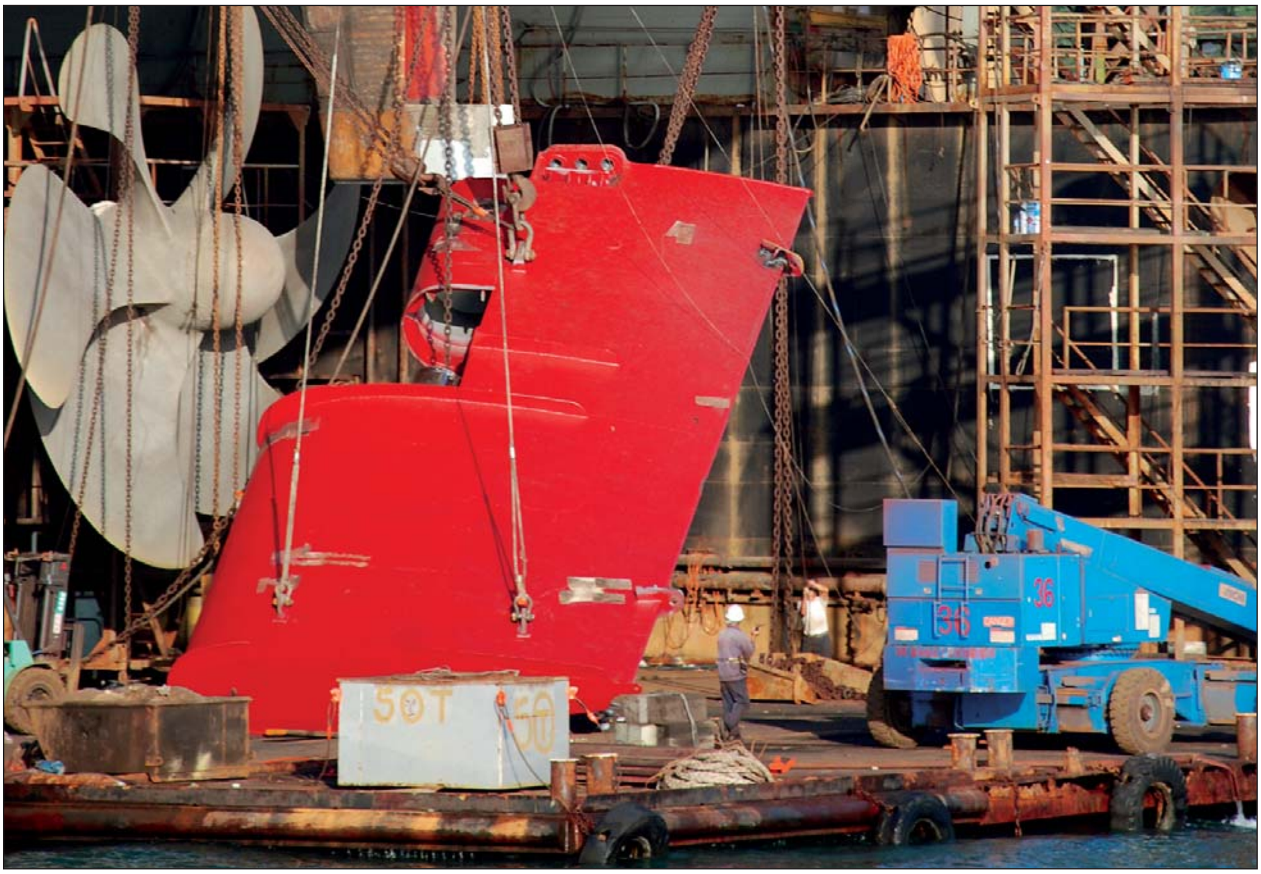
Number 168

HYDREX Magazine

Permanent rudder repairs now possible without drydocking



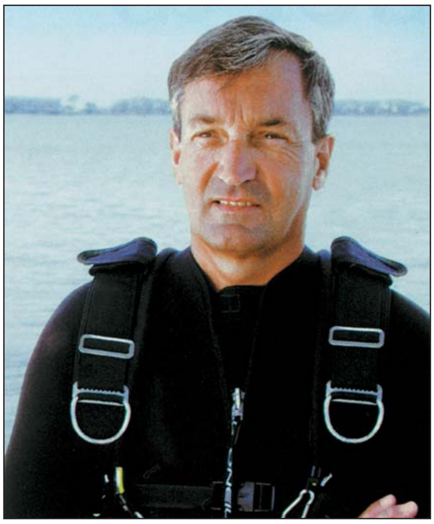
Hydrex has developed an entirely new method enabling permanent repairs of rudders without drydocking the ship. Permanent repairs were hitherto not possible and ships had to drydock in case a major defect was found. The newly designed equipment is lightweight and can be mobilized very rapidly in our special flight containers. Therefore this new service is now available worldwide.

Major defects on rudders very often cause unscheduled drydocking of ships. The new method designed by our technical department allows engineers, welders and inspectors to perform their tasks in dry conditions. Class approved permanent repairs *in-situ*, without moving the ship, are now possible and commercial operations can continue. Steel repairs and replacements can be performed and pintle and bushing defects can be solved without the loss of time and money associated with drydocking.

The equipment can be mobilized within hours to any port in the world and is available for rapid mobilization from the Hydrex headquarters in Antwerp.

HYDREX®
UNDERWATER TECHNOLOGY

Editorial



Hydrex started activities in 1974 to help ship owners solve the problems they might encounter underwater with their vessel and this purpose still holds firm today. We made 'helping you' our responsibility and it is work we continue to enjoy.

The first article in this magazine is a good example of the complete package of services we offer to our customers. In this article you can read of an operation that was carried out by a Hydrex diver-technician team on a tanker at anchor in Port Gentil.

