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alamarin-jet

REPAIR MANUAL 1

EDITION 2006

alamarin-jet water jet propulsion unit

REPAIR MANUAL

Alamarin-Jet Oy has published this manual in order to guide the owners and users as well as companies carrying out repairs to ***alamarin-jet*** water jet propulsion unit .

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

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:

Jet-160 Jet-180 Jet-185

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

Clarifying figures will be used in this manual.

Symbols used in the Repair 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

Index 3

1. Drive Shafts and Coupling Flanges

Between the jet and the engine there is always an intermediate shaft which transmits the power from the engine to the jet propulsion unit's main shaft. There are various types of shafts. Normally, the shaft has been chosen and installed by the boat's manufacturer.

1.1. Joint Types

1.1.1. Constant Velocity Shaft

A constant velocity shaft is a cardan shaft between the engine and the jet, which allows angle deviations. The joints are based on balls rolling on a spherical surface. This shaft type enables vibration-free running even if the joint angles at different ends of the shaft deviate from each other.

Detachment, Repair and Installation

At the engine side the constant velocity shaft is attached to the flywheel, to a coupling flange installed by the engine manufacturer or to the gearbox. There can be an adapter flange between the joint and the engine, with which the engine and shaft hole spacings are fitted with each other.

There can also be an adapter flange between the jet's coupling flange and the joint.

Open the joint fastening screws at the jet side and leave the possible adapter attached to the coupling flange. The bolts can be hex or socket screws (figure 1.1.1-1).

Figure 1.1.1-1

Open the joint fastening screws at the engine side and leave the possible adapter attached to the flywheel.

The rubber covers and the whole end of the joint are removable parts of the constant velocity shaft.

If the rubber cover of the joint is broken, lubricating grease comes out and the danger is that the whole joint may break down. A broken rubber must be replaced immediately.

Follow the manufacturer's instructions in repair and installation.

1.1.2. Rubber Joint

The rubber joint is an elastic rubber element on the intermediate shaft between the engine and the jet. The rubber element dampens the vibrations and sudden torsional loads that are transmitted from the engine to the boat's hull, and allows some angle deviation.

An intermediate shaft equipped with rubber joints is installed similarly to a constant velocity shaft. Because the shaft, engine and jet propulsion unit flanges are not always compatible, it is usually necessary to use adapter flanges.

There are various types of intermediate shafts equipped with a rubber joint. The manufacturer's instructions must be followed in repair and installation.

1.1.3. Cardan Shaft

The cardan shaft has been pivoted with spider bearings. The joint angles at different ends must be of equal size to attain vibrationless and durable running.

The cardan shaft has been installed similarly to the constant velocity shaft. Adapter flanges are used sometimes because the shaft, engine and jet propulsion unit flanges are not always compatible.

1.2. Tightening the Fastening Screws

The following information will serve as general instructions:

Always tighten the fastening screws of the coupling flanges fingertight first and after that in a crosswise sequence gradually until they are at the correct torque. This ensures that the joint is attached evenly to the coupling flange.

However, check with the manufacturer that possible instructions given separately by the manufacturer are followed in tightening.

Use thread locking compound to tighten the bolts. Observe the manufacturer's instructions on using a thread locking compound.

1.3. Balance

The balance and correct installation of the intermediate shaft on the joints at different ends is imperative to a functioning whole. Unbalance of the intermediate shaft, flanges that have been tightened or attached incorrectly cause the equipment to break down very quickly.

WARRANTY

IF AN INTERMEDIATE SHAFT THAT HAS BEEN INSTALLED OR BALANCED INCORRECTLY CAUSES DAMAGE, THE GUARANTEE IS NOT VALID!

1.4. Coupling Flanges

Different kind of coupling flanges are installed to the jet's main shaft depending on the type of the intermediate shaft and engine power. Commonest of these are SAE 1310, VNA 10.

If necessary, there is an adapter between the coupling flange and the transmission shaft, which enables fastening.

Removing:

The coupling flange is tightened on the conical shaft end with an M16 nut. Unscrew the nut (figure 1.4.-1) and pull the flange off the cone with a puller (figure 1.4-2). There is a spacer under the fastening nut, which presses the shaft on the coupling flange. ***Never install the coupling flange without the spacer***. Remove the wedge from the groove (figure 1.4-3).

Figure 1.4-1

Figure 1.4-2

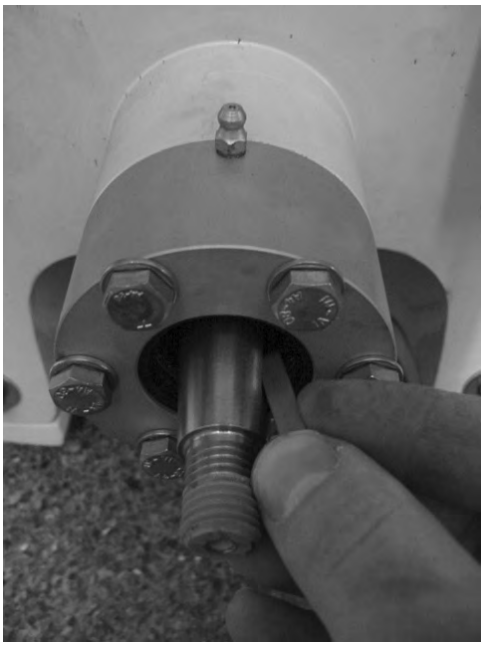


Figure 1.4-3

The shaft can be stopped from rotating with a bolt that is pushed through the fastening screw hole against the surface of the bearing housing. See figure 1.4-1.

Different models have different types of bearing housing structure. This does not affect the fastening of the coupling flange.

2. Bearing and Main Shaft

2.1. Front Bearing

2.1.1. Disassembly

2.1.1.1 Jet-160

The bearing housing is fixed in the casting. Only the support bearing housing is removable.

Before the shaft can be disassembled, the reversing deflector, the steering nozzle, the stator (see sections 4-6), and the impeller (see section 3) must be removed from the rear of the jet. The boat must be out of the water.

Remove the coupling flange as described in section 1.4.

Open the fastening screws of the support bearing housing (6 pcs) as in figure 2.1.1.1-1 and remove the support bearing housing (figure 2.1.1.1-2).

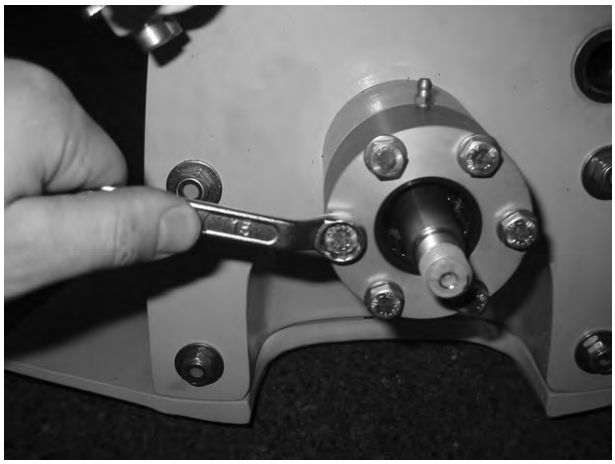


Figure 2.1.1.1-1

Figure 2.1.1.1-2

The shaft protrudes into the engine room with the bearings. The fit may be tight, but when pushed from the outside, enough force is produced to remove the shaft (figure 2.1.1.1-3).

There are still two shaft seals in the bearing housing. They can be removed with for example a screwdriver.

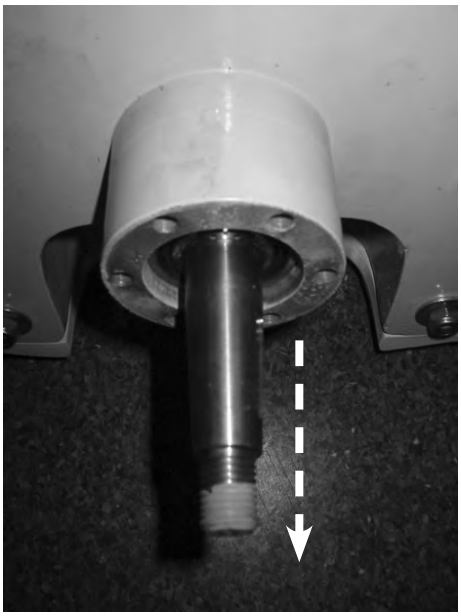


Figure 2.1.1.1-3

The bearing (figure 2.1.1.1-4) consists of a thrust bearing that receives the pure axial force (A) and an angular ball bearing that carries radial loads (C). The plate (B) between the bearings transmits thrust from the thrust bearing to the outer race of the angular ball bearing.

