




= 6/5/2007 = DRAFT - GLOBAL 1200

<b>WÄRTSILÄ</b>	Document title: <b>MOUNTING INSTRUCTIONS RETRACTABLE THRUSTER</b>	
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*This instruction will describe the installation of the mechanical part, in this instruction referred as "Thruster".*

For actions marked " \* " presence of a Wärtsilä Propulsion Netherlands B.V. Service Engineer is recommended.

	<ul style="list-style-type: none"><li>• <b>DURING RETRACTION OF THE UNIT, IT IS NOT ALLOWED FOR PERSONEL TO MOVE UNDERNEATH THE STEERING GEARBOX FOUNDATION. NOTIFICATION SIGNS TO THIS EFFECT TO BE PLACED BY THE YARD. SIGNS TO BE PLACED AT THE ENTRANCE OF THE THRUSTERROOM.</b></li></ul>
	<ul style="list-style-type: none"><li>• <b>ELECTRIC WELDING INTRODUCES SPIKES. ALWAYS DISCONNECT THE MAINS AND BACK-UP POWER SUPPLIES TO THE ELECTRONIC CABINET OR TO COMPONENTS CLOSE TO THE WELDING AREA.</b></li><li>• <b>DO NOT USE CONTROL PANELS OR ELECTRICAL CABINETS AS AN EARTH POINT WHEN WELDING, THIS CAN CAUSE DAMAGE TO ELECTRICAL COMPONENTS.</b></li><li>• <b>IF WELDING IS TO BE CARRIED OUT TO THE STEERABLE PART OF THE THRUSTER, ALWAYS PROVIDE FOR AN ADEQUATE EARTHING. THIS EARTHING IS TO BE PLACED AS CLOSE AS POSSIBLE TO THE WELDING AREA TO AVOID DAMAGE TO INTERNAL PARTS BY CURRENT PASSING THROUGH BEARINGS, TOLERANCED FITS, ETC.</b></li><li>• <b>WHEN WELDING PROTECT THE SURROUNDING FROM WELDING SPATTERS.</b></li></ul>

This is a guideline for installation and alignment of the thruster. Sequence of certain steps can be changed depending on situation on board of the vessel.

According to the submitted handling plan, the yard will make temporary cut-out on the freeboard deck and weld a habitat to the outside shell. All thruster part, except propeller gearbox, propeller and nozzle, will be lifted into the freeboard deck through the openings cut on work deck. Propeller gearbox, propeller and nozzle are to be installed in dry dock after the habitat is removed.

After installation of bottom plate the habitat will be accessible through two manholes cut in each thruster well

Due to alignment purposes it is necessary to have a hydraulic power pack available.


The assembled parts are preserved for a limited period, **but not filled with oil.**

All loose delivered items are packed up in cases and/or boxes or on skids. Each package will have identification marks as listed in the packing lists, and on several packages such a packing list will be attached.

The received goods should directly after receipt be compared with the packing lists.

Any damage found or missing parts should be reported to Wärtsilä Propulsion Netherlands B.V. as soon as possible, with a full description of the extent of the damage or type and number of the missing equipment.

All packed parts are situated in boxes or cases, which are suitable for lifting by forklift and/or hoisting by crane. Any limitation of the lifting fitness of a package is marked on the outside of the package. Care should be taken to attach the hoisting chains/wide slings in the correct position/at the correct lifting lugs/eyes.

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### Preparatory actions

- a When the thrusters parts are lifted into the freeboard deck through the openings cut on work deck shift the parts to allocated locations.
- b. Lower the underwater guides connecting plates (pos. 6 and 19- drwg. W084851507), hull brackets and bolts/nuts by chain block into the habitat.
- c Also lower the thrust beam (pos. 1 drwg. W084851507 –1200 kg.) in the habitat. The guide bush pos. 3 and guide pads pos. 17 are already mounted. But pads pos.17 are not yet fixed by location pins pos.16.

**Note:** After installing the bottom plate the thruster well / habitat is only accessible through two manholes cut in the thrusters well.

### Placing sealing profile

(See step by step mounting instruction: W084850409)

#### Step 1

Paint well counter flange surface with Philadelphia Phillyclad 1000 or equivalent, not WPNL supply (to accommodate the epoxy resin).  
Place sealing profile according dwg. W084849830 on top of the ships structure (free space between deck cut-out and sealing profile is approx. 20 mm). Place fastening strips in to the sealing profile and copy holes (dia ø9 mm). Remove the fastening strips and enlarge the holes up to ø12 mm. Place distance bushes into the sealing profile and copy these holes onto the ships structure. Drill and tap threaded holes M8 into the ships structure. Remove the sealing profile and thoroughly clean the ships structure. Mount the sealing profile with the by WPNL supplied fasteners. Apply grease on top rubber sealing surface to **reduce friction at aligning**.  
Make sure that length of stud bolts inside sealing profile will not hit on foundation plate after compressing the seal.  
Finally place rubber damming on top of the ships structure according dwg. W084849830.

### Mounting the thruster mounting plate


#### Step 2

Bottom plate is supplied final machined and painted. For details of bottom section see dwg. W084849830. Great care should be taken that the centrelines of the mounting plate and therefore of the whole thruster, the underwater guide tubes and the guide rods are parallel and that they only have a minimal angular deviation in relation to the theoretical centreline

Shift the bottom plate (5120 kg.) to the well and lower it onto the well counter flange. For location and orientation of the bottom plates see arrangement dwg. W084848682 sh.2)  
Provide to the requested clearance, needed for the chockfast, between well counter-flange and the bottom section by means of jack-screws, not WPNL supply, mounted into the threaded holes provided in the bottom section. Use anti seize on jack screws.  
Pre-drill undersized holes in well counter flange (use M16 bolts) for about half the number of bolts normal to be used. Note: surfaces to be cleaned with compressed air. Apply tension/compression on rubber sealing profile to obtain required thickness of chockfast. (32 mm. ±2 mm.) Also apply at least 2 horizontal jack screws at each side of base plate.

Dismount items 2, 5, 6, 8, 10, 11, 13 of guiding column dwg. W084826116 (lowest bearing housing) and mount them on the mounting plate at the position shown in detail E with Ø 200. Do not apply the torque given in instruction 2050443 and do not mount the dowel pins until this is mentioned in this mounting description.

Clean bearing surfaces (belonging to Ø 333 H7) on mounting plate as shown in detail E on drawing W084849787 and the surfaces on underwater guide columns (item 18 on drwg. W084851507). Mount o-ring (item 5 on dwg. W084851507) with some grease.  
Lower guide tube in the well closing plate; do not fasten bolts yet. Note that the two tubes are somewhat different in shape. One of the columns has flat sides which will correspond with the

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thrust beam. It is therefore imperative that the guide columns are mounted on the correct position on the mounting plate as shown in drawings W084848682 and W084851507. The guide column which can take the full reaction force (the fully round one) is normally situated at the most ridged position in the ship.

### **Removing the brackets from stem section (dwg. W084827989 )**


Check o-ring ( pos. 94 on dwg. W084849906) for damage and apply some grease. Also check the stud bolts fixed in the bottom section. Remove protective material attached to the stainless steel surface of the support pipe and clean the surface.

Shift the stem section, including steering gearbox foundation, to the well. The weld-on lifting lugs, in pairs, on top of the gearbox foundation have been designed to take the full load of the thruster.

To have sufficient height under the gearbox foundation for mounting the gland seal into the bottom plate, place two approx. 1,5 m. high blocks on top of the bottom section to temporary support the steering-gearbox foundation.

Chain (twin) to be connected to the lifting lugs on the hoisting brackets on the steering gearbox foundation (dwg. W084827989). **Use equaliser** for easy handling. The chains should be capable of carrying the complete unit weight (23500 kgs.). Moreover care should be taken that hydraulic piping and components are not damaged during heeling over.

Apply tension on the chains in such way that the upper transport brackets do not carry the thruster anymore. Bring the thruster unit in vertical position at such a height that the lower brackets do not support the stem section any more (take care to keep the chains free from the thruster). Remove brackets (pos.1, 3,4,5,6,7 ) by loosening the fasteners. Do not dismount protection cover intermediate shaft yet.

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### **\*Mounting of stem section into the ship (including gearbox foundation)**

#### **Step 3**

The gearbox foundation ( dwg. W084849828 ) and stem section (dwg. W084849906), with upper gearbox on of top of the steering gearbox, is shipped as one complete unit. The openings at lower side are closed by means of transport covers. The three (3) steering units (hydraulic motor/reduction gearbox) and the azimuth feed-back unit are ready mounted on the steering gearbox.

Clean the contacting surface of the gland housing recess in the bottom plate (detail D, dwg. W084849787). Also clean the contacting surface of the gland housing.

Lift the topside of the thrusters and remove the transport bracket. Then lift the lower end to remove the transport bracket.

Bring the stem section with gearbox foundation above the bottom plate and manoeuvre the steering pipe through gland housing hole in the bottom plate. Let the stem section rest on the 1500 mm high blocks. Now mount the stuffing box, part of the stem section, on the bottom section. First smear bearing surface of mounting plate at the position where the gland housing will be placed with Loctite 574. Loosen gland to allow easy retraction during aligning/retraction of the unit.

Before the stud bolts of the mounting plate enter the holes of the watertight gland housing, the stem section has to be in the correct position as shown in drawing W084848682. Tighten the nuts (before unit is completely lowered) so the gland is fixed on the mounting plate.

Now 1500 mm. blocks can be removed and stem section lowered completely resting on distance blocks of about 250 mm. high.

