may cause the joint to be in a wrong position.

Appendix 1: MOUNTING TEMPLATE

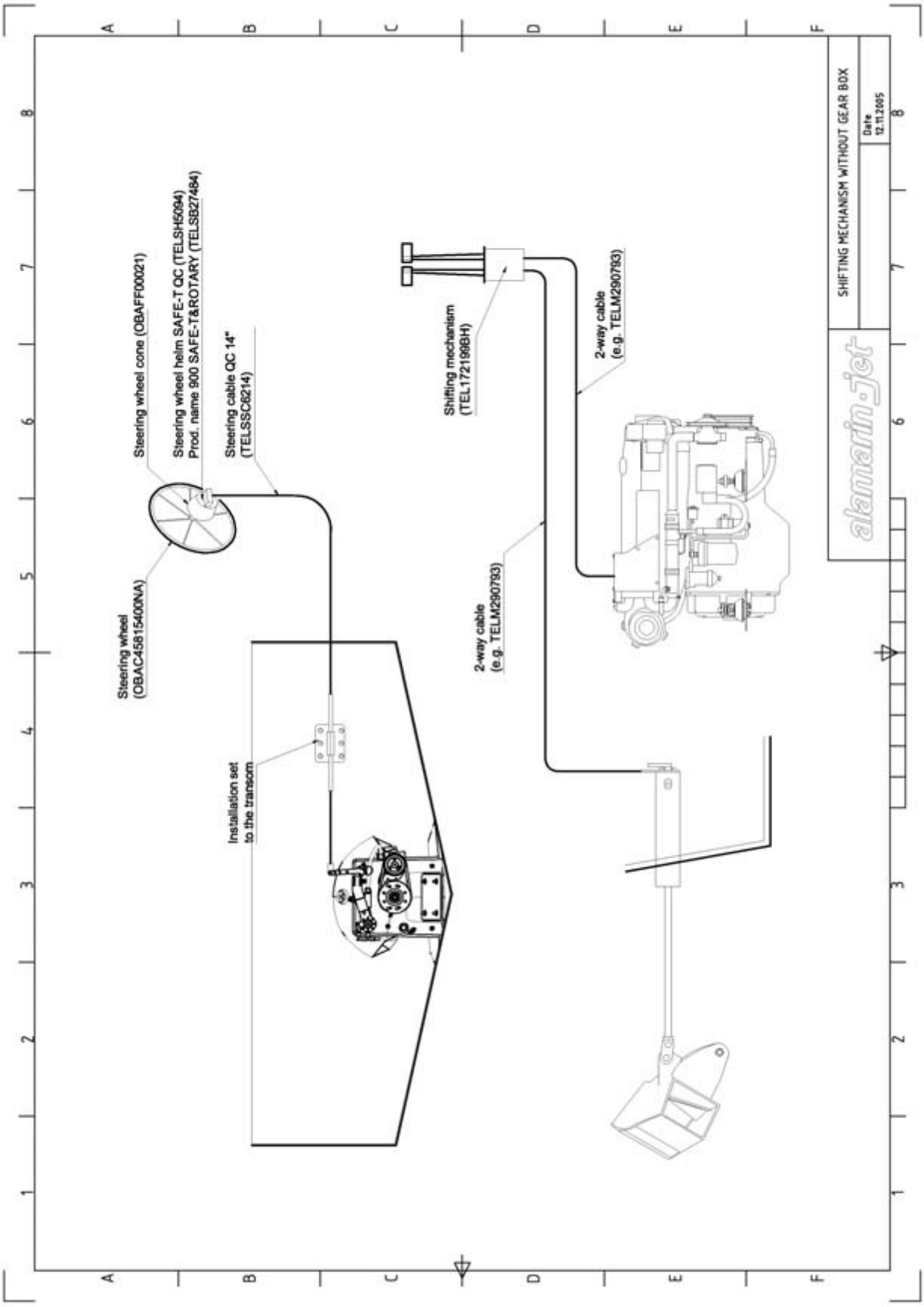


Version 1.4

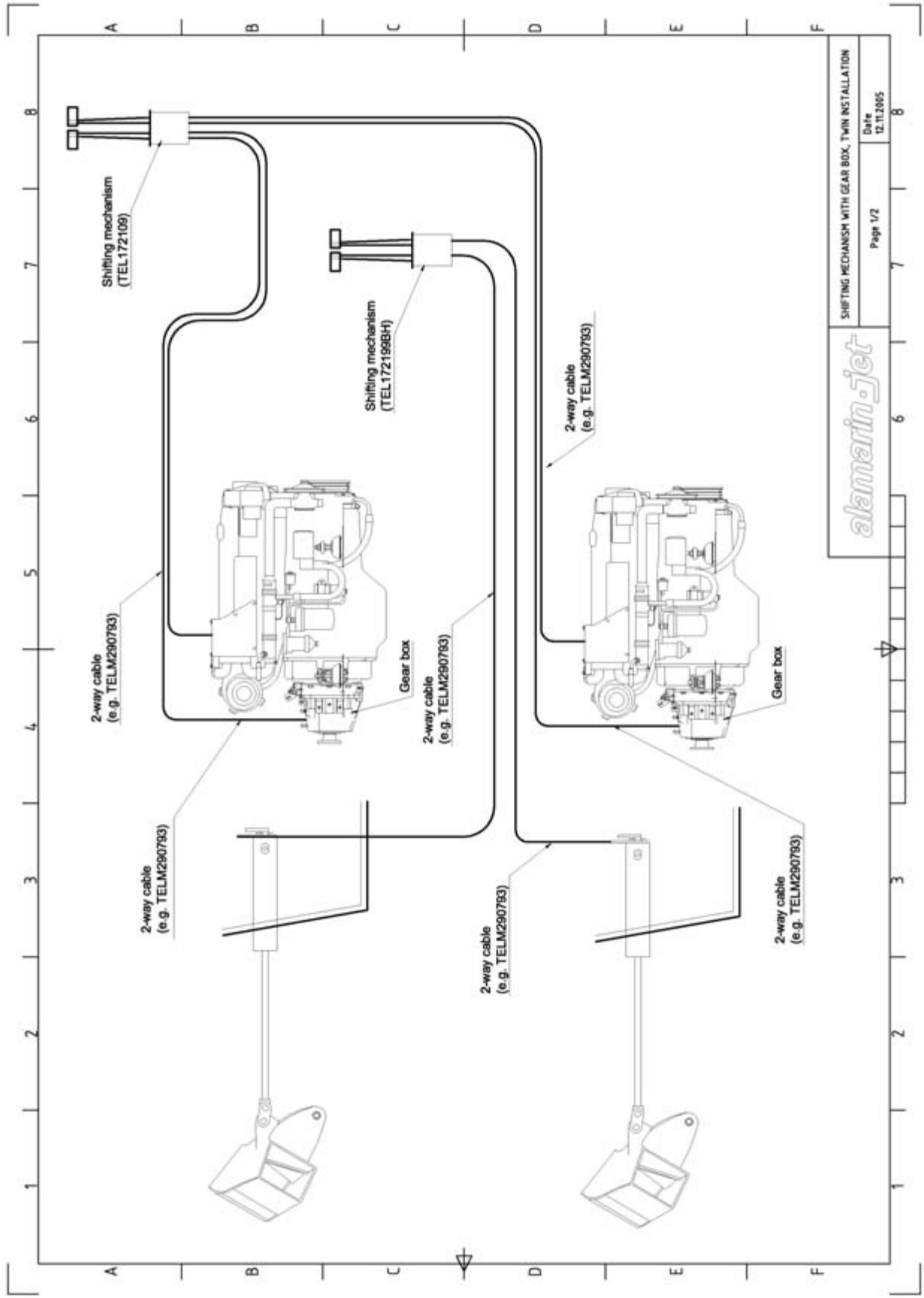