The safety ring (D) prevents the bearings from sliding off the shaft. The actual forces are received with the shoulder in the support bearing housing, which presses on the outer race of the bearing.

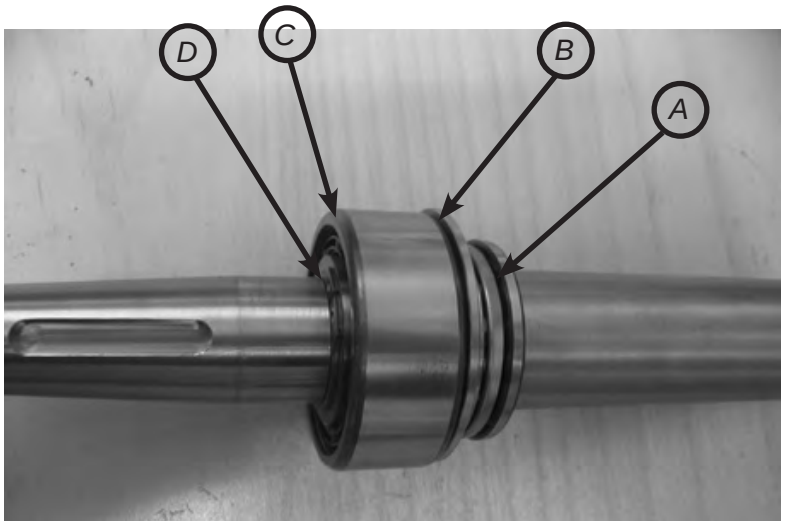


Figure 2.1.1.1-4

To remove the bearings, first remove the safety ring (A) and then push the bearings off the shaft (B) (figure 2.1.1.1-5).

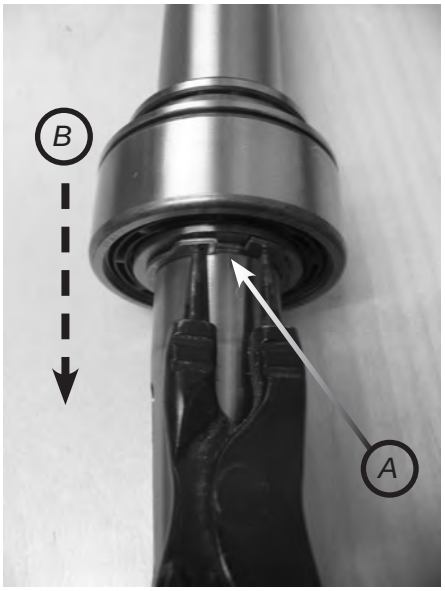


Figure 2.1.1.1-5

There is a needle bearing in the support bearing housing, which carries radial forces. There is a shaft seal behind the bearing, and a safety ring in front of it, which stops the bearing from sliding out from the bearing housing.

To remove the bearing, first remove the safety ring (figure 2.1.1.1-6) and then push the seal and the bearing from the seal side at the same time.

Figure 2.1.1.1-6

2.1.1.1 Jet-180/185

In removing the shaft, the Jet-180/185 requires the same procedures as the Jet-160.

Open the fastening screws of the support bearing housing (4 pcs) and remove the support bearing housing (figures 2.1.1.2-1 and 2.1.1.2-2).

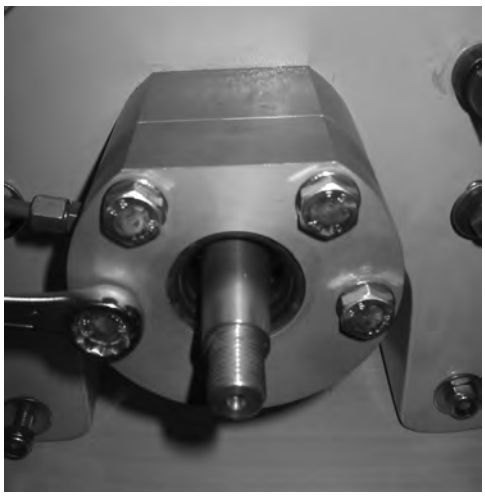


Figure 2.1.1.2-1

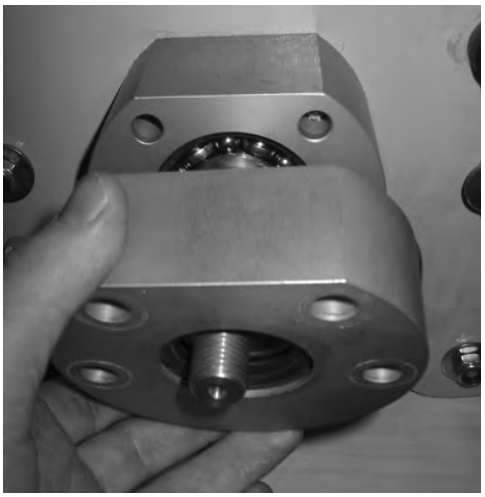


Figure 2.1.1.2-2

The shaft protrudes into the engine room with the bearings. The fit may be tight, but when pushed from the outside, enough force is produced to remove the shaft (figure 2.1.1.2-3).

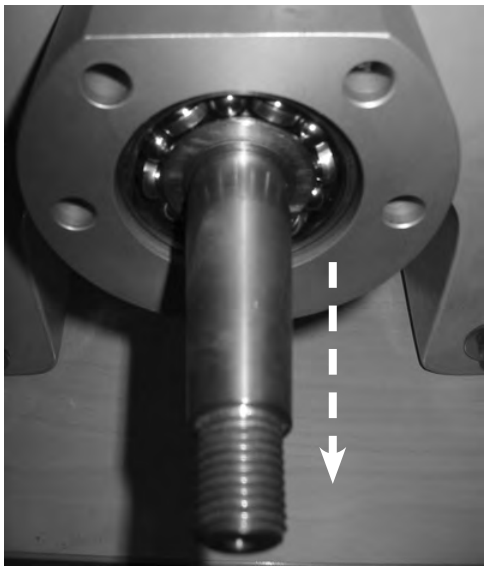
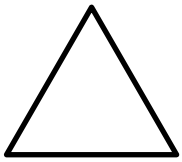


Figure 2.1.1.2-3



The actual bearing housing is attached to the body with sealing and adhesive compound. It is not necessary to remove it, unless it is damaged.

One four-point bearing is fitted to the shaft, which receives the thrust and carries some radial loads. The safety ring (A) stops the bearing from sliding off the shaft. The actual forces are received with the shoulder in the support bearing housing, which presses on the outer race of the bearing. See figure 2.1.1.2-5.

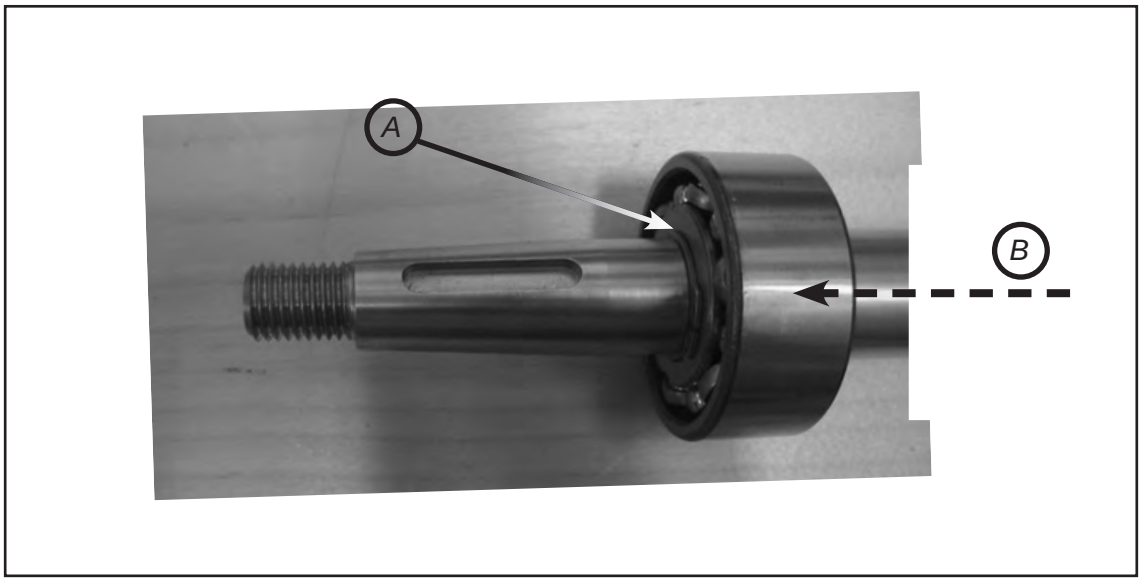


Figure 2.1.1.2-5

To remove the bearing, remove the safety ring and push the bearing to the direction of the safety ring groove (B). See figure 2.1.1.2-5.