While one unit of the team was performing a class approved insert repair on the side shell plating of the vessel, the second unit was simultaneously performing a full presale inspection and cleaning of the underwater hull of the vessel, combined with a propeller polishing. The combination of these two jobs enabled the new owner to sail his vessel with a permanently repaired hull and at the same time have the ship's performance restored as close to its optimum condition as possible.

Best regards

Boud van Rompay

Cutting away damaged area on side shell plating of tanker

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HYDREX
KEEPING SHIPS IN BUSINESS

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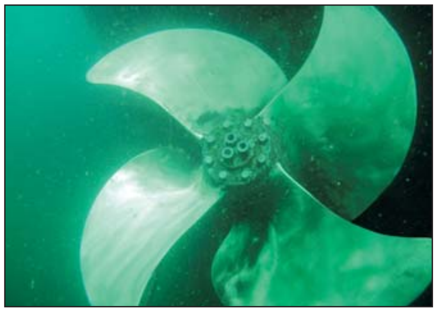
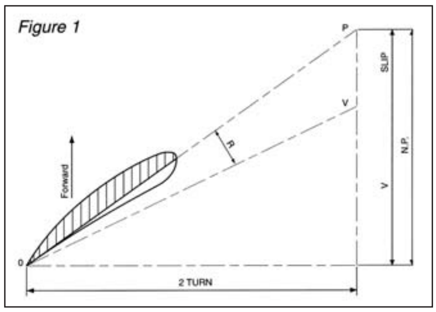




Insert repair, underwater hull cleaning and presale inspection of tanker in Port Gentil

Recently Hydrex was asked to perform an insert repair combined with a presale inspection, an underwater hull cleaning and propeller polishing on a 230 metre tanker while the vessel was at anchor in Cap Lopes Bay, Port Gentil. A diver-technician team was therefore mobilized from the local Hydrex office.

Hydrex equipment loaded onto work barge


New frames after installation

The operation was performed with two work barges, one on which all the equipment needed for the insert repair was loaded and one on which a monitoring station was installed which was used for the underwater hull inspection and the underwater hull cleaning work. This enabled the team to split up and perform the two parts of the operation simultaneously.