Appendix 2: CONTROL SYSTEM 1



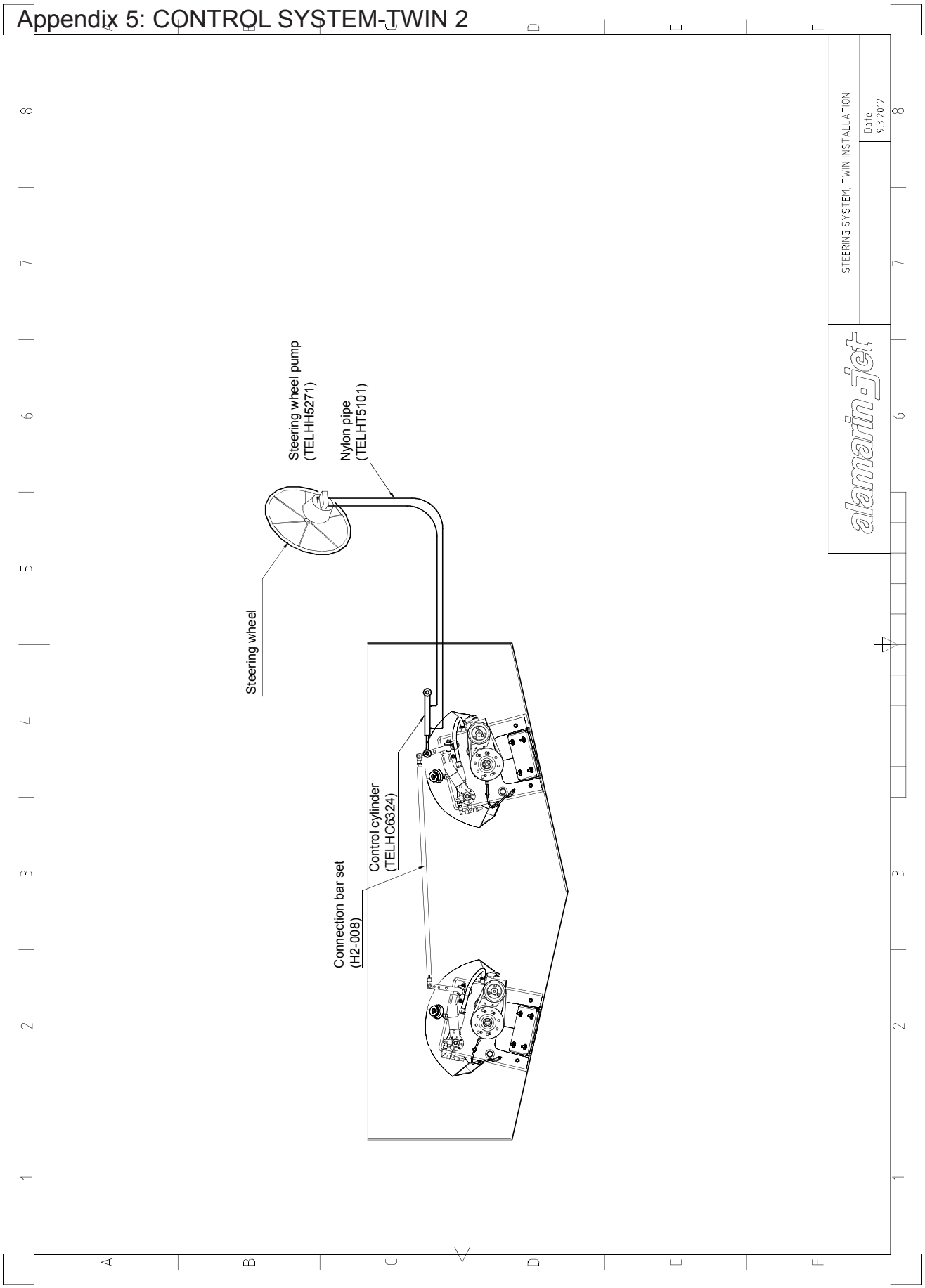
