WÄRTSILÄ **Propulsion Services**

PROPELLER MODIFICATIONS

ENERGY
ENVIRONMENT
ECONOMY

TRAILING EDGE ADJUSTMENT FOR HEAVY RUNNING PROPELLERS

One propeller modification that Wärtsilä carries out is the trailing edge adjustment to cure “heavy running” propellers.

“Heavy running” means that power generation by the propeller no longer matches the performance of the engine. Because of this, the engine operates in an overload condition at inadequate rpm. This leads to high exhaust gas temperatures as well as increased wear of pistons, liners and valves, resulting in high maintenance costs. It may also be impossible to maintain the vessel’s operational speed, which may cause problems with schedules. Figure 1 shows the engine loading diagram for a regular situation. The propeller’s pitch is selected so that 85 % of the MRC power is generated at 100 % nominal shaft speed. This creates a sea margin to accommodate any increase in the ship’s resistance due to the weather. Full power can be generated at full rpm in service conditions (including the sea margin).

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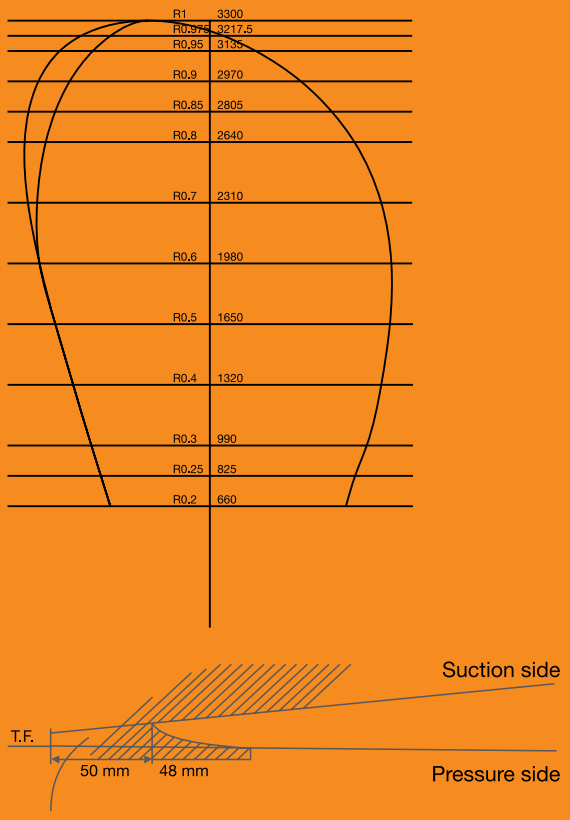

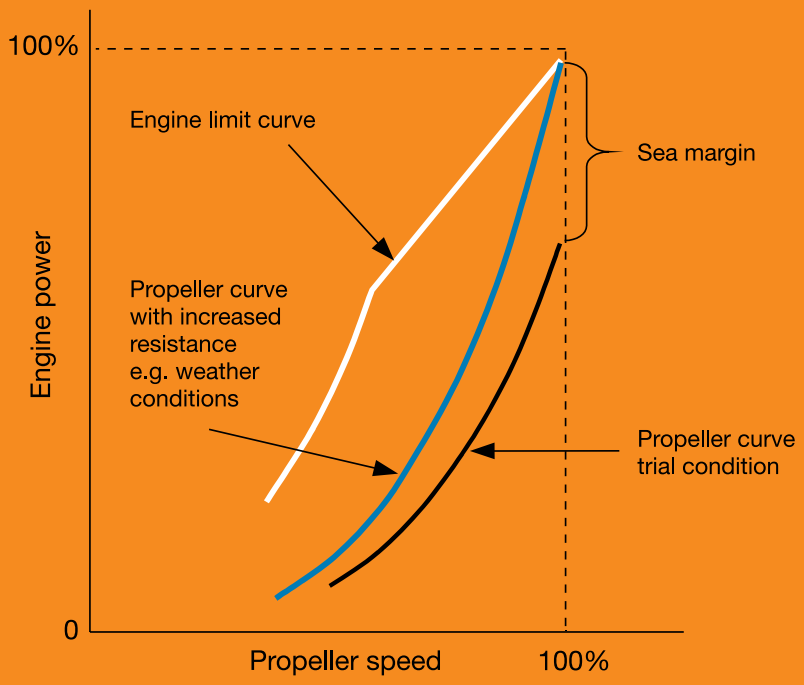

Fig. 1 The engine loading diagram in a regular situation.