### **Placing guide rods (see W084826116)**

#### **Step 4**

Items 2, 5, 6, 8, 10, 11, 13 of guide column dwg. W084826116 (lowest bearing housing) where already dismounted at step 2 and mounted on the mounting plate. Insert the guide rods through the steering gearbox foundation into lowest bearing housing (clearance between bearing and guide bushes: 2 mm.) as shown in step 4. Mount split rings pos. 5 again. Remove distance blocks of 250 mm.

Move unit several times up and down and align the guide columns in such a way that foundation in highest position uses both bearing housing as a stop, and in lowest position both split ring supports the foundation via the bearing housings. Nominal thickness split rings is 25 mm. (see dwg.W084851507)

Do not mount the dowel pins and do not lock fasteners yet (pos.9,10,11 of drw. W084826116)

Check for position of unit when completely down (centreline, baseline, height etc.).

Fill the bearing with grease at item 12 on dwg. W084826116 as shown on this drawing.


#### **Step 5**

Now lift the underwater guide column into the steering gearbox foundation frame for about 450 mm. (use hoisting eyes M 16) to make room for mounting the thrust beam. Lock position underwater guide column by e. g. a flat bar or blocks and bring in thrust beam (item 1 of W084851507) into position in the ships well. (several hoisting eyes are situated underneath well closing plate to accommodate easy handling.)

Apply Molycote CU-7439 or equivalent on the outside of the two columns with exception of the stainless steel parts, which must be covered, with a thin layer of copaslip (item 20) or equivalent. Also apply a thin layer of copaslip or equivalent on the bronze bushing on the support pipe. Mount thrust beam (item 1 on dwg. W084851507) as shown on drawing. Items 3 and 17 should already be mounted. The alignment of the guide rod with the flat sides is dependent of position of items 17 on dwg. W084849906. Now connect the two halves of thrust beam and mount connecting plates (item 14). Before mounting connection plates apply some flange sealant between the adjacent faces of the thrust beam.

Now the guide tubes can be lowered and positioned and temporarily fastened. (4 x M16 –item 10). Align the guide rods in such a way that the gap on both sides of item 17 is of the same size. If the guide rods are aligned fixate the guide rods with the dowel pin item 11.

Drill through dia. 8H7, and torque and lock with Loctite connecting bolts item 10 of W084851507.

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Do not mount the dowel pins at lower side and do not lock fasteners yet (items 9, 16, 21) Check for position of unit when completely down (centreline, baseline, height etc.).

#### **Step 6**

Retract unit fully by means of (chain) hoist until steering gearbox foundation hits upper bearing housings or gland will hit foundation plate. Lock and secure unit in this position e.g. by means of angle bars (4 of same length) over guide columns –between lower bearing housings and gearbox foundation or use distance blocks. Temporarily mount the brackets (yard supply) onto the columns in a way that the exact height of 4658 mm. as shown on dwg. W084826116 is reached. Do not finally mount the brackets to the ship's foundation until the final alignment is made (see step 7) and the spacer plate (yard supply) between the brackets and the foundation is machined to the right thickness.

Place the hydraulic cylinders in the guide tubes as shown on dwg. W084826341.  
Torque and lock with Loctite connecting bolts item 3 of W084826341.

Have a hydraulic system installed in order to lift unit. A simple yard supplied hydraulic power pack at this stage is the most obvious because no extra connections to the steering system have to be made. The power pack must be provided with additional filters, **safety valves with correct settings** and counter balance valves (non-return valves), using an allowed type of oil (For retraction ISO 46 ). Above-mentioned valves are necessary for safe operation of the retraction system. Always use clean oil (max pollution for hydraulics steering/retraction system 15/12 acc. ISO 4406) and make sure that all material used for filling is cleaned before the filling takes place.

The units must be connected as shown on the hydraulic diagrams with the prescribed pipe diameters. The units to be linked will be supplied with pipe connections suitable for these pipe diameters.

Pressurise cylinder. Items 2 and 6 (dwg. W084826341) should be dismantled. Check position of cylinders in steering gearbox foundation. Reposition top of guiding columns with chain hoist in order to guide-in cylinder into steering gearbox foundation.

Lift thruster unit with chain hoist for about 30 mm. Compensate by means distance blocks. Check distances between thruster mounting plate and lower split rings (to be equal between PS and SB side. Thickness of spacer plate item 3 (WPNL supply) is nom. 25 mm / pre-machined 30 mm. If all within alignment possibilities then continue.

Bring unit up (full stroke) by means of chain hoist.

Push up cylinders and check if cylinders are centred correctly into steering gearbox foundation. Re-position steering gearbox foundation if necessary ( 3 mm run out in top position is allowed). Correct positions of top bearing pots at guide rods.


Drill holes in brackets. Secure bearing pot to bracket and bracket to sub frame (if applicable) Spacer (yard supply) could be fully welded against the main frame.

Now first lower hydraulic cylinders and mount item 2 of W084826341 to cylinder and unit can be lowered into working position onto the split rings. Connect hydraulic cylinders to Steering gearbox foundation with locking plates (see dwg. W084826341, item 4 and 6). The sliding surfaces of item 2 and 6 must be greased. The cylinder was already pre-assembled by WPNL so gap should be OK.

Check the total stroke of the unit. Take into consideration what is the lowest and highest position of the unit and decide on which split ring to correct in order to have a good working position and correct stroke. The split rings have a thickness of 30 mm pre-machined. Rings must be machined to obtain a retraction stroke of 3200 mm + 10 mm extra to create space for moving the safety hooks. After safety hooks are actuated the unit will descend this 10 mm. Nominal thickness of split spacer rings is 25 mm. Split rings on the bottom have to be machined in such a way that the motor foundation is resting on both rings.

Note: The hydraulic cylinder should always be **free from the cylinder bottom** in the lowest position to avoid direct forces on this bottom cover.

Bring unit up and machine top split rings of the motor foundation (possibly under angle) for proper touching contact when unit is completely up.

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Position hooks so that unit is resting when lowered about 10 mm (2 mm. tolerance, but must be equal at both sides). For safety hooks assembly, see dwg. 3001450.

For correct position and assembly of safety hooks see dwg. W084848682. For proper adjustment of the hooks, use spacer plates. Spacer could have been prepared with pre-drilled holes. Spacer plates and fasteners are yard supply.

### Step 7

Mount "connecting plates" items 6 and 19 of W084851507 at the lower end of each guide. Use a nylon bush (temporary replacement for bush pos 12, dwg. W084851507) to fix the guide columns during mounting (see also note on dwg. W084851507).

Temporarily fasten and align connection plates to the ships structure by using M16 bolts and nuts in pre drilled holes of dia. 18. Now retract and lower unit several times and align guide tubes/connecting plates correctly now. Also check on position on guide fingers (item 17 of W084851507) and check stroke (3200+10) and nominal free distance of 45 mm. between connecting plates and boss of item 3/19.

On top and bottom side of the steering gearbox foundation, split pre-machined spacer rings are mounted (dwg. W084849828, item 3). Check if the unit is seated properly on the lower split rings (min. 70%).

#### Pouring of resin

Then the resin can be poured under the mounting plate. (see dwg. W084849830; sealing section thruster"). Note that pouring should be done in one piece and to be watertight. (no compartments) and that all bolts and setscrews are properly protected so they can be easily removed. Use release agent on mounting plate. Cast according instructions, if needed with the assistance of a representative of the resin. Resin should be poured so that the space between the mounting plate and the counter flange is completely filled. **(for instructions of pouring Chockfast see "Installation procedure for watertight Thruster foundation using Chockfast Orange" instr. nr.2017276)**

Dowel pins for retaining the position have to be installed. Use one hole in each corner of the thruster mounting plate (4x), pre-drilled dia. 27 mm. These holes must be drilled and reamed to suit a dowel. Dowels are yard supply. Spray dowels with release agent and mount them into thruster mounting plate and well mounting flange.

After resin is cured, bolts of well closing plate can be **tightened to torque given by resin manufacturer.**

Lower the thrusters and make sure that the sleeves of thrust cross slide smoothly over the guide columns. Check the lower point of support for proper mounting and position. Now weld the connecting plates (items 6 and 19, dwg W084851507) to the brackets welded to the ship's structure.

Check alignment by applying pressure to the cylinders and moving the steering gearbox foundation (and stem section) up and down.

At last lower the thruster into working position and remove one of the nylon bushes which must be replaced by a stainless steel ring (pos 12, dwg. W084851507). The stainless steel ring (see dwg. W084851506) is supplied with an oversized outside diameter. Determine the eccentricity of the guide column in relation to the hole diameter of the adapter bush welded into the connection plate. Apply four equally divided position marks on both adapter bush and stainless steel ring and take the measure of the distance between guide column and the fitted hole of the adapter bush. Also check for squareness of the guide column compared with the fitted hole in the adapter bush.


Machine the stainless steel ring to the prescribed outside diameter reckon with the measure of eccentricity and squareness (see notes on dwg. W084851506 and W084851507).

After final machining mount the stainless steel ring in the adapter bush (note the positioning marks).

Repeat this procedure for the second stainless steel ring at the other side.

Move the thrusters a few times up and down to check the mechanism on proper working.

General: The stainless steel carrier pipe should be protected at all times against welding sparks, paint, dirt etc. Special care is to be taken with retraction cylinders. Guiding columns to be greased and protected at all times and to be cleaned before every lifting or lowering of the

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unit.

Note that usually during alignment ship is still being built and heavy parts / equipment is installed. This is affecting alignment and it should always be kept in mind.

Final drilling of dowel pin holes in guide rod foundation (up and down) can best be drilled and reamed after launching the ship.