Appendix 3: CONTROL SYSTEM 2



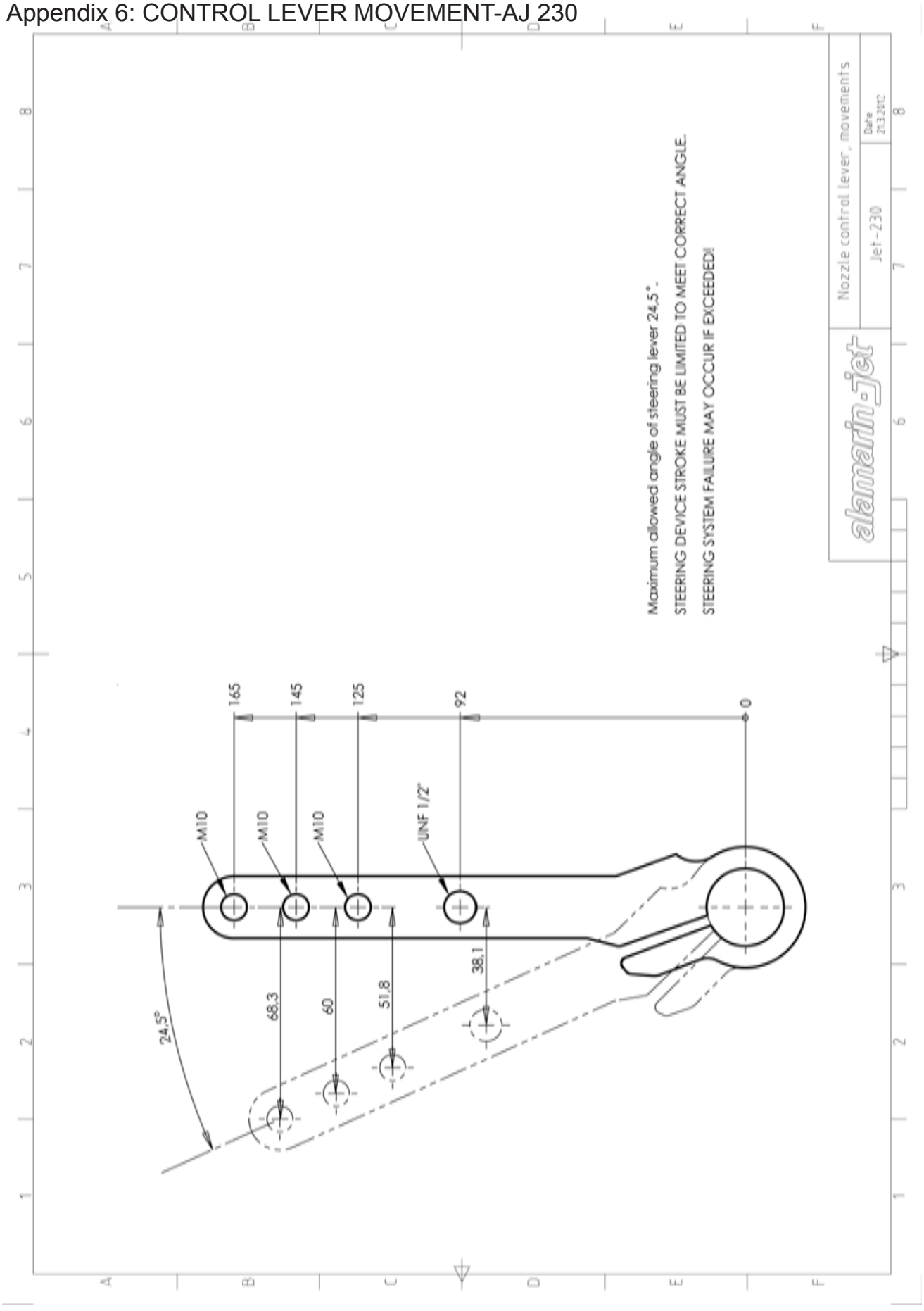
Appendix 4: CONTROL SYSTEM-TWIN 1



