1.1 **Keyless propeller mounting procedure**

- For installation sufficient space is needed.
- Hoisting facilities must be arranged.

1.1.1 **Documents**

- Instruction “General warnings and cautions”.
- Drawing “Propeller boss”.
- Drawing “Assembly hydraulic nut / ring” (if WPNL supply).
- Instructions for hydraulic nut / ring (if not WPNL supply).
- Propeller push–up diagram (located on the drawing “Propeller boss”).
- Procedure “Propeller cone fit procedure”.
- Instruction “Assembly of pump holder”.
- Instruction “Tools and equipment for (de-) mounting of propeller”.

1.1.2 **Preparations**

Pay attention to instruction “General warnings and cautions”.

<table>
<thead>
<tr>
<th>Tools provided with the propeller (see scope of supply for exact WPNL delivery).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifting eyebolt for propeller.</td>
</tr>
<tr>
<td>Pump holder with pressure gauges and high-pressure pumps.</td>
</tr>
<tr>
<td>Hydraulic hand pump with high-pressure hose.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Provided by the yard</th>
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</thead>
<tbody>
<tr>
<td>Hoisting facilities and sufficient space.</td>
</tr>
<tr>
<td>Check the “Safe Work Load” of every hoisting tool against the weight of the propeller.</td>
</tr>
<tr>
<td>Save positions for workers.</td>
</tr>
<tr>
<td>Cleaning materials.</td>
</tr>
<tr>
<td>Thermometer.</td>
</tr>
<tr>
<td>Dial gauge.</td>
</tr>
<tr>
<td>Fresh and clean mineral oil, viscosity 4,5º Engler (33,4 cSt.) at 50ºC.</td>
</tr>
<tr>
<td>A sufficient sized oil catch tank, oil will drain from between the coupling parts</td>
</tr>
</tbody>
</table>

- Check propeller fit on the shaft cone. Make sure that the fit is according to the classification’s requirements. See the procedure “Propeller cone fit procedure”.
- All parts that are fitted for temporary protection, such as covers, caps and plates, have to be left in place as long as possible and are only to be removed for immediate connection to opposite parts.
- All pipe ends, O-rings and O-ring grooves are to be inspected for damage before mounting.
- All temporarily unprotected parts are to be kept extremely clean.
• It is advised to start propeller mounting early in the morning in order to avoid temperature differences between propeller and shaft.

1.1.3 Lift and pull the propeller on the shaft cone

Pay attention to instruction “General warnings and instructions”.

1. Do not unpack propeller hub.
   Position the propeller at the tapered side of the propeller shaft.
   Check the port and starboard position if twin propellers, see installation drawings
2. Unpack and clean the propeller shaft cone, check the cone for burrs and damages, repair when necessary, clean and lightly oil the shaft cone.
3. Unpack and clean the propeller bore, check the bore for burrs and damages, repair when necessary, clean and lightly oil the propeller bore.
4. Lift with care the propeller to the proper position in front of the propeller shaft cone. Lifting can be done with slings.
5. Carefully pull the propeller on the propeller shaft cone.
6. Move the propeller on to the shaft until no further movement up the taper is possible.
7. Install the hydraulic nut / ring. The hydraulic nut / ring should have the piston in the fully closed position.
8. Screw the nut / ring to the end of the propeller boss.
9. Remove all plugs of the oil inlet connections in the hub.
10. Assemble and install the pump holder with the pressure gauges. See instruction “Assembly of pump holder”.
11. Provide for all other necessary tools. See instruction “Tools and equipment for (de-) mounting of propeller”.

1.1.4 Determination of the starting point and of the propeller drive up.

For an accurate first determination of the starting point the mounting procedure shall be carried out at least twice.

The starting position when compared between first and second push-up may differ more than 5% of the total required axial drive-up because of the possible bedding action of the fitting process.

Temperature stabilization

Time should be allowed to stabilize the temperatures of the propeller and shaft before commencing any push-up procedure. Record the prevailing ambient temperature.

• It is essential to commence the push-up process from the correct axial starting point on the shaft. This is achieved by applying an initial start point load with the hydraulic nut / ring without oil injection into the propeller boss. The start point load is given on the drawing “Propeller boss”. The start point load is stamped on the propeller hub as well.
• To convert pressure as measured by the pressure gauge on the hydraulic hand pump to a load applied by the hydraulic nut / ring, see the drawing “Assembly hydraulic nut / ring” or to the hydraulic nut / ring suppliers manual.
• The appropriate push-up distance has to be determined from the push-up diagram on the drawing “Propeller boss”. When the ambient temperature is measured the belonging push-up distance can be read out or calculated.
• Only the axial drive-up distance will give the right position of the propeller. The theoretical mounting force as given in drawing “Propeller boss” is only for guidance to get an indication of the required pressure in the nut / ring.
• The movement of the piston of the hydraulic nut / ring shall not exceed the maximum value as given on the drawing “Assembly hydraulic nut / ring”.