### **Mounting the propeller gearbox assembly**

To continue with the mounting of the propeller gearbox and nozzle, the ship must be in the dock and the habitat removed.

Dismount propeller from propeller gearbox (for transported situation see W084827989) preferable in a workshop. Mark propeller and locking plates to the related thruster. Dismount fairing cover pos. 30 of propeller gearbox (see dwg.3003898). Disconnect liner and secure liner to seal housing (pos. 55).

The propeller is temporarily mounted. This means that the propeller is fitted with a small pressure as described in items 1 to 6 in instruction 2006192. The liner of the seal is also temporarily mounted to the propeller boss. This means that the bolts which connect the liner to the propeller boss (item 69 on dwg. 3003898) is fastened without applying torque or locking wire. Also the locking ring (item 2 on dwg. 3004121) is temporarily fitted but not locked. Dismount acc. dwg. 3004121. For propeller ass'y see 3004122. Use pumpset acc. 2050610. (delivered with aft thrusters )

To dismount the propeller, first dismount the bolts of the liner (item 69 on dwg. 3003898) then a pressure has to be applied between the shaft and the boss until the propeller shifts loose. After that the locking ring (item 2 on dwg. 3004121) can be dismounted and the propeller can be taken of the propeller shaft. Mount hoisting plate (items 18 and 19 on dwg. W084827989) on the forward side of the propeller hub.

Seal off opening between liner and propeller with tape. Protect propeller shaft-taper against damages and dirt.

Dismount heel (skeg) pos.2 -see nozzle ass'y acc.W084823105.

Dismount upper and lower flanges from nozzle -see dwg.W084849811 and nozzle ass'y W084823105. Note that dowels are numbered to their related hole and care should be taken to prevent problems at assembly. *Mark parts to the related thrusters*

Bring propeller gearbox , propeller, nozzle and upper and lower flanges of nozzle and heel (skeg) pos. 2 of W084823105, into or near the thruster well flat on the dock floor. Great care must be taken to protect items against dirt, moisture grit blasting etc.


Check now if positions of the steering pipe do correspond with the retraction/parking position, if not turn the steering pipe by operating the hydraulic system with the hand operated valve of the hydraulic aggregate. If there is no power/aggregate available use a wrench and a strip (#70x5, L=38 mm) on top of the planetary reduction gear (one hydraulic motor has to be removed and other openings of hydraulic motors must not be closed off) until the positions do correspond. Test proximity switch (24VDC) on correct working. See detail of proximity switch on Stem section W084849906 at 0° azimuth.

The propeller gearbox has remained in the status it was left in after unloading. Special hoisting bracket (item 20 of dwg. W084827989) is already mounted around the shank of the unit.

Note: The set of transport parts should be kept on board of the vessel for use in case of removal/repair of the propeller gearbox.

#### **Step 8**

Remove the cover item 105 that protects the opening at the top of the shank and clean the contact area of the latter. Mount the o-ring (item 7 of shank ass'y dwg. 3004165)

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The total weight of the propeller gearbox ass'y is approximately 13500 kgs. And the weight of just the propeller gearbox is approximately 4500 kg.

Remove cover, on the bottom side of the stem section, which is protecting the intermediate shaft (item 12 of dwg. W084827989).

Retract the stem section as far as practical so that the propeller gearbox can be mounted. Lift/move the propeller gearbox assembly to the mounting position as shown, under the stem section and clean the faces of both flanges to be mated. Make sure that the vertical intermediate shaft is hanging in one centreline with the steering gearbox. Also make sure that the flanges of steering pipe and shank are parallel and aligned concentric. Use some grease on the outside of tooth coupling of the vertical-intermediate shaft.

Check whether no irregularities have entered the shank. Apply flange sealant (Loctite 574 - part number T002014948) between the o-ring and the stud bolts on top flange of shank.

It is of paramount importance to align the two loose parts (the stem section and the propeller gearbox assembly) before moving the unit any further.

Hoist propeller gearbox assembly carefully until the vertical- intermediate shaft is just resting on the pinion shaft of the propeller gearbox. Now turn the input flange of the upper gearbox or turn propeller-shaft until the teeth of the gear coupling mate and the oil pipe item 2 of shank assembly 3004165 will mate with corresponding hole in steering pipe flange. Now the assembly can be hoisted further, continuously verifying that the flanges of steering pipe and shank remain parallel and concentric is very important that the stud bolts and the hydraulic oil pipe (dwg. 3004165 item 2; apply some oil) shift smoothly into the steering pipe. At first the propeller gearbox assembly will move without taking the intermediate shaft upwards, but at a certain stage the shaft will reach its end position on the pinion of the propeller gearbox and then the intermediate shaft will move along with the propeller gearbox assembly. Before tightening the nuts completely the propeller-shaft should be turned by hand to make sure that the drive gear is running properly.

When the above is checked and the propeller shaft can be turned without real effort, all the original nuts item 4 of shank ass'y are applied and tightened to the torque value indicated on the drawing (see also torque manual 2050443). Use anti-seize on thread. The nuts are to be secured with locking wire welded over the nuts. The hoisting straps and the hoisting bracket on the shank can now be removed and stored on board of the vessel. Lower the stem section and lower gearbox at the approximate position as shown in step 7. Place the nozzle in the position as shown in step

#### **Step 9**

Move and hoist the nozzle as shown in step 9. Hoist the propeller into place and lower the propeller gearbox in such a way that the propeller can be finally mounted. Protect, support and secure the tips of the propeller with wood between the nozzle and the propeller.


#### **Step 10 and 11**

Mount propeller again. Beware of o-ring between prop. hub and bush on prop. shaft. Propeller ass'y acc. dwg. 3004122 according final mounting step 2. Use already machined locking plate as template for push up distance. For push-up distance see diagram on dwg 3004121.

Minimum start point load for hydraulic nut HMV 45 is approx. 40 bar. Maximum press. to be expected is about 450 bar. Injection pressure to expected between 1000 and 1100 bar. Use pumpset acc. 2050610 (WPNL supply, delivered with aft thruster). Check if possible propeller shaft seal by applying compressed air of 0, 2 bar. on the unit. (seal of all other openings). Also check if the propeller shaft seal compartments are still filled with oil.

Mount the loose upper nozzle flange to outside pitch circle of the steering pipe with 16 fitted bolts (item 14 of W084823105) and one hex. bolt (item 28). Torque M30 bolts of the upper nozzle flange with 1200 Nm. (see dwg. W084823105 and W084849811). Note that dowels are numbered to their related hole. Seal off dowel with hex. plugs and holes with silicon kit. Also mount items 31 and 32. See all related marks on ass'y dwg. W084823105. Mount the skeg,



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item 2 as shown on dwg. W084823105.

Bring lower nozzle flange into the thruster well and mount it onto nozzle and skeg. Mount pintle and cover plate. Lock all items acc. assembly drawing.

### **Aligning and mounting of the quick connect clutch**

#### **Step 12**

At this stage the ship is still in dock.

Bring main e-motor in thruster room on related foundation.

Provide provisional alignment with upper gearbox.

Mount floating shaft in position as per drawing W084849804 sh1 and approximately position (no chockfast yet) the air operated engaging / disengaging mechanism as per drawing W084849804 sh2.

Test quick connect clutch by using compressed air and movement by hand force. Install a pipeline from the vessel's compressed air system to the clutch control panel, drawing W084849590. Air supply: dry and clean air, min. 7 bar (102 psi), max. 15 bar - 220 psi).

#### **Launching of the vessel.**

After applying some water resistant grease on the underwater guides and a final inspection on painting, (paint repair set is delivered by WPNL) and after removal of the additional hoisting eye's on the nozzle entrance diameter (if not removed these hoisting eye's will cause cavitations on the propeller and nozzle) the unit can be retracted and locked and is ready for launching. If during the launching g-forces occur of more than 1 x G, the unit must be protected adequately; for instructions contact WPNL Thrusters.

After launching the height of the rings should be checked (ref. step 6) and dowels should be reamed and mounted into bearing housings of the guide columns.

### **Final alignment and mounting of thruster**

At this stage the ship is afloat and has sufficient bottom clearance to fully lower the thruster.

Check the alignment by retracting the unit several times.

Provide proper alignment of the E-motor with the upper gearbox. Laser alignment is recommended. Finally the E-motor can be mechanical mounted. Test quick connect clutch by using compressed air and movement by hand force.

Final drilling of off dowel pins in guide rod foundation (up and down) can best be drilled and reamed at this stage.

Testing of the steering system can now be done with the unit fully extended. This must be done when the vessel is afloat using the hydr. power unit. For hydraulic diagram see W084849552.

After test turn steering pipe to parking position. See detail of proximity switch on stem section W084849906 at 0° azimuth.


#### **Setting of limit switches**

A total of four limit switches are mounted on the unit. Limit switches to be placed in correct position. The four switches are mounted on the safety hooks, one for "hooks out" and one for "hooks in" on both hooks.

Retraction position measurement sensor to be hooked up as per drawing PAAI000877. Note the max. length of the wire. If required it needs to be extended to suit the total retraction way.

#### **Safety precautions**

During retraction of the unit, it is not allowed for personnel to move underneath the motor foundation. Notification signs to this effect to be placed by the yard. Signs to be placed at the entrance of the thruster room.

<b>WÄRTSILÄ</b>	Document title: <b>MOUNTING INSTRUCTIONS STEERABLE THRUSTER</b>			
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After applying some water-resistant grease on the underwater guides the unit can be retracted and locked and is ready for launching. If during the launching g-forces occur of more than 1 x G, the unit must be protected adequately.