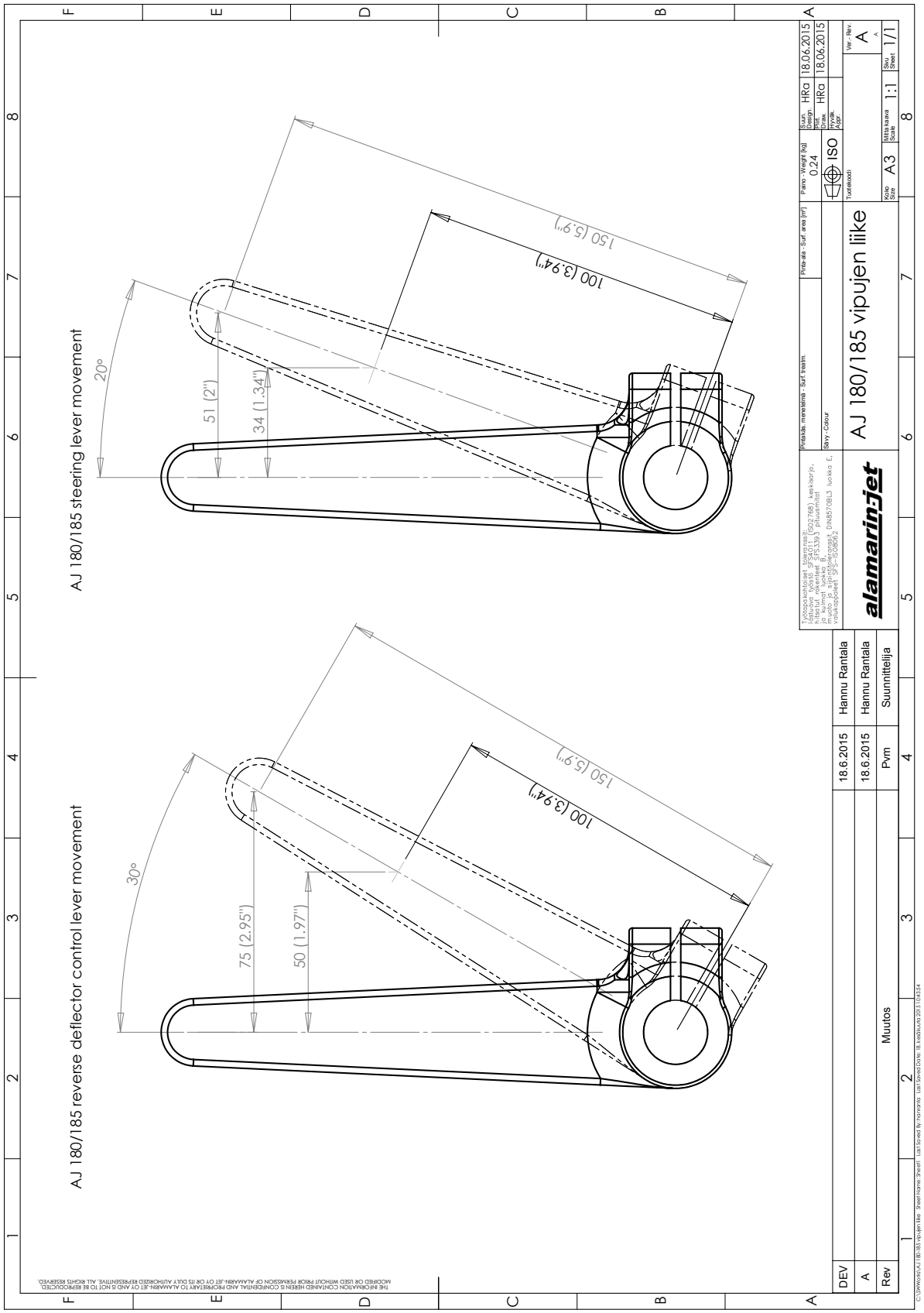
Appendix 5: CONTROL SYSTEM-TWIN 2