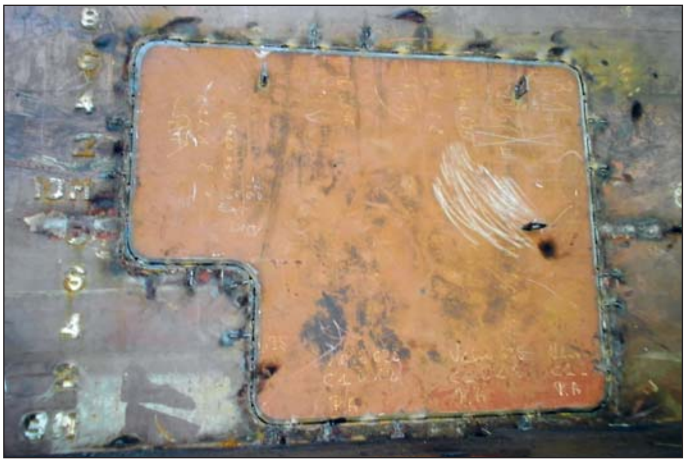
After doing a full underwater inspection, the hull cleaning team removed all marine fouling from the underwater hull of the vessel and carried out a propeller polishing with the Hydrex in-house developed range of underwater cleaning units. This restored the vessel's performance to a level as close to optimum as possible.

Meanwhile the repair operation started with the installation of scaffolding on both sides of the hull to give the team access to the affected area on the side shell plating of the vessel. Next both an onboard and an outboard inspection of the damage was performed. This revealed that an area of 2255 mm x 1760 mm needed to be cut away and replaced with a new insert plate.

While the new insert was fabricated to the exact measurements, the affected shell plating was cut away together with several frames that were also damaged. New frames were then installed and the edges of the hole were prepared for the installation of the insert which was subsequently positioned and secured with a deep penetration weld according to the class approved Hydrex procedures.

When the insert plate was fully welded, ultrasonic testing was carried out with positive results. The full penetration weld was also inspected from the outside, found in a good condition and authorized by the class. This allowed the new owner to sail his vessel with a permanently repaired hull. ■


Preparing the edges of frames prior to installation of new ones


New insert prior to full penetration weld

The value of regular underwater propeller polishing

An observed reduction in ship performance is readily associated with the condition of the ship's hull but the effect of the propeller surface condition is often overlooked. Nevertheless, the effect can be significant. In economic terms, a high return for a really low investment can be obtained by propeller maintenance.

Propeller blades prior to polishing

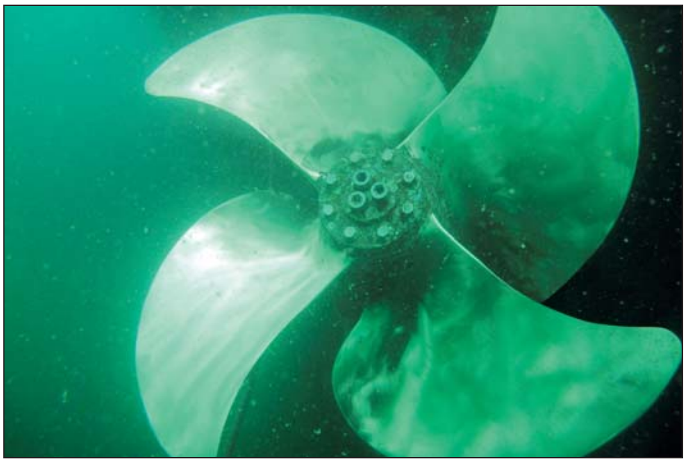
When considering the propeller surface condition a distinction has to be made between fouling and surface deterioration. The effects of propeller fouling in terms of a power penalty are much greater than those of surface deterioration. Research has shown that propeller fouling can quickly reduce the delivered horsepower by 20%. While rough propellers can be as destructive of fuel economy as rough hulls, the remedy is much cheaper.

Propeller roughness is most easily measured underwater by divers using a comparator gauge, whereby the propeller surface is compared to surface finishes of known roughness. The predominant effect of an increase in roughness of the propeller blades is an increase in the propeller torque, thereby lowering the propulsive efficiency. By using a propeller performance analysis tool the losses in propulsive efficiency were calculated.