This is a guideline for installation and alignment of the thruster and will be part of the final instruction manual.

Sequence of certain steps can be changed depending on situation on board of the vessel.

### **Connecting the electric components of the thrusters unit**

Connect the speed pick-up sensor terminal box, which is located between input flange and upper gearbox.

The other components should also be connected (hydraulic unit and lube oil tank) acc. cable connect diagram (see separate instructions).

### **Acceptance (tests) and release for use**

The thruster unit has been completely pressure-tested in the Drunen workshop; therefore the only connection still to be tested is that between the steering pipe flange and the shank.

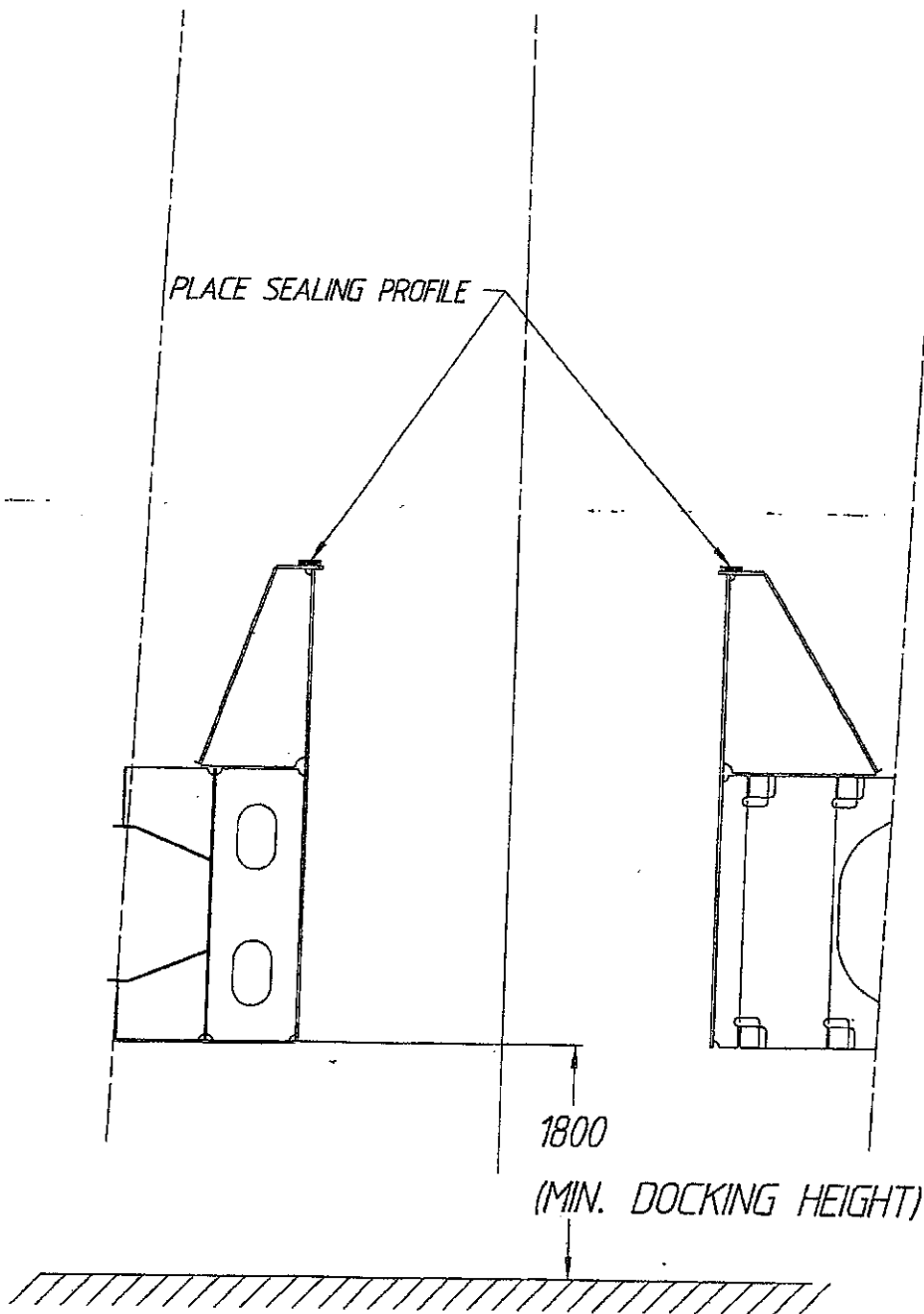
This is achieved by applying air pressure (50 kPa, 0, 5 bar).

Note: For pressure testing normal available air pressure can be used through a reducing valve. The areas to be tested can be checked by a soap solution or the dye-penetrant agent supplied. When no leaks are found the air connections and blinding plugs are removed.

W084850409 - step 1

# PLACING SEALING PROFILE

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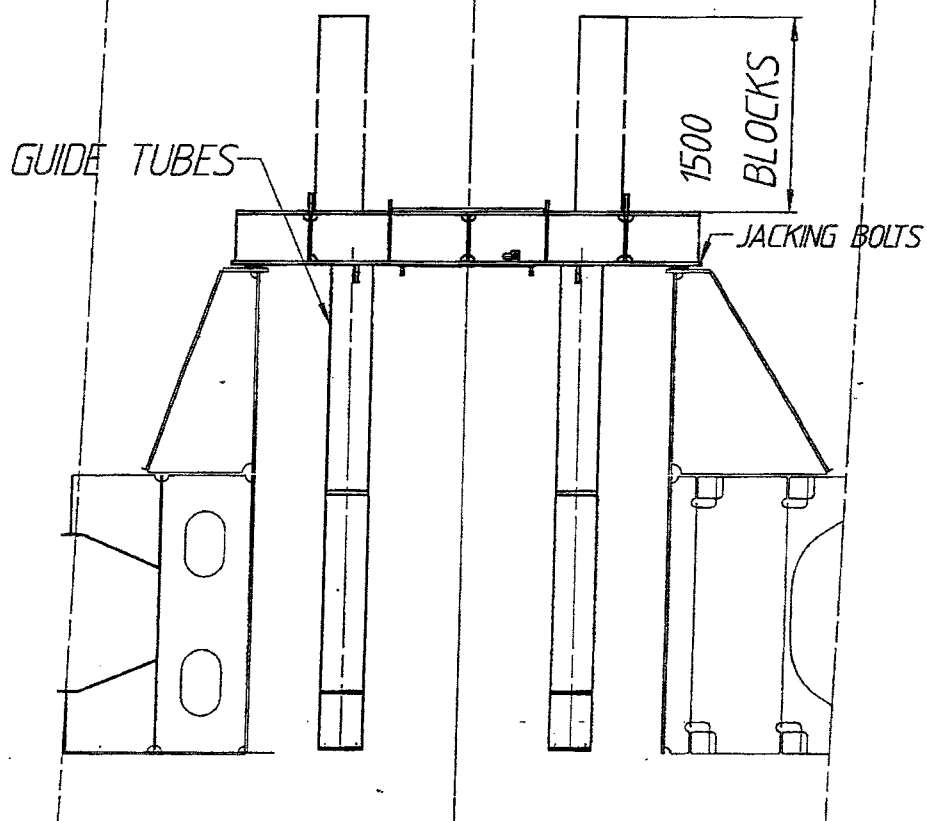
2006-06-14

MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 2

WÄRTSILÄ  
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PLACING FOUNDATION PLATE  
PRELIMINARY MOUNTING UNDERWATER GUIDE TUBES