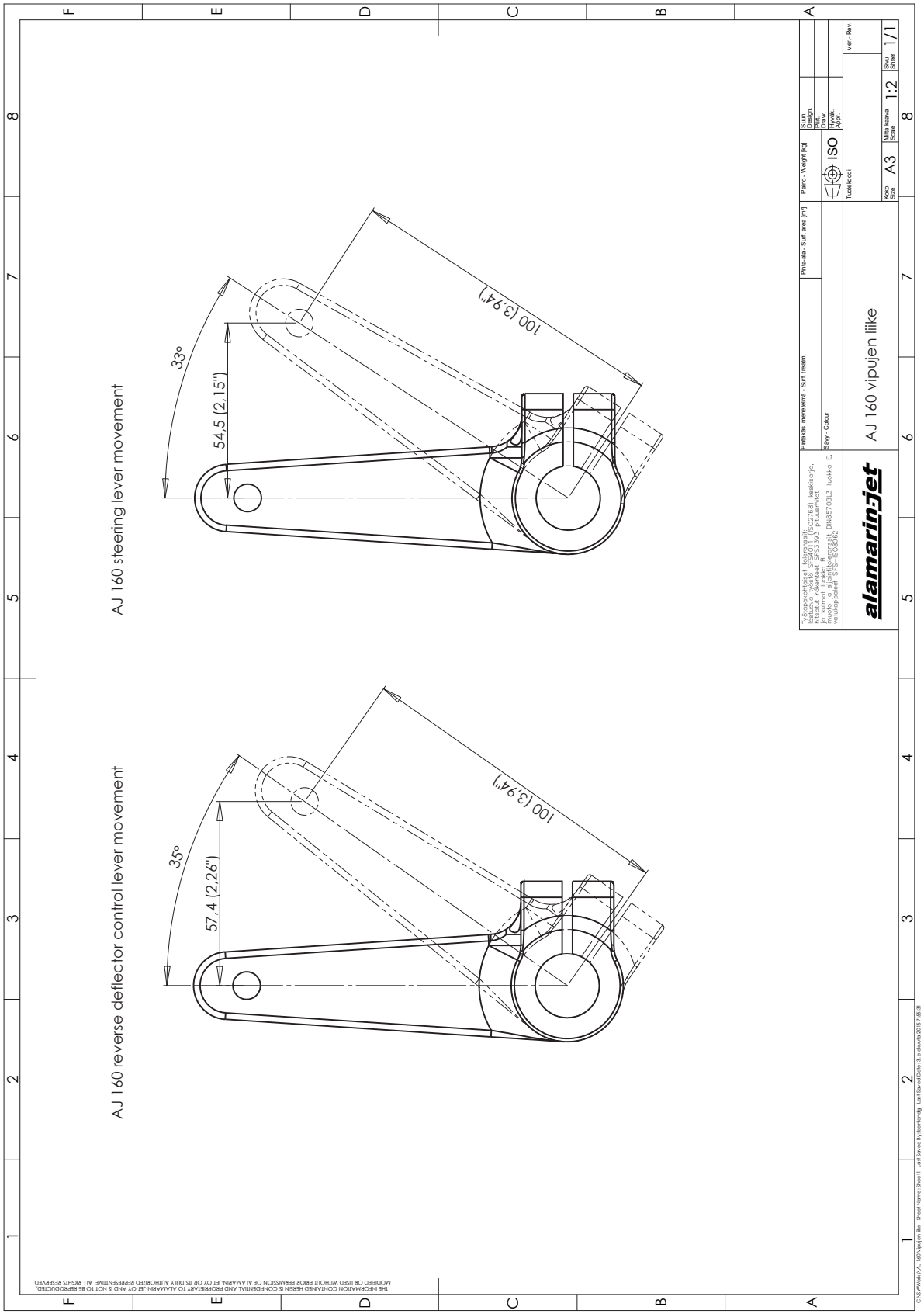
Appendix 6: CONTROL LEVER MOVEMENT-AJ 230