Behind the safety ring in the support bearing housing is the actual groove ball bearing that carries radial forces. Behind the bearing there is a shaft seal. To remove the bearing, first remove the safety ring and then push the seal and the bearing from the seal side at the same time (figure 2.1.1.2-6).

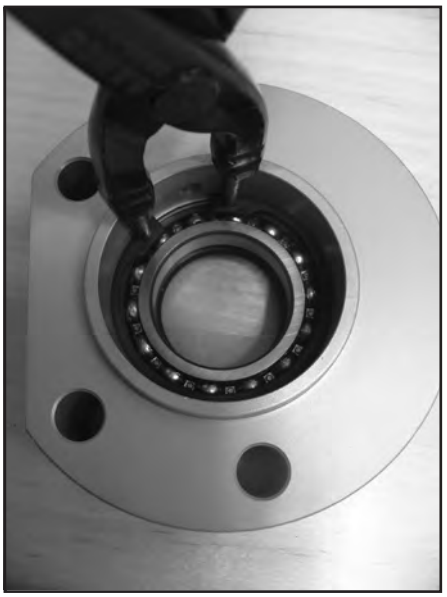


Figure 2.1.1.2-6

There is one shaft seal in the bearing housing. There are two additional seals between the bearing housing and the body, so the bearing housing must be removed to replace them. This is done by pushing the bearing housing to the direction of the engine room through the intake duct. The easiest way to remove the shaft seals is e.g. with a screwdriver, but the bearing housing surfaces must not be scratched. See figure 2.1.1.2-7.

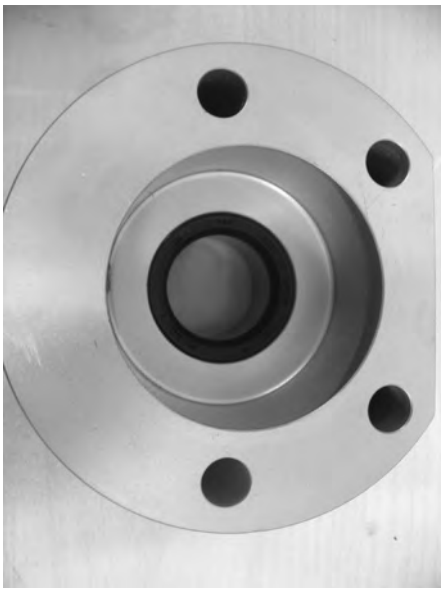


Figure 2.1.1.2-7

2.1.2. Assembly and Installation

2.1.2.1 Jet-160

Make sure that the bearing housing and the support bearing housing are absolutely clean.

Push the thrust bearing on the shaft. The thrust bearing consists of three parts. It is important that the parts are placed on the shaft in the correct order.

The thrust washer (A), whose shaft hole diameter is smaller, is placed first. The rolling element (B) is placed after this, and the thrust plate (C), whose shaft hole diameter is larger, is placed last. The spacer ring (D) that goes between the bearings has to be installed so that the relief goes on the four-point bearing side. The four-point bearing (E) and the safety ring are installed last.

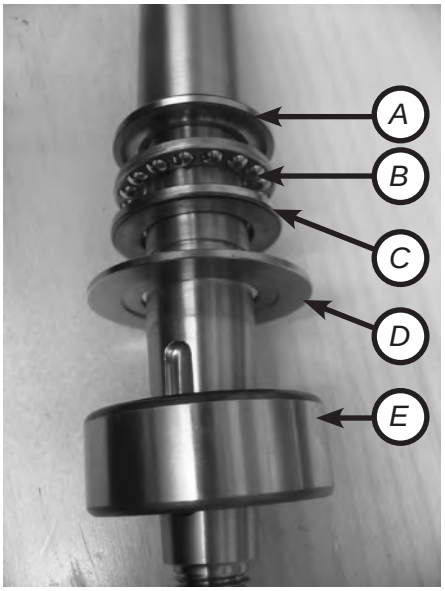


Figure 2.1.2.1-1

Place the shaft seals in the bearing housing. Pay attention to the direction of the lips! As the seal is being pushed into place, the lips must point away from the installer.

WARNING! If the shaft seal is installed backwards, water gets into the bearing housing! Also, make sure that the ring that supports the lip is made of rubber. A steel spring will rust! See figure 2.1.2.1-2 (A).

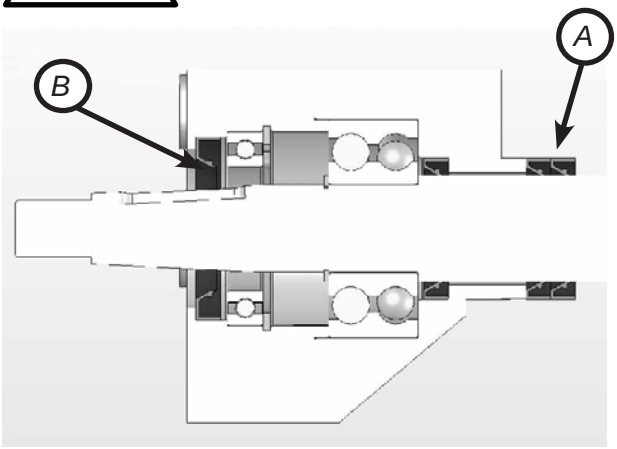


Figure 2.1.2.1-2

Push the shaft through the bearing housing so that the bearing definitely goes to the bottom of the bearing housing.

Install a shaft seal in the bearing housing. The orientation of this seal is also important, as a seal that is installed correctly stops grease from going into the engine room. The lip must point at the installer. See figure 2.1.2.1-2 (B).

Push the needle bearing in the support bearing housing and place the safety ring in the groove.

2.1.2.2 Jet-180/185

Make sure that the bearing housing and the support bearing housing are absolutely clean.

If you also wanted to change the seals behind the bearing housing, the bearing housing must be pushed off the housing. New seals are installed sequentially and the same way up. Pay attention to the direction of the lips! As the seal is being pushed into place, the lips must point away from the installer.

WARNING! If the shaft seal is installed backwards, water gets into the bearing housing! Also, make sure that the ring that supports the lip is made of rubber. A steel spring will rust! See figure 2.1.2.1-2 (A).

The third, securing shaft seal is placed in the bearing housing. Continue to pay attention to the direction of the lips!

Push the new bearing on the shaft and use bearing retaining compound to ensure the fixity of the inner race.

Place the safety ring into its the groove.

Push the shaft through the bearing housing so that the bearing definitely goes to the bottom of the bearing housing.

Install a shaft seal in the bearing housing. The orientation of this seal is also important, as a seal that is installed correctly stops grease from going into the engine room. The lip must point at the installer.

Push the groove ball bearing in the support bearing housing and place the safety ring in the groove.

2.2. Rear End Bearing Disassembly and Assembly

The rear end bearing is similar in Jet-160 and Jet180/185 models. Most commonly the rear bearing is grease lubricated. The alternative is a water lubricated bearing. Removing and installing is done the same way in both cases.

Before the rear end bearing can be disassembled, the reversing deflector, the steering nozzle and the stator (see sections 4-6) must be removed from the rear end of the jet. The boat must be out of the water.

The rear end bearing housing is glued to the stator. It is possible to remove the housing. When changing the rear end bearings, it is recommended that the whole housing is replaced. When only changing the seals, they should be replaced without removing the bearing housing.

Shaft seals can be removed e.g. with a screwdriver. When placing new ones, the correct orientation of the lips must be paid attention to! The lips must point at the installer.

Figure 2.2-1

WARNING! If the shaft seal is installed backwards, water gets into the bearing housing! Also, make sure that the ring that supports the lip is made of rubber. A steel spring will rust!

After the stator has been removed, the bearing housing is pushed from the back until it comes loose.