SCALE 1 : 50

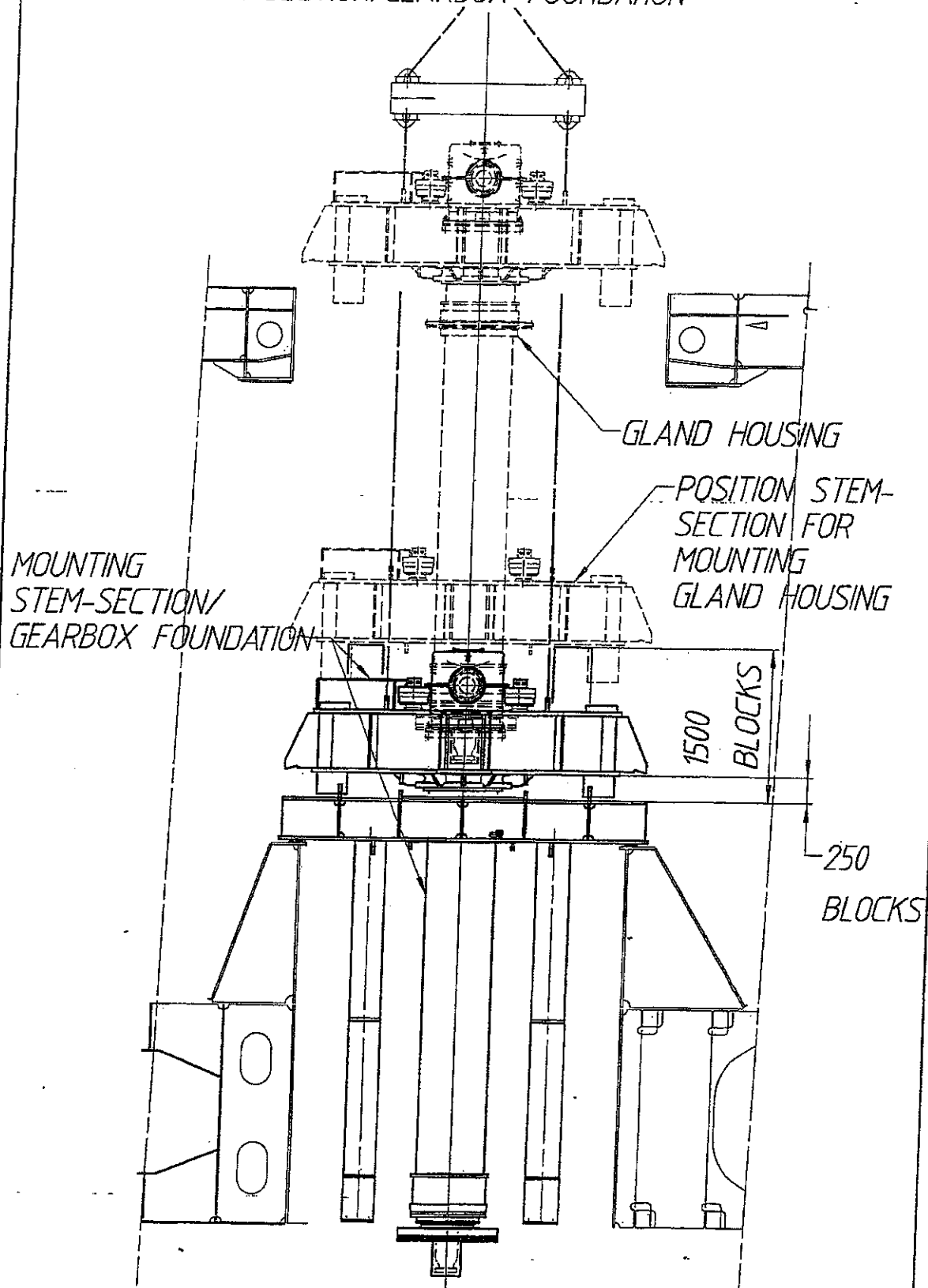
2006-06-14

MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 3

WÄRTSILÄ  
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# MOUNTING STEM-SECTION/GEARBOX FOUNDATION



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MOUNTING SEQUENCE FS1510-350/1530 MNR

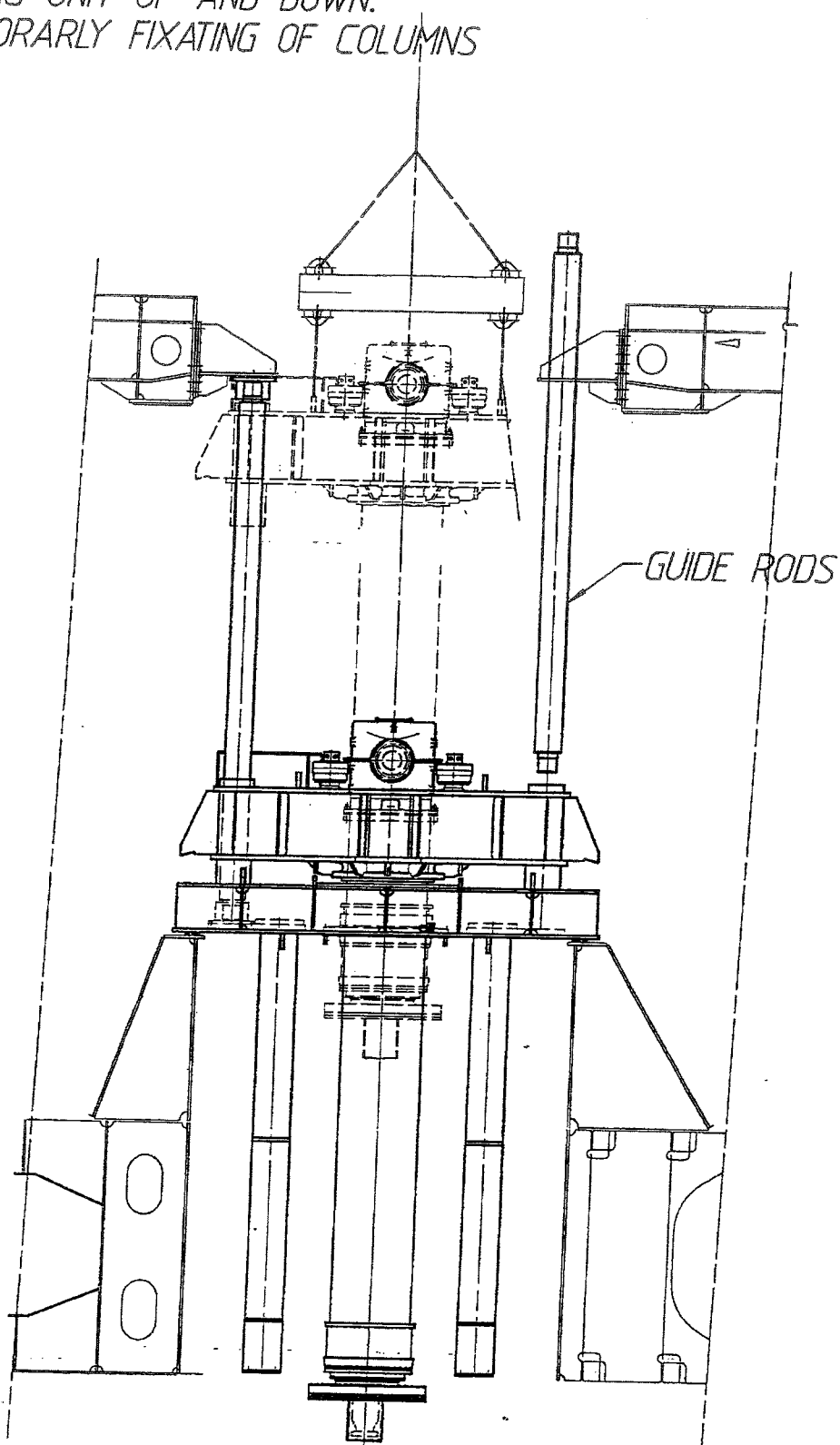
W084850409 - step 4

**WÄRTSILÄ**  
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PLACING GUIDE RODS

MOVING UNIT UP AND DOWN.

TEMPORARILY FIXATING OF COLUMNS



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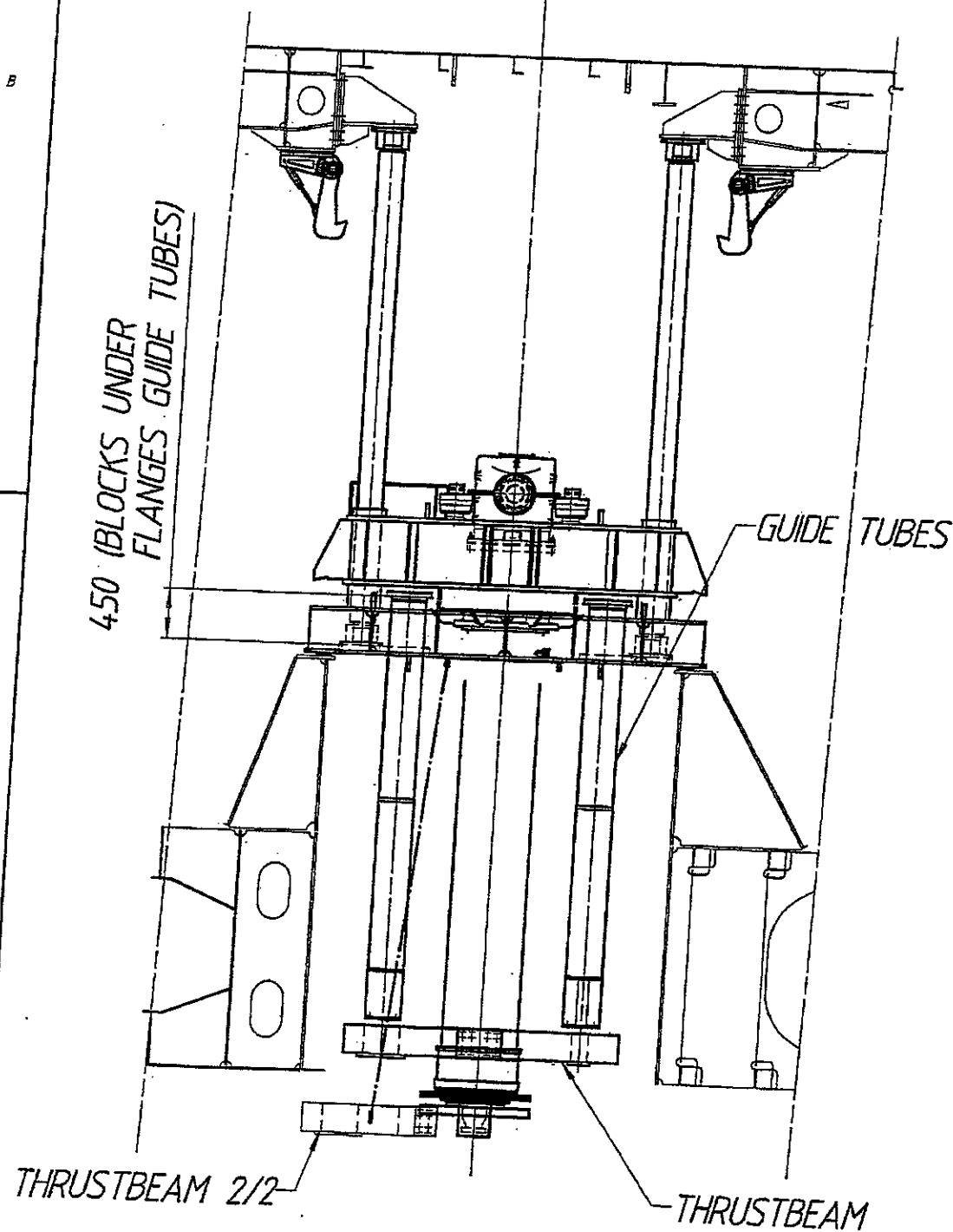
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MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 5

**WÄRTSILÄ**  
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LIFTING GUIDE TUBES FOR ABOUT 450 mm.  
MOUNTING OF THRUSTBEAM.  
FINAL MOUNTING GUIDE TUBES.