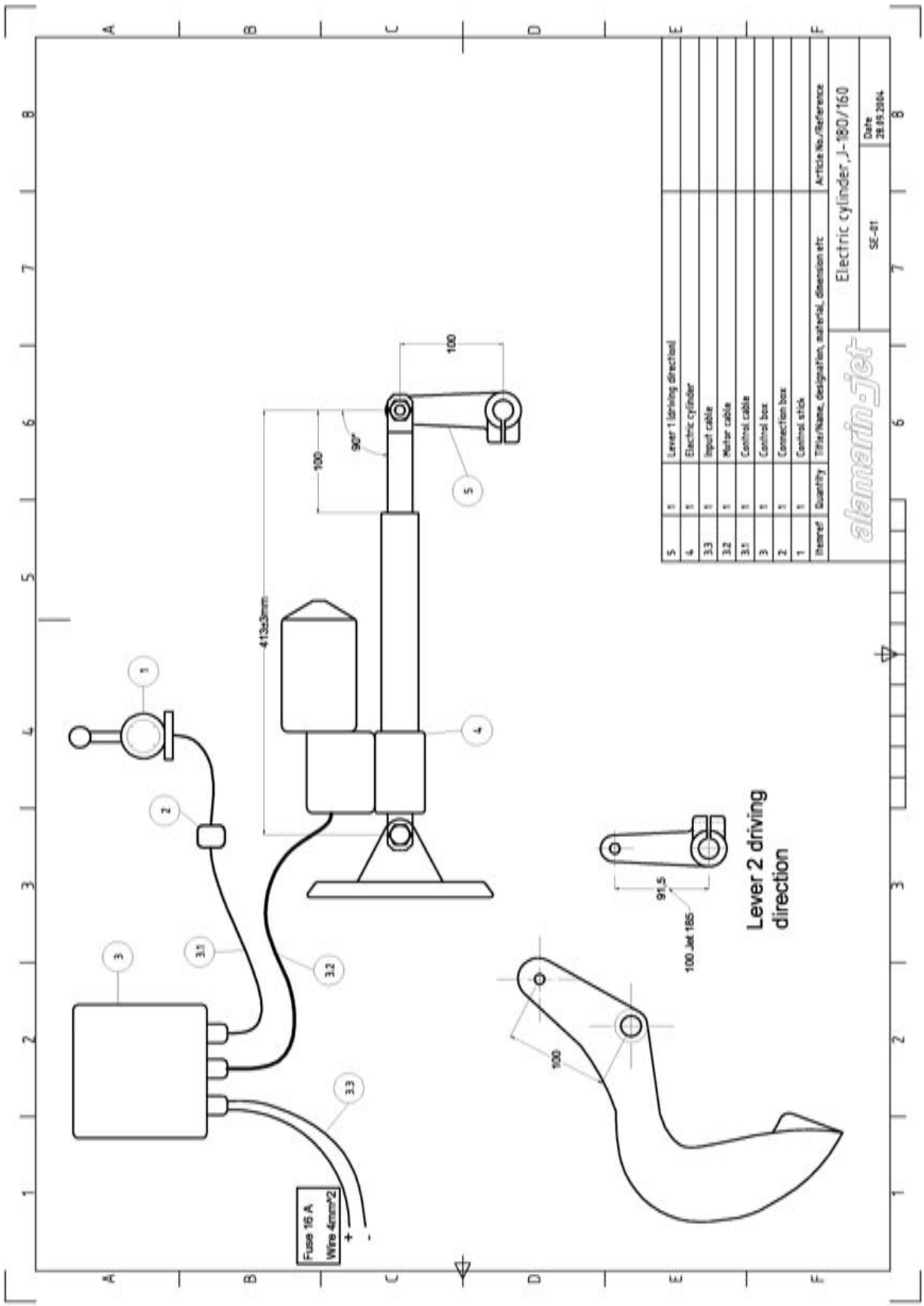
Appendix 7: CONTROL LEVER MOVEMENT-AJ 180 and 185