This showed that significant losses resulting from blade roughening can be regained by cleaning and polishing of the blades.

Fuel savings of up to 5% can be gained if a polishing is performed on a propeller after 1 to 2 years in service. Exact figures depend on a number of factors such as operating conditions and propeller design, but it is advised to perform propeller polishing at regular intervals to avoid losing propulsion efficiency. This keeps the propeller in optimum operational condition and can keep a vessel's fuel consumption as low as possible, leading to significant financial savings. ■

Hydrex diver polishing propeller blades



Propeller blades after polishing

Hydrex diver during propeller blade polishing

Slip and propeller efficiency

Figure 1

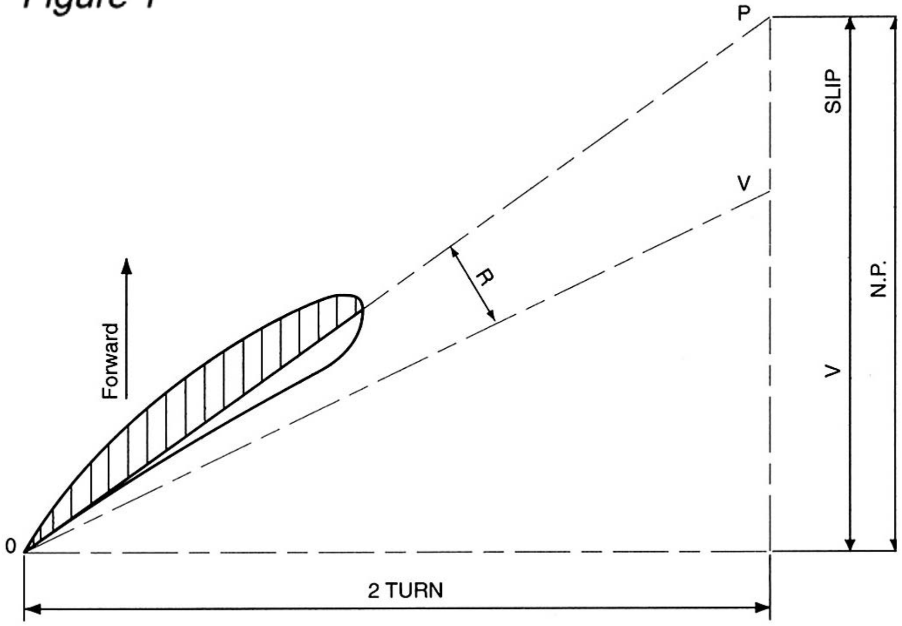


Fig.1. Diagrammatic representation of slip

Most shipowners provide their engineers with standard log sheets for the daily entry of performance data. These log sheets almost invariably contain a column for the recording of 'slip' and the superintendent consults these columns to obtain information on the performance of the ship, engine and propeller, and possibly also to compare the performance with that of other ships in the fleet.

What is the real significance of this slip figures, and what relationship exists between slip, propeller efficiency and ship performance? To what degree does the condition of the propeller affect its slip, and how do repairs impact on this?

Propeller efficiency

The function of the propeller is to absorb the horsepower delivered by the engine at the correct rate of revolutions, to ensure optimum engine running conditions, and must itself have the highest possible efficiency in order to produce maximum thrust and hence maximum speed.

The power is absorbed as torque at the tail-shaft, i.e. delivered horse-power d.h.p. at N revolutions per minute. Thrust horsepower, t.h.p. is given by thrust T x speed of advance Va, and propeller efficiency is given by $\frac{\text{t.h.p.}}{\text{d.h.p.}}$

Slip

Perhaps the simplest conception of this is to consider the screw to work in a solid block, when, in one complete revolution it would advance a distance equal to its pitch. Due to the fluidity of the medium in which it actually works, however, the screw advances forward a distance somewhat less than the pitch, and the difference between these is called the 'slip'. This can be shown diagrammatically in the form shown in *Figure 1*.