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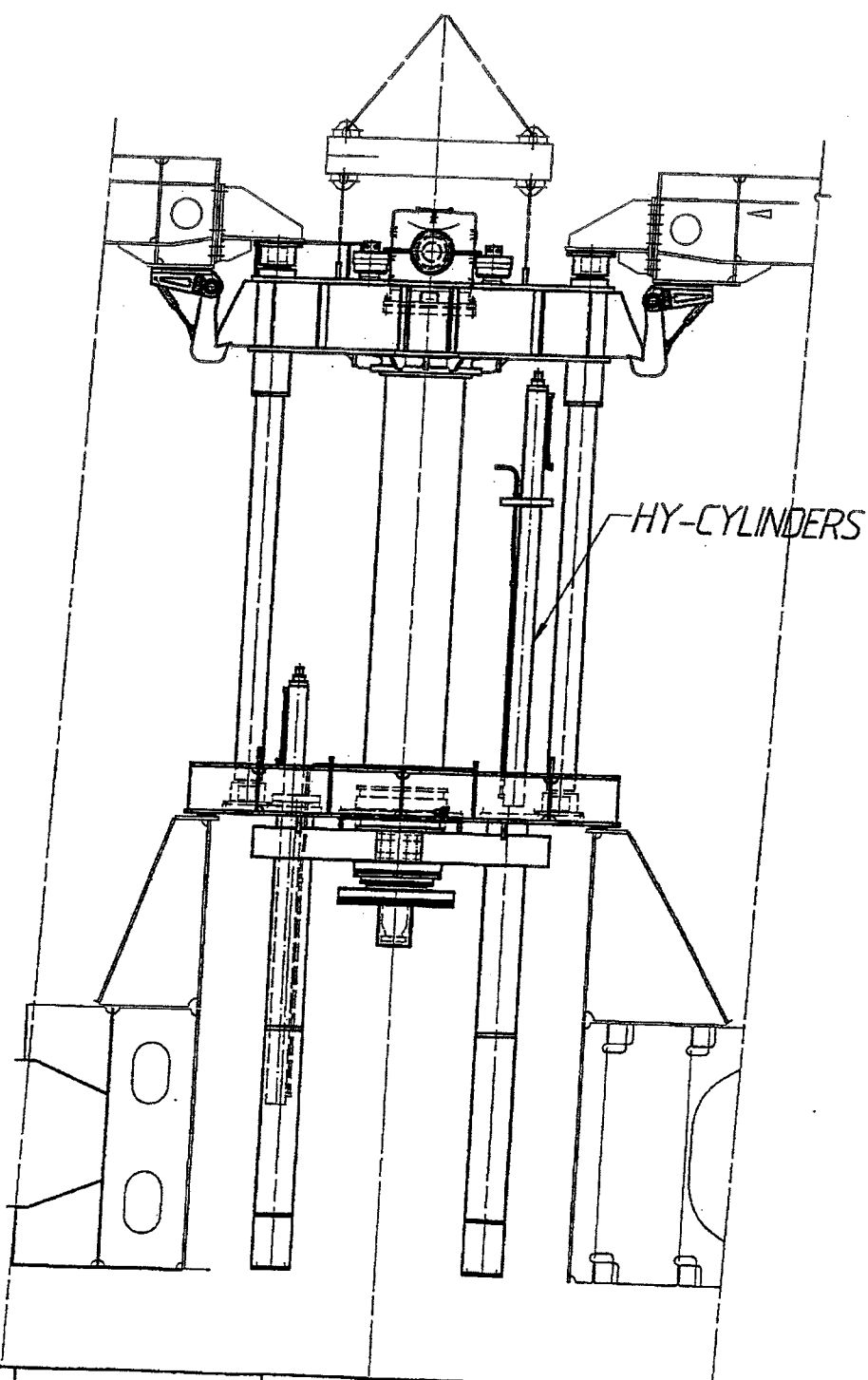
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MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 6

WÄRTSILA   
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FIXATING OF COLUMNS AND  
MOUNTING OF HY-CYLINDERS.  
MOUNTING OF SAFETY HOOKS.



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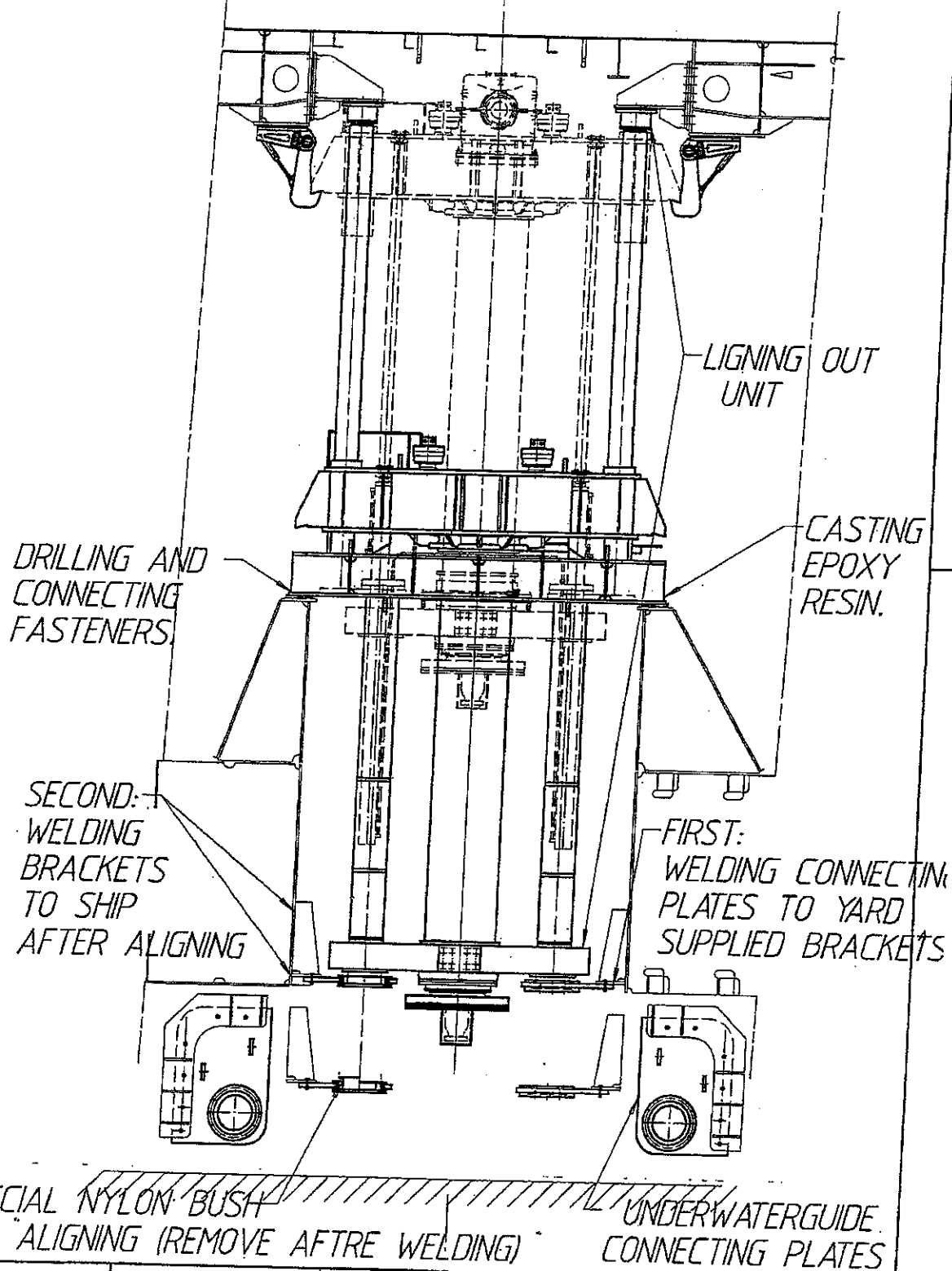
MOUNTING SEQUENCE FS1510-350/1530 MNR



W084850409 - step 7

WÄRTSILÄ  
Wärtsilä Propulsion Netherlands B.V.

LIGNING OUT UNIT,  
CONNECTING UNDERWATERGUIDE CONNECTING PLATES.  
WELDING AT ALIGNING.