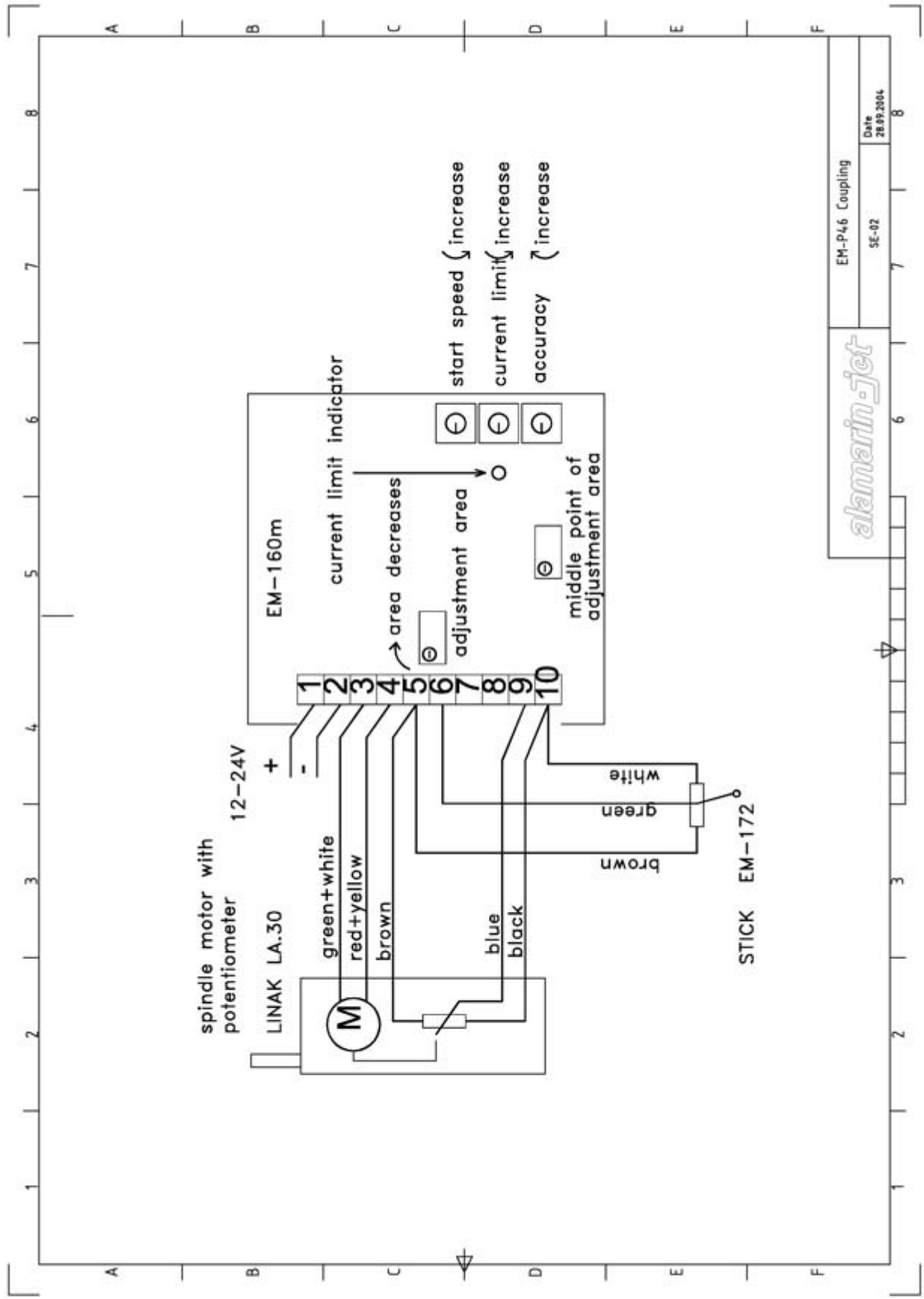
Appendix 8: CONTROL LEVER MOVEMENT-AJ 160



Appendix 9: SE-01



Appendix 10: SE-02



Appendix 11: RECOMMENDED GREASES AND OILS AND TIGHTENING TORQUES OF THE SCREWS

1. The grease used for lubricating the bearings of the propulsion unit must meet the requirements below.

- lithium soap and a thickener with EP additives
- mineral oil as a base oil
- NLGI class 2
- operating temperature range –25…130˚C
- continuous operating temperature min. 75˚C

The following grease brands are recommended as an example:

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 lubricating.

2. The operating hydraulic system of the reversing deflector has been designed operate with automatic transmission oil.

Kinematic viscosity 40˚C	33…36 mm2/s
Kinematic viscosity 100˚C	7.1…7.7 mm2/s
Viscosity index	min 170
Density 15˚C	0.835…0.890 g/cm3
Pour point	max. 42˚C
Flashpoint	min. 180˚C

The following oil brands are recommended as an example:

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

3. The tightening torques in the table below must be used when tightening the screws on the propulsion unit. The values 8.8, 10.9, and 12.9 signify the strength classes of the screws. The strength class of the A4-80 acid-proof screw corresponds to a 8.8 class screw.

Tightening torques of the screws			
Thread	Tightening torque (Nm)		
	8.8	10.9	12.9
M5	5.5	8.1	9.5
M6	9.6	14	16
M8	23	34	40
M10	46	67	79
M12	79	115	135
M16	145	215	250

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

Appendix 12: Exploded Views

When delivering this manual in paper form, the manufacturer has added to the following pages the exploded views of the propulsion unit model with which the manual is delivered. In the electronic version the exploded views are as a separate file.