A better, and more scientific explanation is to consider that the propeller blade works as an aerofoil, and as a result gives its best lift/drag characteristics at low angles of incidence. It is customary to present aerofoil data on a base of angle of incidence as representing the operating conditions, and this can be shown to be the same as the slip function commonly used for this purpose by marine engineers.

Figure 2

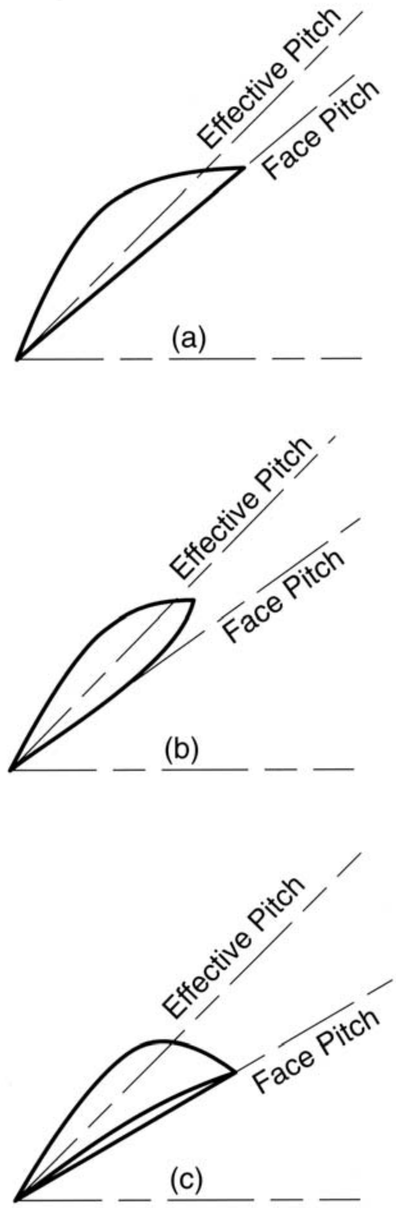


Fig.2. Typical examples of the difference between effective and face pitch on various blade section shapes.

Referring to diagram 1, it will be seen that if the velocity at right angles to the direction of advance is plotted as $27\pi RN$, and the ship speed V is plotted in the direction of advance, the resultant apparent water flow will be along the line OV. The attitude of the blade is, of course, defined by the pitch and revolutions, and thus for a given propeller the angle of incidence is defined by the slip shown.

Slip is usually expressed as a percentage of the pitch, thus, if the propeller turns at N r.p.m. and the forward speed is V in knots, then slip =

$$\frac{NP-V \times \frac{6080}{60}}{NV} \times 100 = 1-\frac{101.3V}{NV} \times 100$$

The ship's engineer sometimes refers to NP, the product of revolutions and pitch, as the 'engine speed'. It is useful to note from the above, for future reference, that slip is a function of V/N i.e. the relationship between ship speed and propeller revolutions, and that therefore some of the parameters often used in presenting propeller information are functions of slip. For convenience' therefore, it is usual for e.g. Advance coefficient $J = \frac{V}{ND}$

Diameter constant $\delta = \frac{ND}{V}$

Effective Pitch

Another anomaly concerns the pitch used in the slip calculations. The pitch that determines the power absorption characteristics of the propeller is the mean effective pitch, sometimes called the virtual or no-lift pitch, which is always greater than the face pitch when the blade has finite thickness. The difference between the effective and face pitch can vary from propeller to propeller because of the different types of blade section profiles used. Some typical examples of the difference typical examples are shown diagrammatically in *Figure 2*.

The effective pitch of the three sections shown is the same in each case but the face pitch decreases progressively from (a) to (c). The effective pitch can only be found by calculation or experiment and cannot be measured from the propeller or readily shown on the propeller drawing. For convenience, therefore, it is usual for the engineer to use the face pitch in his slip calculations, this being the pitch that can be measured on the actual propeller.