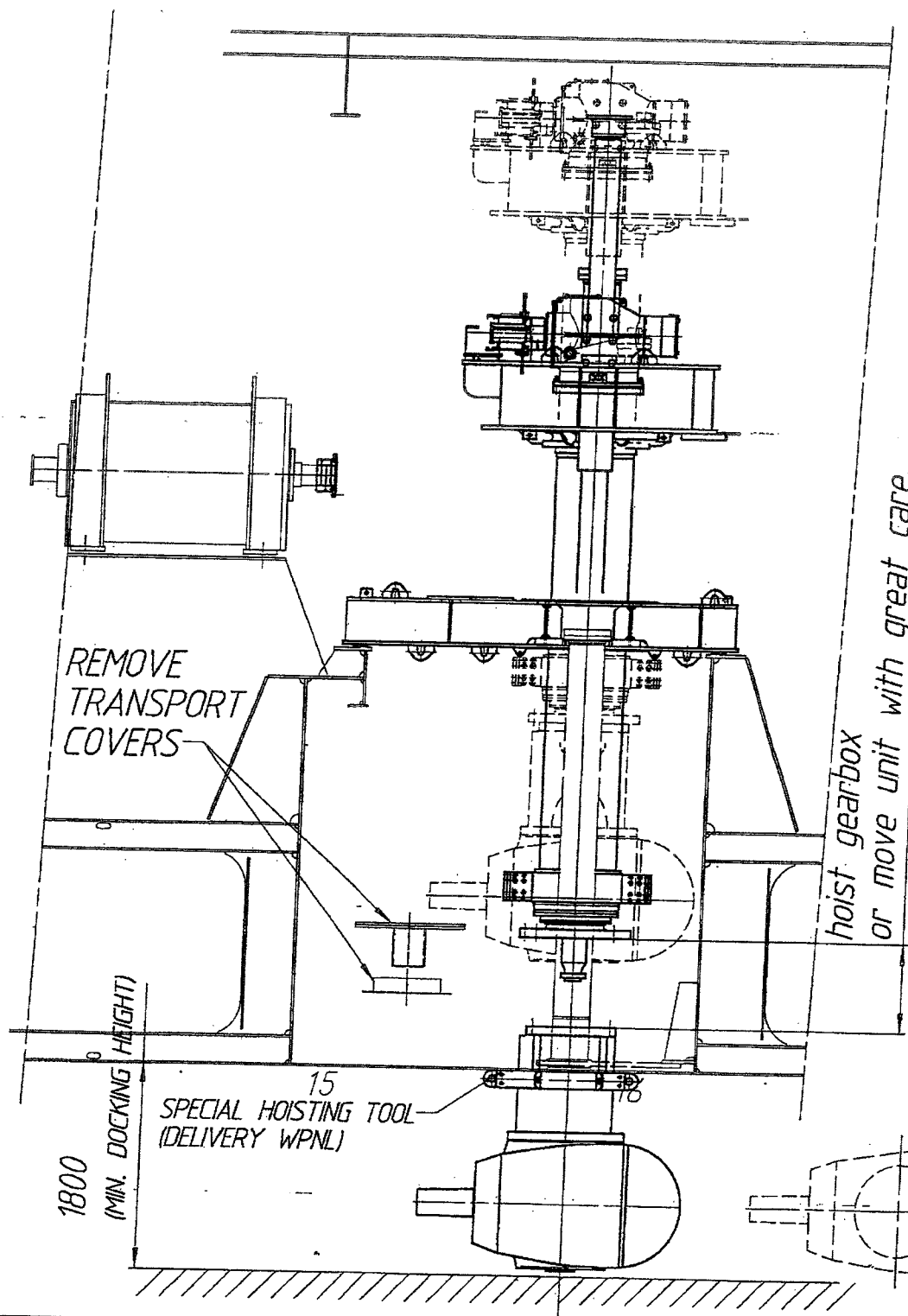
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MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 8  
MOUNTING PROP. GEARBOX

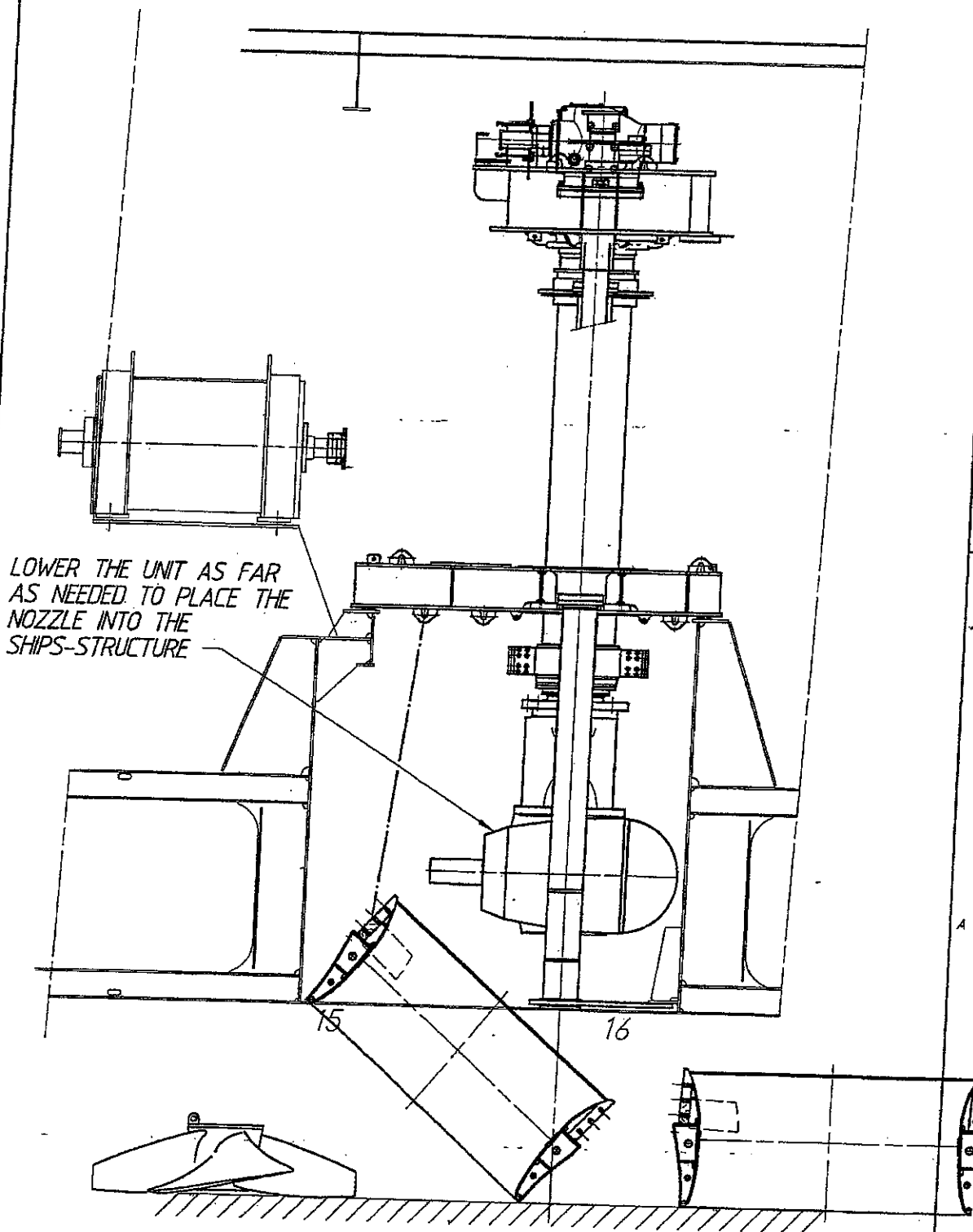
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MOUNTING SEQUENCE FS1510-350/1530 MNR



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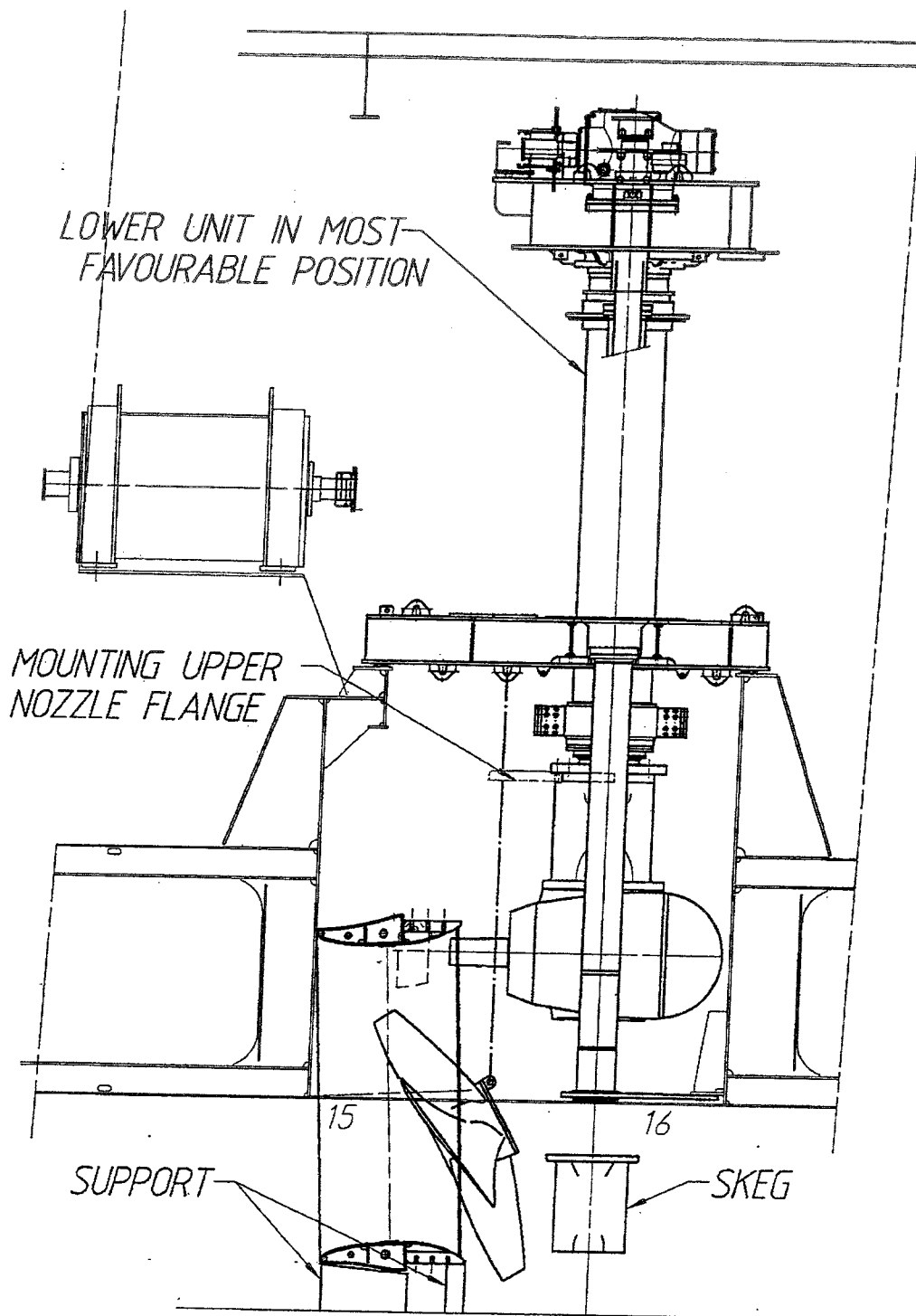
2006-06-14

MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 10

WÄRTSILÄ   
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POSITIONING PROPELLER  
MOUNTING UPPER NOZZLE FLANGE.  
MOUNTING OF SKEG.