The engine loading diagram for a heavy running propeller is shown in Figure 2. For some reason, the propeller's power absorption in trial conditions may show only a small or even a non-existent sea margin. If the ship's resistance increases now, the engine will run in overload. At low propeller speeds, the power demand is larger than the engine can deliver; the propeller's power curve crosses the engine load limit before the full power of the engine is reached.

A PROPELLER CAN BECOME "HEAVY RUNNING" DUE TO:

- Fouling of the hull and propeller
- Ageing of the engine
- Incorrect design of the propeller (pitch is too high)
- Modification of the ship (length and/or draught of ship increased)
- Change in normal operating profile and/or loading conditions.

Basically there is a mismatch between the propeller curve and the engine limit. Modifying the propeller's pitch can improve interaction between propeller and engine.

WORKING PRINCIPLE

It is necessary to raise the operating point of the propeller to a higher shaft speed, so as to bring the engine out of the overload area.

A decrease in pitch will result in a higher shaft speed with the same engine power.

Up until 10 years ago, a propeller was repitched either by twisting the blade or by diameter cropping. Twisting the blade is inaccurate and cannot be carried out on site. Diameter cropping is effective but not recommended since it results in two or three per cent loss in efficiency. Today the most sophisticated way to cure a heavy running propeller is trailing edge adjustment.

Figure 3 shows a sketch of the modified trailing edge. The pitch angle of a profile section is defined by the line through the nose and tail of the propeller section. The trailing edge is cut off at a certain length, in order to reprofile the section. The new tail is raised above the original nose-tail line, decreasing the pitch angle. A hydrodynamic profile is grinded to assure that the wing section works properly and to avoid erosive cavitation. In addition, an anti-singing edge is incorporated to avoid unwanted inboard noise. A major benefit of the trailing edge adjustment is that there is no loss in efficiency.

In principle, a propeller can be modified up to a maximum of seven per cent in the propeller's rotational speed. In most cases this is sufficient to restore good interaction between propeller and engine.

PROPELLER MODIFICATION CALCULATIONS

Working closely with the owner of the vessel we first determine the current performance of the propeller and the engine. We then define the required new performance and increase in rpm. We carry out detailed hydrodynamic calculations for power absorption, cavitation, efficiency, pressure pulses and strength. These analyses can be made both for LIPS propellers and for third party designs. We

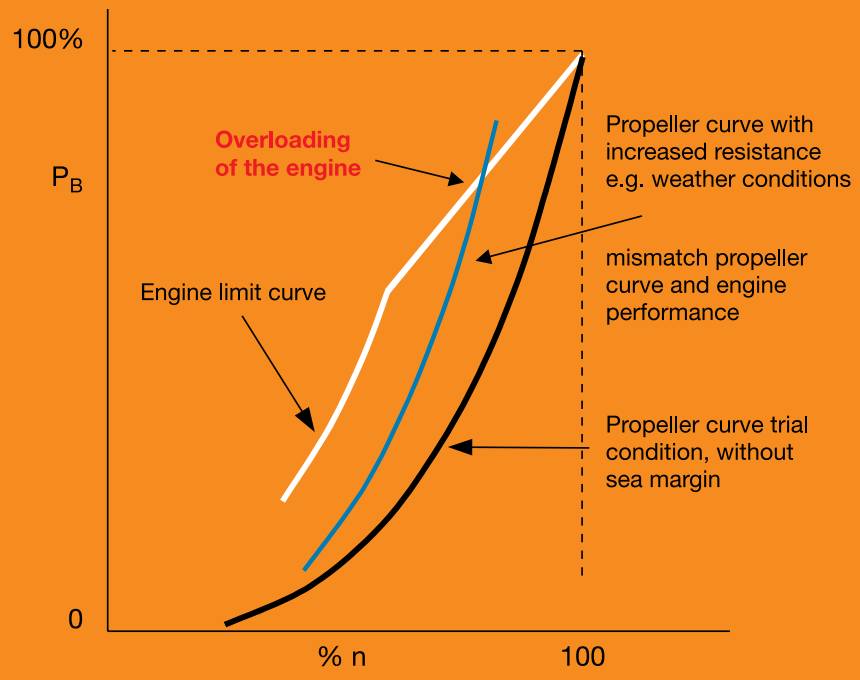

Fig. 2 The engine loading diagram for a heavy running propeller.

produce a report for the customer, and after approval the designed trailing edge modification can be made.