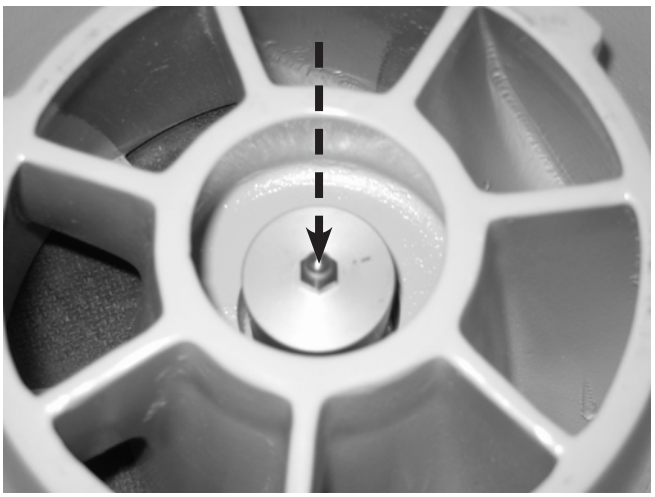


Figure 2.2-2

When installing a new housing or water lubricated bearing, clean the old adhesive residues off the stator.

After removing the adhesive residues, spread adhesive on the outer surface of the bearing housing (figure 2.2-3) and push the bearing housing in place. Wipe excess adhesive off the area of the bearing housing and stator seam.

Figure 2.2-3

Let the adhesive dry for 48 h before installing the stator (NB. the adhesive manufacturer's recommendations).

There is a replaceable wear sleeve (figure 2.2-4 A) at the rear end of the shaft. It is removed by first opening the bolt (figure 2.2-4 B) and removing the locking plate (figure 2.2-4 C) at the end of the shaft. Sealing compound has been put between the wear surface and the shaft to prevent water flow, which is why force must be used to withdraw the sleeve.

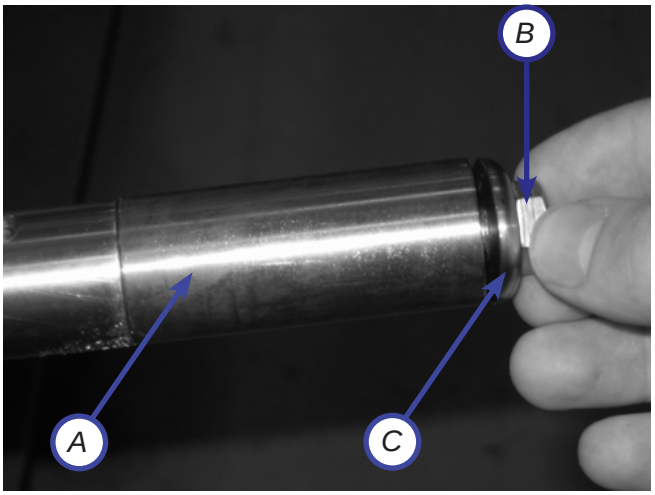


Figure 2.2-4

After you have installed the rear bearing to the stator, and the stator has been installed in place, remember to grease the rear bearing. Instructions for installing the stator have been given in section 6.1.3.

Grease recommendation: See Appendix 1.

3. Impeller

3.1. Detachment

The boat must be lifted out of the water to remove the impeller. Before you can get to the impeller, the reversing deflector, the steering nozzle and the stator must be removed. See sections 4-6.

Before the rear end bearing can be disassembled, the reversing deflector, the steering nozzle and the stator (see sections 4-6) must be removed from the rear end of the jet. The boat must be out of the water.

Loosen the fastening screws of the impeller and remove one of the screws (figure 3.1-1).

Screw the screw into the threaded hole (A) in the cone and tighten carefully until the cone loosens.

Take the bolt out of the threaded hole and spin it loosely into the free hole (B), i.e. back in its original place.

Pull the impeller off the shaft.

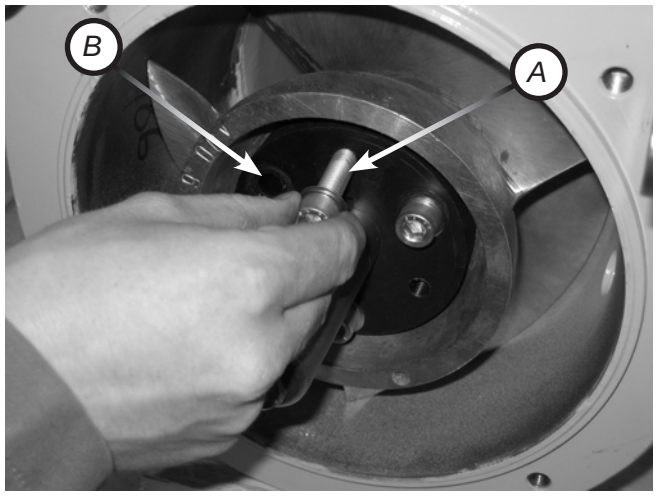


Figure 3.1-1

The plastic cone may still sit tightly on the shaft, but it can be loosened by pushing a screwdriver into the opening in the cone and forcing the cone open. See figure 3.1-2.

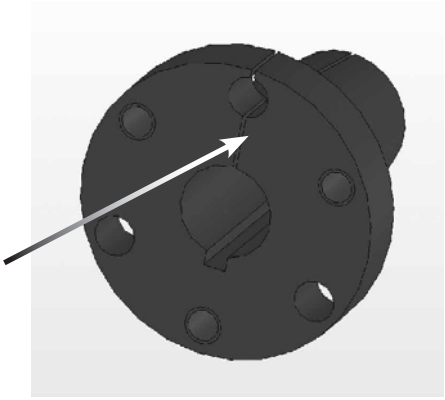


Figure 3.1-2

3.2. Repair

Faults with the impeller that require repair are slight bending and cracking of the blades.

If a blade has been bent, carefully tap it back to its former position. Compare the position of the blade to the other blades.

After straightening, make sure that there are no cracks at the bending point. If there are cracks, the blade must be repaired by welding.

If a piece has broken off the blade, it can be repaired by welding filler metal in the crack. However, we strongly recommend to exchange the whole impeller.

Welding can create heat stress, which may cause the impeller to break when used. This is why the manufacturer is not responsible for the breaking down of a repaired impeller.

Impeller material: GTp10
Filler metal: EL-CuSn7 (ESAB OK 94.24).

If the impeller has been repaired with filler metal, it is to be machined if necessary and it is imperative that it be balanced!

3.3. Installation

Screw the adjuster sleeve (A) and the possible additional ring on the shaft. The sleeve has a left hand thread, but the additional ring is unthreaded.

Place the wedge (B) in its groove (figure 3.3-1).

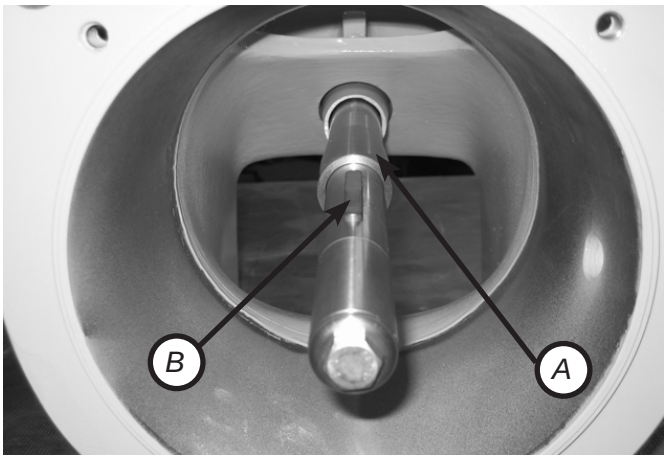


Figure 3.3-1

The place for the wedge groove (A) on the mounting cone is marked on the impeller with a line. Set the cone so that the wedge groove is aligned with the line (B) as in figure 3.3-2.

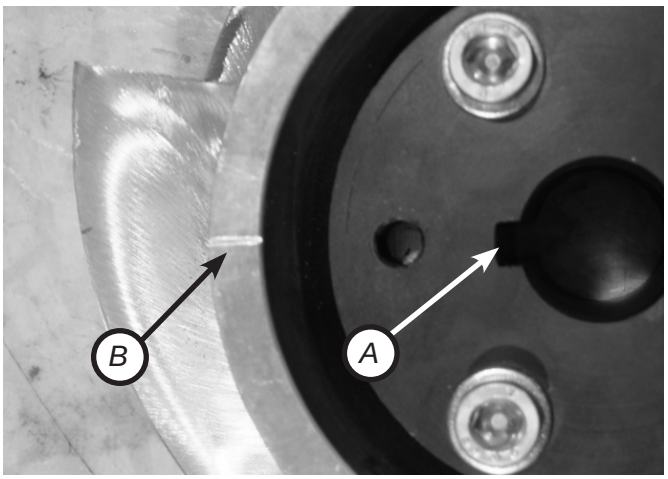


Figure 3.3-2

Push the impeller with the cone on the shaft (figure 3.3-3).