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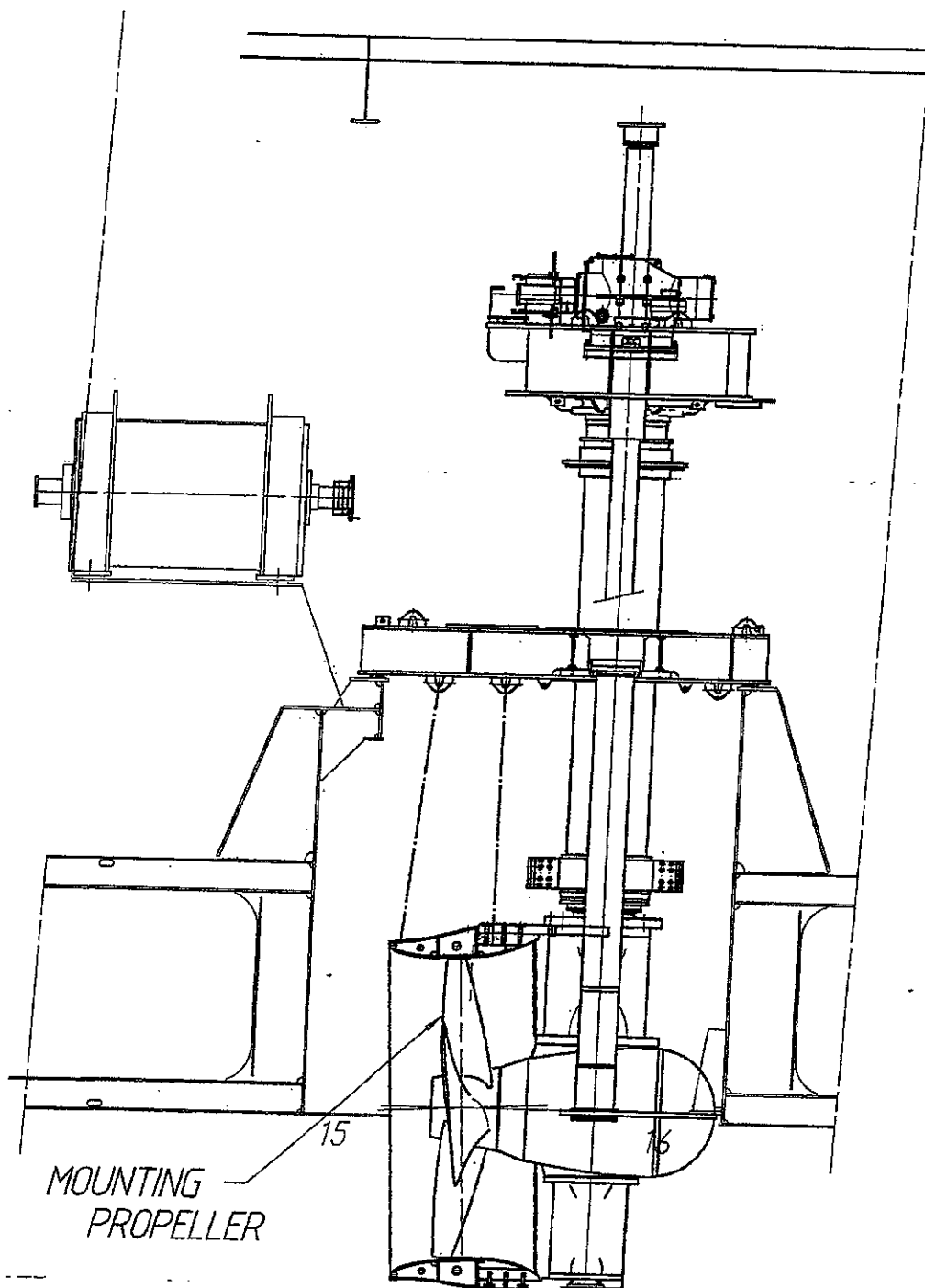
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MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 11

WÄRTSILÄ   
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LOWERING THRUSTER  
MOUNTING PROPELLER  
FIXATING NOZZLE AND SKEG



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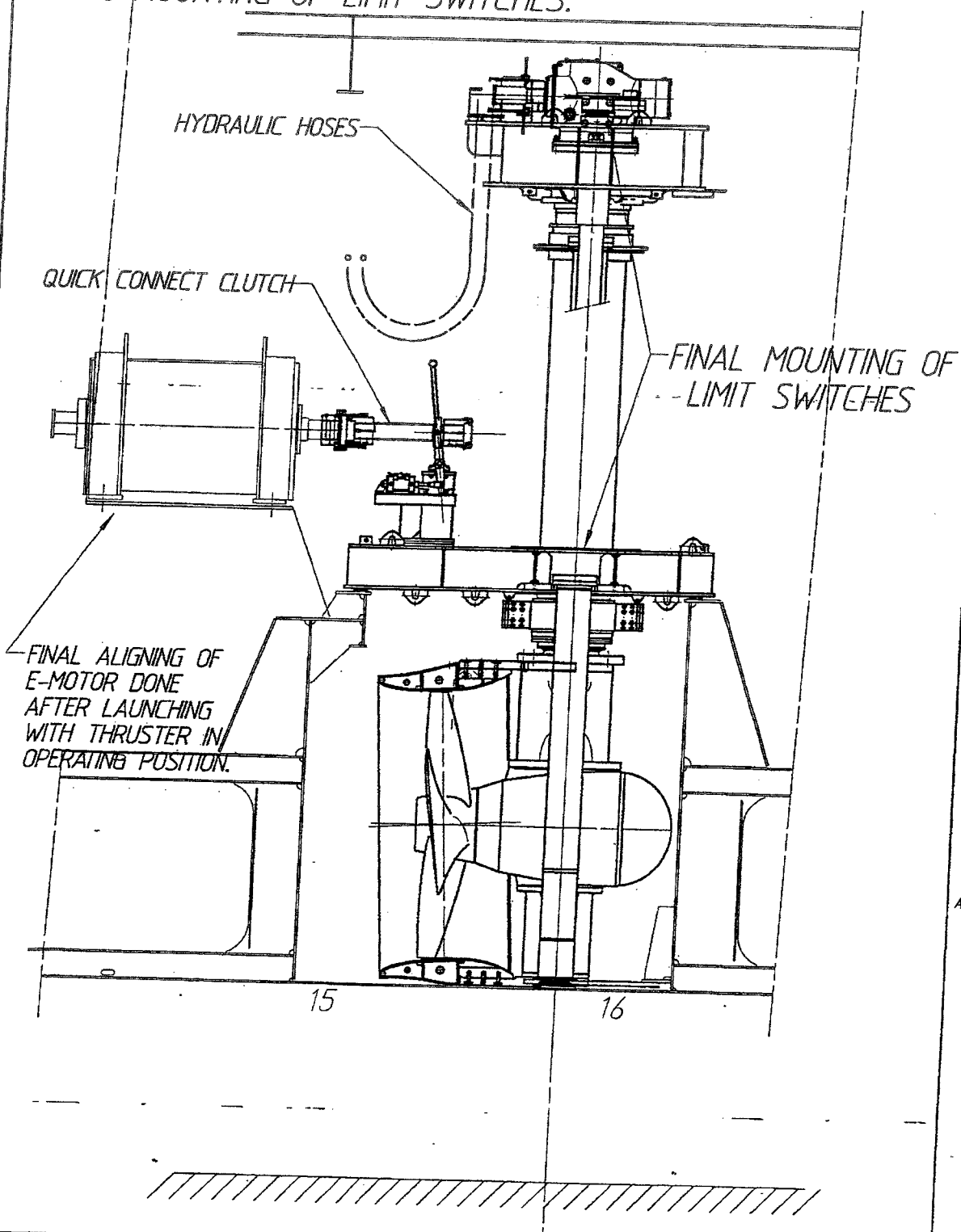
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MOUNTING SEQUENCE FS1510-350/1530 MNR

W084850409 - step 12

WÄRTSILÄ  
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RETRACTING UNIT.  
MOUNTING OF QUICK CONNECT CLUTCH  
AND HYDRAULIC HOSES.  
FINAL MOUNTING OF LIMIT SWITCHES.



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2006-06-14

MOUNTING SEQUENCE FS1510-350/1530 MNR