From the above it will readily be seen that it can be misleading and is indeed incorrect, to compare values of slip from propellers of different design families. Likewise, one should guard against claims that one propeller is superior to another merely on the grounds that it gives less slip. ■

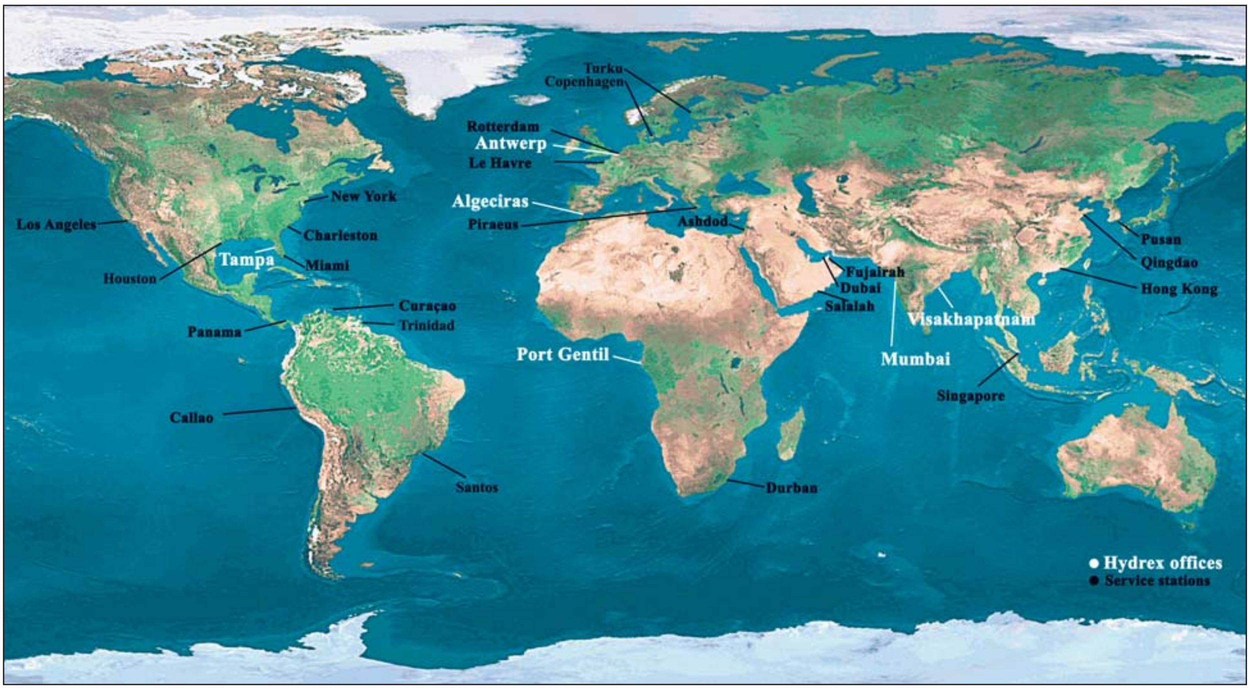
Cold straightening of severely bent propeller blades

In its quest to provide cost effective services to customers, Hydrex developed procedures to address different kinds of damage to propellers. This research led to the design of the Hydrex cold straightening machines first used in 2002.

By taking advantage of this technique damaged blades can be straightened underwater, allowing the ship to return to commercial operations without the need to drydock. Blades can be brought back close to their original form, restoring the propeller's optimum efficiency.

The cold straightening machines have been in use for quite some time now but the Hydrex research department has been looking into ways to expand the technique even further to improve our services. A new version of the straightening machine was recently put into practice. It is compatible with the existing models and is used to restore more severely bent propeller blades to their original condition.

Keeping ships in business



Hydrex underwater technology and services provide high quality solutions to the repair and replacement problems encountered by ships and offshore vessels.

We deliver a complete line of services that may reduce or avoid off-hire time entirely. From major projects to simple inspections, Hydrex has the worldwide facilities and capability to meet your demands.

Drydocking is not necessary so time, trouble and expense are saved by doing work *in-situ*. Hydrex services cover highly technical major repairs or replacements of a ship's external underwater equipment such as thrusters, propellers, rudders, stern tube seals and damaged or corroded hulls.

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