Tighten the screws fingertight and push the impeller as far in the intake duct as it goes.

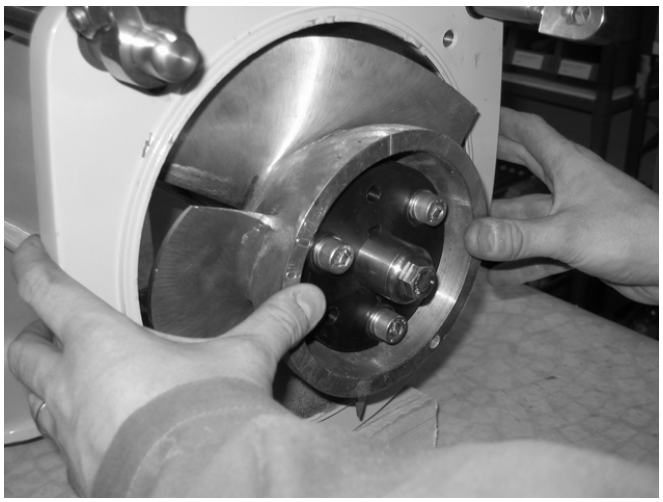


Figure 3.3-3

When installing the impeller, be careful not to leave your fingers between the impeller blade and the cone wall! Use the working position shown in figure 3.3-3!

Tighten the screws to a torque of 20 Nm. During tightening the impeller recedes slightly outwards in the cone hole, which causes the gap to adjust to the correct size automatically. After this, tighten the impeller adjuster sleeve as tight as manually possible. See figure 3.3-4 (A).

There can be a gap of 0.2 mm between the impeller blade and the cone (B). During installation, the lower edge is touching the cone and in the upper part of the impeller there may be a slightly bigger gap due to the weight of the shaft and the impeller. This gap disappears when the shaft is centered on the stator finally.

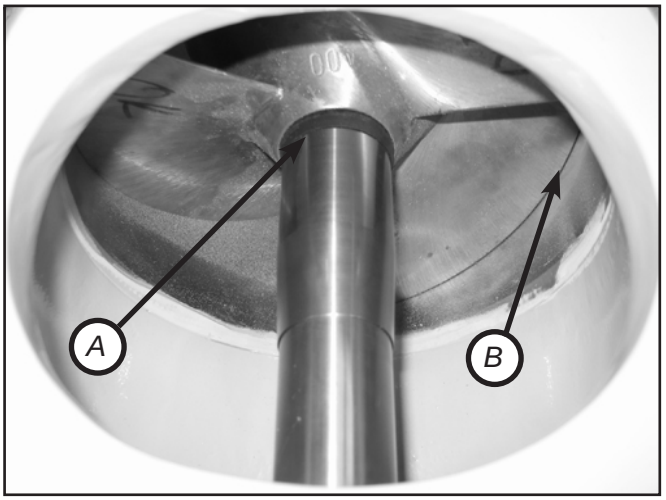


Figure 3.3-4

Too wide a gap between the cone and the impeller blade causes loss of power.

If the impeller does not rotate properly after installation, open the impeller screws, pull it out a little and tighten the screws again.

Close the inspection hatch.

Install the reversing deflector, the steering nozzle and the stator in place as one whole. (Section 6.1.3.)

Attach the loop joint on the reversing deflector to the lever at the end of the control shaft. (Section 4.1.3)

Attach the loop joint on the steering nozzle to the lever at the end of the control shaft. (Section 5.1.3)

Add grease in the end bearing.

See grease recommendations in appendix 1.

3.4. Type

Impeller type is determined by engine power and maximum revolutions.

You can check the type by looking at the markings on stamped on the impeller (figures 3.4-1 and 3.4-2).

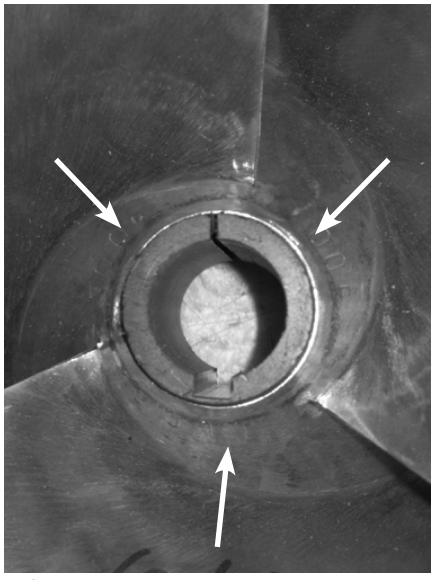


Figure 3.4-1

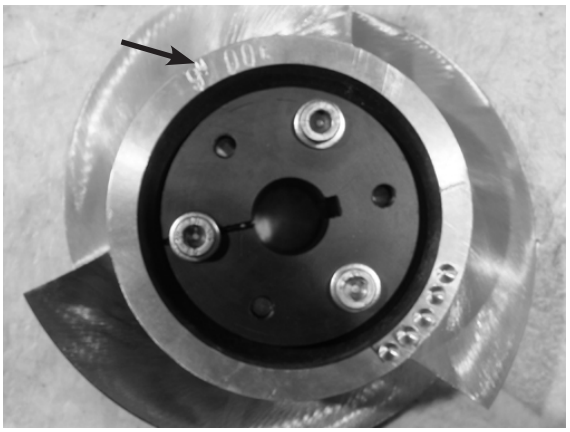


Figure 3.4-2

If there are no markings or they are worn, it is easiest to check the impeller type as follows:

1. Push the impeller in the cone as deep as it goes.

2. Place a straight ruler against the rear edge of the cone as indicated in figure 3.4-3 and measure the distance from the rear edge of the cone to the rear edge of the impeller.

This measure is about 2 mm at the smallest.

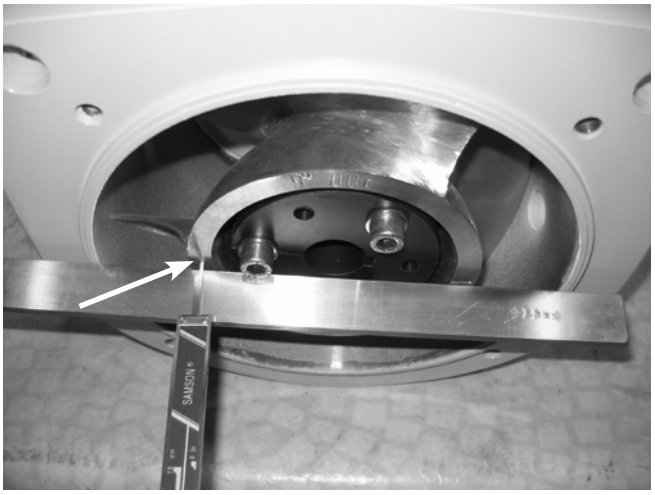


Figure 3.4-3

3. The impeller blade span is measured as indicated in figure 3.4-4. Drawing 2, included as an appendix, shows of all the dimensions that determine the impeller size.

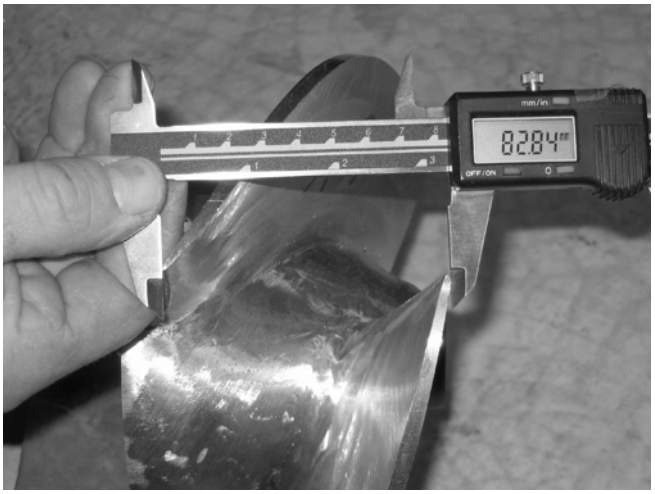


Figure 3.4-4

4. Reversing Deflector and Control Shafts

4.1. Reversing deflector

4.1.1. Detachment

The three fastenings indicated in figure 4.1.1-1 must be removed to take off the reversing deflector.