1.1.5 Push–up the propeller on the shaft cone

**WARNINGS**

- MAKE SURE THAT HIGH PRESSURISED OIL CANNOT LEAK. PLACE PROTECTIVE GUARDS IN POSITION.
- ALWAYS WEAR PROTECTIVE GLASSES AND CLOTHES WHEN YOU WORK ON EQUIPMENT.
- OIL PIPES OR HOSES OF INSUFFICIENT STRENGTH CAN BURST UNDER PRESSURE. SEVERE INJURY CAN RESULT.
- DO NOT DISCONNECT HYDRAULIC PIPES OR HOSES WHEN PUMPS ARE OPERATING.
- MAKE SURE THAT ALL PROTECTIVE GUARDS AND COVERS ARE CORRECTLY INSTALLED.

- MAKE SURE THAT THE PROPELLER CONE AND SHAFT CONE PRESSURE IS TOTALLY RELEASED BEFORE RELEASING THE NUT PRESSURE.

- DANGER COULD RESULT IF THE PROCEDURES ARE NOT FOLLOWED. WÄRTSILÄ PROPULSION NETHERLANDS BV DOES NOT ACCEPT ANY CLAIM WITH RESPECT TO DAMAGE DONE AS WELL AS TO OPERATIONAL HAZARDS.

• THE INFORMATION GIVEN IN THIS CHAPTER IS FOR GUIDANCE ONLY. THE RESPONSIBILITY FOR FITTING REMAINS IN THE HANDS OF THE SHIPYARD AND TO THE SATISFACTION OF THE OWNERS AND THE CLASSIFICATION SOCIETIES, UNLESS AGREED OTHERWISE.

1. Bleed all air from the hydraulic nut / ring.
2. Slowly inject oil into the hydraulic nut / ring to meet the predetermined start point load pressure. No oil injection in the boss is required.
3. If the propeller moves up the taper without any significant pressure recorded on the hydraulic nut / ring, this indicates a lack of full mechanical contact between bore and shaft. The tightening of the propeller shaft nut might be insufficient. Tighten the nut and repeat from point 1.
4. When the start point load is reached, set the dial gauge to zero.
5. Inject oil into the boss, with the center vent plug removed, until all air is bled from the center vent hole, then plug center vent hole. Continue pumping until oil bleeds at the forward end of the propeller boss.
6. Record the hydraulic nut / ring pressure and all boss injector pump pressures during the axial movement of the propeller at steps of 1 mm. The pressure difference between the two boss injectors should not exceed 10%, as the pressures become higher. Increase pressure in the hydraulic nut / ring and the boss injectors in the same ratio. Operate all pumps i.e. boss injector pumps and hydraulic nut / ring pump.
7. When the maximum piston movement is reached release boss injector pressures while maintaining the hydraulic nut / ring pressure, allowing the boss to settle and oil to drain off for a period of not less than 30 minutes. Record the dial gauge reading.

8. Release pressure from the hydraulic nut / ring. Screw on the hydraulic nut / ring till the piston is again in fully closed position.

9. Repeat the procedure as described in 5 and 6. Add new dial gauge readings to the already recorded readings.

10. When the required axial drive–up is achieved, release boss injector pressures while maintaining the hydraulic nut / ring pressure, allowing the boss to settle and oil to drain off for a period of not less than 30 minutes. Record the dial gauge reading.

11. Release the pressure in the hydraulic nut / ring by slowly opening the pump return valve. Record the dial gauge reading.

**At first drive up**

12. Remove the propeller; see instruction “Keyless propeller demounting procedure”.

13. Fit the propeller by repeating all steps 1 to 11.

14. In case a hydraulic nut is applied, tighten the nut on to the boss. In case of a hydraulic ring is applied, unscrew the propeller nut. Remove the hydraulic ring and screw on the propeller nut again.

15. Tighten the nut with a wire rope around the nut groove to about 1 ton tension.

16. Fit all plugs in the oil inlet connections. Secure by punch mark.

17. Remove the hoisting facilities from the propeller.

18. If applicable, remove the lifting eyebolt and fit the plug. Secure by punch mark.

19. Clean and store all tools and auxiliary equipment.

20. Continue with mounting the propeller cap, connection of the aft seal liner and installation of the rope guard.