THE FOLLOWING INFORMATION IS REQUIRED:

- Propeller drawing, incuding profile section drawings in case of third party design
- Engine diagram
- Current performance of propeller (power-rpm-ship speed)
- Expectations of the owner after modification of the fixed pitch propeller.

A MODIFICATION CALCULATION INCLUDES:

- Engineering
- Modification drawings of propeller
- A report
- Template drawings
- One set of steel templates.

If we receive the order to carry out the modification, the costs for the modification calculation will be deducted from the total costs. Engineering of the trailing edge adjustment can be carried out within one week.

WHERE CAN PROPELLER MODIFICATIONS BE PERFORMED?

The propeller can be modified while the propeller is fitted on the shaft, there is no need to demount the propeller. This means the cutting and grinding can be carried out at ship repair yards, in dry dock or at the pier side at trimmed position. The work can even be carried out offshore, depending on the weather conditions. We have a global service network of engineers trained to perform propeller modifications in order to serve locally and keep the costs as low as possible.

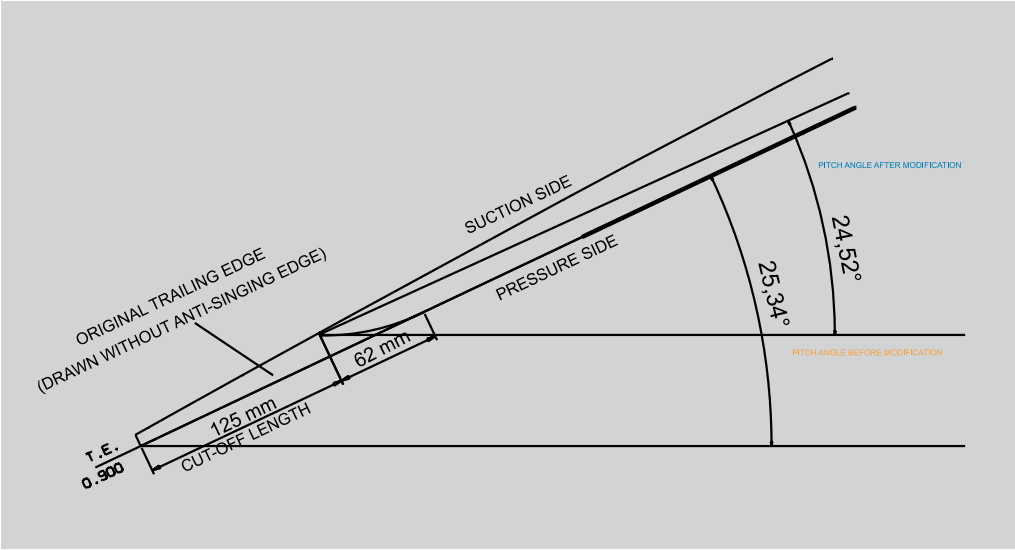

Fig. 3 A sketch of the modified trailing edge.

SUMMARY

A propeller is “heavy running” if the propeller curve no longer matches engine performance. Repitching the propeller can restore good interaction between propeller and engine. A decrease in pitch will result in the desired higher rpm for the propeller.

A trailing edge adjustment can decrease the mean pitch of the propeller. Dedicated hydrodynamic analyses are made while designing the modifiation.

This sort of pitch correction is usually carried out on site, at ship repair yards, by the pier side etc.

We have executed over 150 designs and modifications in the following operational area:

- Wärtsilä’s LIPS design – third party design
- Diameter ranging from 2.0 m up to 8.5 m
- Rpm corrections from 2% to 7%
- Ship speeds from 10 knots to 25 knots.

Checking modified trailing edge profile section by means of templates.

Trailing edge adjustment at pier side.

Equal pieces of propeller material are cut off.

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