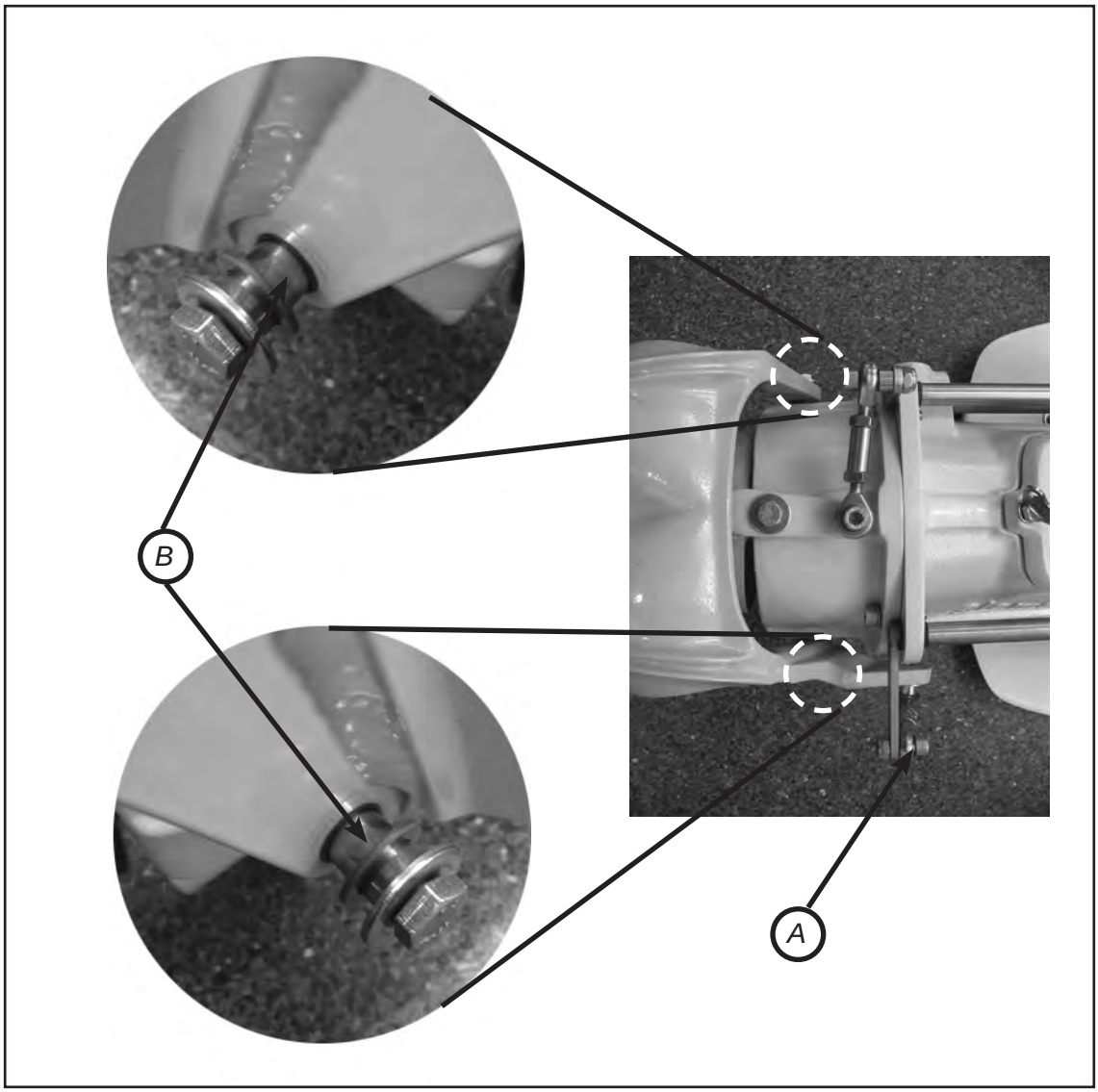


Figure 4.1.1-1

The control shaft of the reversing deflector is attached to the reversing deflector with loop joints (A). Remove the loop at the shaft side.

The deflector is pivoted to the stator with acid-proof sleeves and hex screws (B).

Open the screws and take note of the order of the washers. The free threading on the stator resists screw rotation and, in addition, thread locking has been used in installation, so the screw will not open by hand.

4.1.2. Repair

The wearing parts of the reversing deflector are plastic bearings, hard plastic spacer plates, joint loops and zinc anode. The parts must be replaced if they have cracks or they are highly worn. The joint is maintenance-free so it does not require lubricating.

The plastic bearings are removed by using a suitable sleeve and new ones are installed using sealing compound.

Small cracks on the reversing deflector can be repaired by welding filler metal into the notches. If the deflector's fastening screw brackets or cylinder brackets have broken, they must not be welded, but instead the deflector must be replaced. After welding, the repaired sections must be abraded and bare aluminium must be painted with appropriate paint.

Material of the deflector and other casting parts: AlSi7Mg
Filler metal: AlMg5.

4.1.3. Installation

The reversing deflector is installed in a reverse order compared to removing.

Attach the deflector first to the stator with two hex screws. After this attach the loop to the control shaft. Use thread locking compound.

The tightening torque of the screws is 50Nm.

4.2. Control Shafts

The control shaft of the reversing deflector goes through two points of support or lead-throughs: one is in the stern (A), as indicated in figure 4.2-1, and the other one is in the rear flange (B), as indicated in figure 4.2-2. In the support point in the stern, there is a plastic sleeve screwed in the aluminium casting, as well as a shaft seal. The rear flange has only a slide bearing. These parts may wear in the course of time and they should be replaced when necessary.

The lead-through seal in the stern must be checked regularly because if it leaks, it allows water to flow into the engine room.

Figure 4.2-1

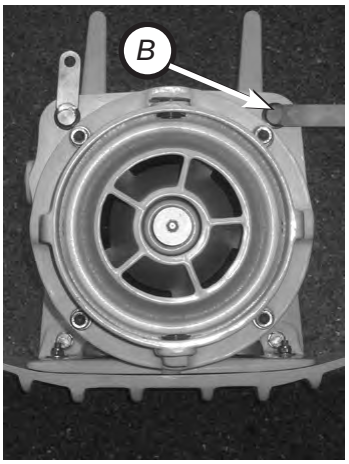


Figure 4.2-2

5. Steering Nozzle and Shafts

5.1. Steering nozzle

5.1.1. Detachment

To remove the steering nozzle, the reversing deflector must be taken off first (section 4.1.1).

The steering nozzle is pivoted to the stator with acid-proof sleeves and two hex screws (A). The steering shaft is attached to the nozzle with loop joints (B), as indicated in figure 5.1.1-1.

Remove the loop at the steering shaft side.

Open the screws and take note of the order of the washers. The free threading on the stator resists screw rotation and, in addition, thread locking has been used in installation, so the screw will not open by hand.

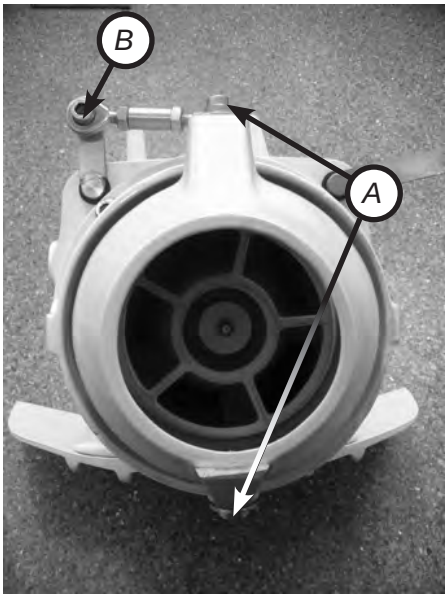


Figure 5.1.1-1

5.1.2. Repair

The wearing parts of the steering nozzle are the hard plastic spacer plates, joint loops and zinc anodes. The parts must be replaced if they have cracks or they are highly worn. The joint does not require lubricating.

The plastic bearings (A) of the steering nozzle joints indicated in figure 5.1.1-2 are attached to the stator. The bearings are removed by using a suitable sleeve and new ones are installed using sealing compound.

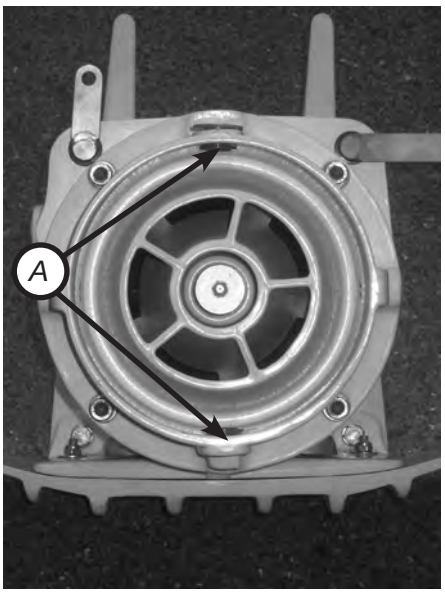


Figure 5.1.1-2

Small cracks on the steering nozzle can be repaired by welding filler metal into the notches. If the steering nozzle's fastening screw brackets or operating lever have broken, they must not be welded, but instead the nozzle must be replaced. After welding, the repaired sections must be abraded and bare aluminium must be painted with appropriate paint.

Material of the deflector and other casting parts: AlSi7Mg
Filler metal: AlMg5.

5.1.3. Installation

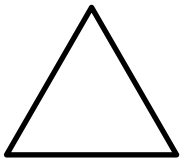
The steering nozzle is installed in a reverse order compared to removing.

Attach the nozzle to the stator first with two hex screws and after that attach the loop to the control shaft. Use thread locking compound.

The tightening torque of the screws is 50Nm.

5.2. Steering Shafts

As the control shaft, the steering shaft goes through two points of support or lead-throughs: one is in the stern, the other is in the rear flange. In the support point in the stern, there is a plastic sleeve screwed in the aluminium casting, as well as a shaft seal. The rear flange has only a slide bearing. These parts may wear in the course of time and they should be replaced when necessary. See pictures in section 4.2.



The lead-through seal in the stern must be checked regularly because if it leaks, it allows water to flow into the engine room.

6. Stator

6.1. Detachment

The boat must be lifted out of the water to remove the stator.

The stator can be removed as one whole with the reversing deflector and the steering nozzle or one part at a time.

6.1.1. Detachment One Part at a Time

First remove the reversing deflector and the steering nozzle (sections 6.1 and 5.1).

Open the stator's four fastening screws as indicated in figure 6.1.1-1.

Carefully crank the stator loose using a screwdriver (figure 6.1.1-2).

Figure 6.1.1-1

Figure 6.1.1-2

6.1.2. Detachment as Whole

Remove the reversing deflector and steering nozzle loop joint at the shaft side.

Open the stator's four fastening screws.

Carefully crank the stator loose using a screwdriver.

Pull the stator, the steering nozzle and the reversing deflector out of their place as one whole.

Figure 6.1.2-1

6.2. Repair

The wearing parts of the stator are the plastic bearings of the steering nozzle (see section 5.1.2), the rear bearing (see section 2.2), and the zinc anode.

Small cracks on the stator can be repaired by welding filler metal into the notches. However, at the ends of the blades this is practically impossible, and there are no guarantees of a durable result.

After welding, the repaired sections must be abraded and bare aluminium must be painted with appropriate paint.

Material of the deflector and other casting parts: AlSi7Mg
Filler metal: AlMg5.

6.3. Installation

The stator is installed in a reverse order compared to removing.

Carefully push the end of the shaft inside the rear bearing housing, then push the stator against the body.

Screw the four tightening screws fingertight, then tighten them evenly to a tightening torque of 50Nm. A small gap is left between the stator and the body, because the end of the propeller duct extends outer than the other parts and corresponds with the stator.

If the deflector and the steering nozzle are attached, just attach the loop joints to the shafts. Otherwise, see installation instructions for the deflector and the steering nozzle in sections 4.1.3 and 5.1.3.

After you have installed the stator, add grease in the rear bearing.
Grease recommendations: appendix 1.

7. Electronic Reversing Deflector Control

The electronic reversing deflector control system has been described in appendix 1.

The main components that the system consists of are #1 a control lever (potentiometer), #3 an electronics unit and #4 a spindle motor.

The electronics unit changes the position of the lever into a signal to to the spindle motor.

The system requires maintenance as all electronic equipment in marine conditions. If there is a malfuction in the equipment, the cause must be determined.

Stages of system check:

1. Check that there is no short circuit anywhere, and that the fuses are intact. Also check that voltage is present in the system.

2. Check the conductivity of all connections by measuring.

3. Check the spindle motor by running it directly with a battery. Connect the + and – wires to the battery terminals and make sure that the spindle motor moves.

4. If the fault has not been detected yet, it is probable that the adjustment potentiometer or the electronic unit is malfunctioning. These components cannot be measured easily, instead they must be tested by trying them.

Replace with a component that definitely works, and test whether the system functions.

7.1. Installation Instructions

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

2. If the water jet unit has already 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 ad justment instructions first.

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

7.2. 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 counter-clockwise.

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 jam med.

- 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.

Appendix 1: RECOMMENDED GREASES AND TIGHTENING TORQUES

Specification of the properties of the greases used for lubricating the bearings in *alamarin-jet* water jet propulsion units

Alamarin-Jet recommends that the greases that are used have the following properties:

- 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.

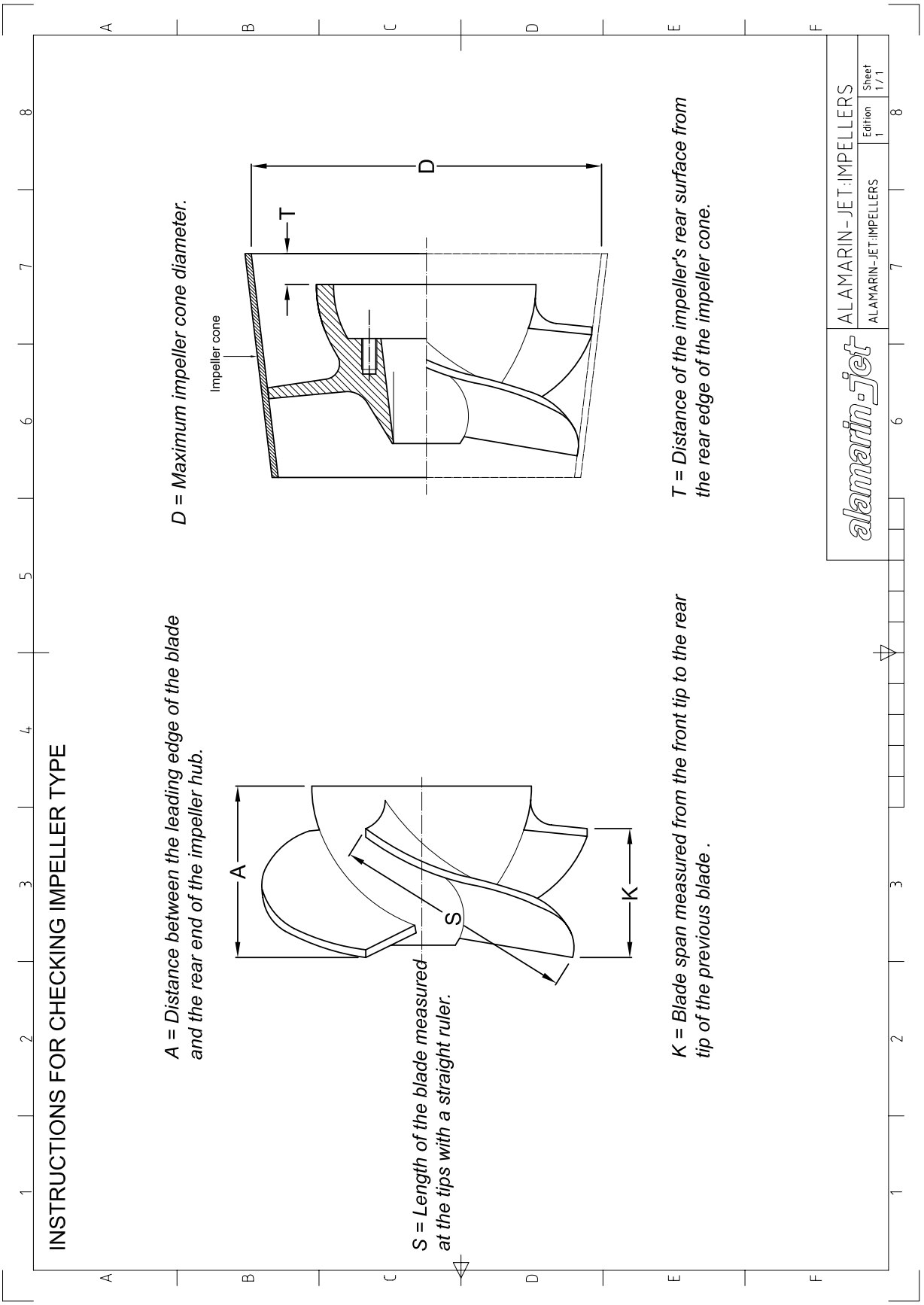
A grease that has equivalent properties to those mentioned above can also be used for lubricating.

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	9.6	34	40
M10	46	67	79
M12	79	115	135

Tightening torques of a strenght class 8.8 screw are used to tighten A4-80 strength class acid-proof screws.

Appendix 2: IMPELLER DIMENSIONS



Appendix 3: ORDERING AN IMPELLER

SPARE PART IMPELLER INFORMATION

If there are no type markings on the impeller, the following information is required for manufacturing a spare part impeller.

1. Engine information

Type: _____

Propulsion (petrol/diesel): _____

Power kW/hv: _____

Number of cylinders:_____

Capacity in litres: _____

Gear box (discount): _____

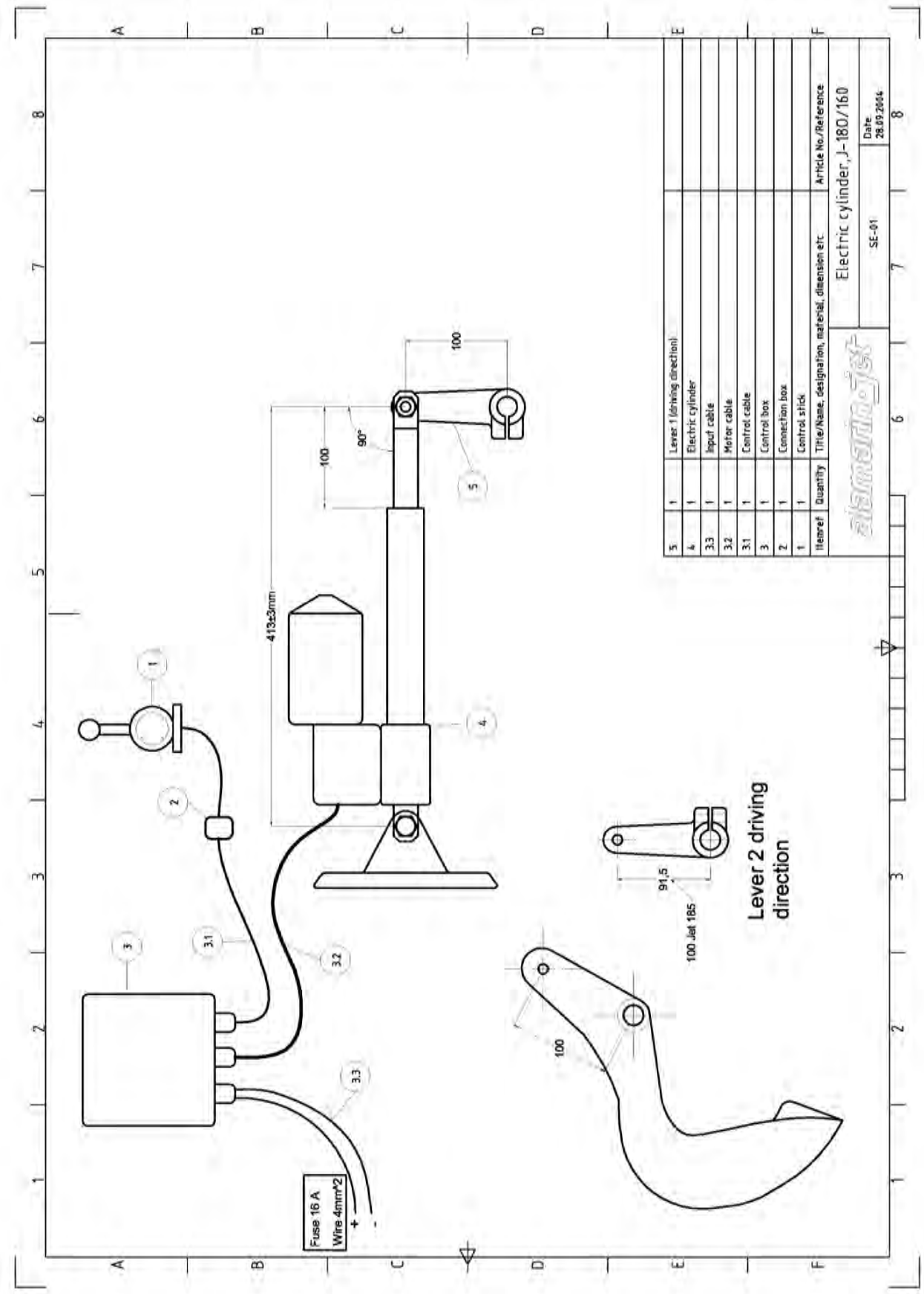
2. Dimensions of the existing impeller

Number of blades =_____pcs

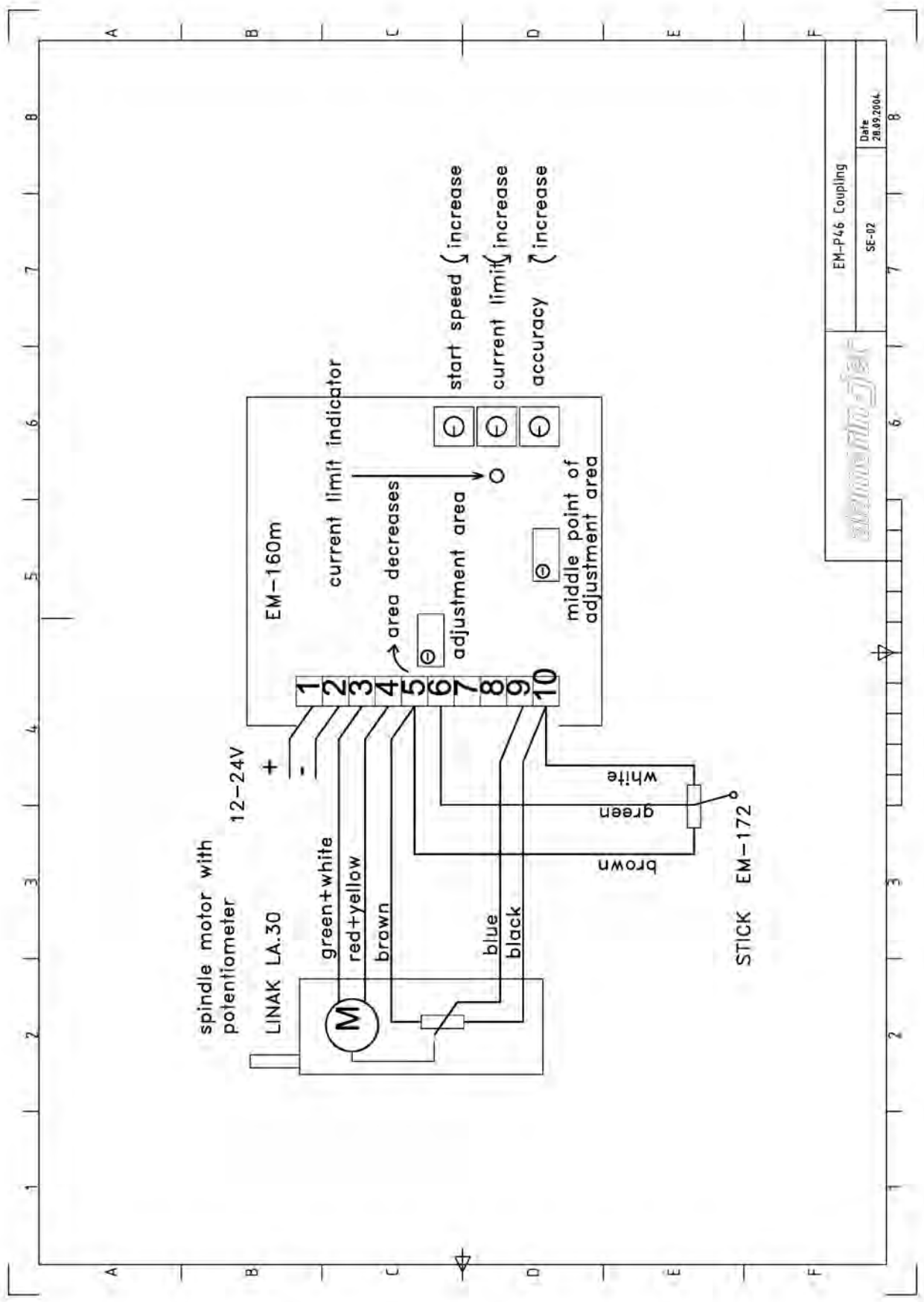
T = _____ mm
D = _____ mm
K = _____ mm
S = _____ mm
A = _____ mm

The measures are explained in a separate file Impeller dimension.pdf.

Appendix 4: SE-01



Appendix 5: SE-02



Appendix 6: 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.