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KEEPING SHIPS IN BUSINESS

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ClassNK



Stern tube seal repairs



Using our flexible mobdock method to create a dry underwater environment, we have carried out stern tube seal repairs and replacements underwater for some years now in cooperation with OEMs.

This technology brings drydock conditions to the ship rather than having to take the ship to drydock, saving a considerable amount of time and money in doing so.

This class accepted method is performed by our diving teams under our warranty. It can be used while the ship is carrying out its usual cargo or other commercial operations in port.

Visit the special stern tube seal repair section on our website for more information and examples of the many seal repairs we have performed in recent years.

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UNDERWATER TECHNOLOGY

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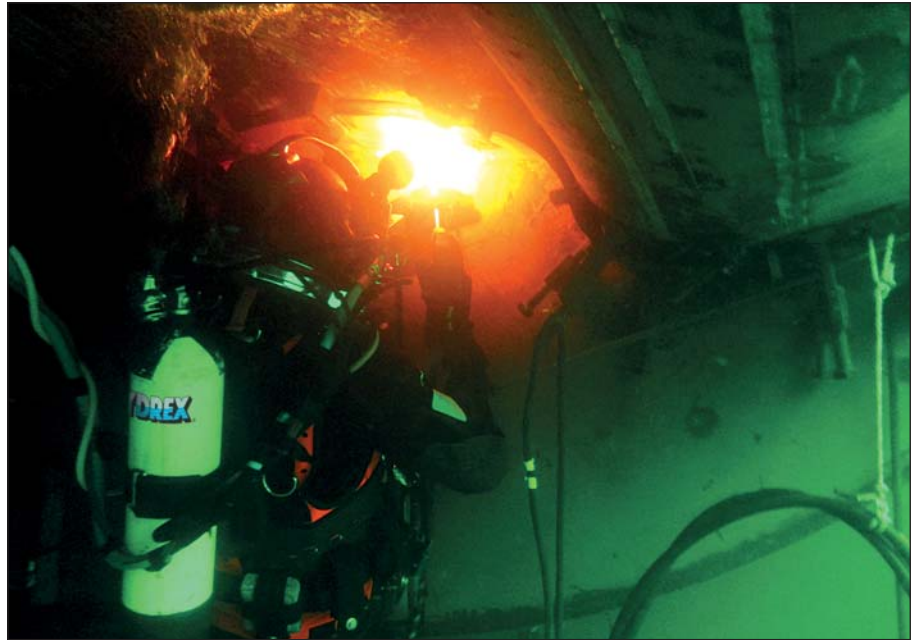
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Revolutionizing underwater welding repairs since 1974

“In the early 20th century, it would have been considered suicide for a diver to shoot an electric arc into the water. Though professional diving was already an established industry and had been for hundreds of years, underwater welding was not. That all changed when Konstantin Khrenov, a Soviet engineer, invented a method to join and cut metals underwater.

Khrenov wanted to find a way to weld underwater for quicker vessel repairs. WWI had ended, but WWII was beginning to brew and the USSR was mobilizing their fleets. As Khrenov discovered, one of the largest hurdles to successful wet welds lie in the sporadic outflow of gas bubbles from the point of contact with the arc and metal. This reaction caused major porosity



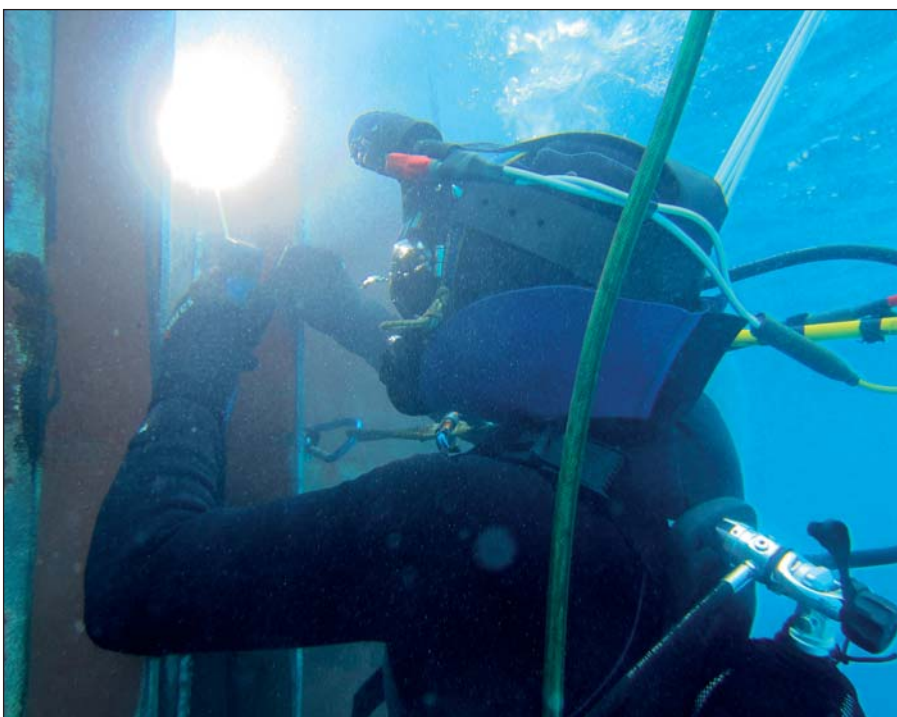
Our teams can perform underwater welding work to the highest quality standard and this on a daily basis.

in the welds, and the bubbles burst out, untamed. With the help of others, Khrenov devised a water-proof coating for the electrodes and stable power source.

In 1932 after successful experimentation in the labs, Khrenov traveled with engineers to the Black Sea for further successful testing. Underwater welding was born.”¹

However, it was not until the 1970s that the first underwater wet welding procedure was qualified to AWS standards by White Grubbs and Dale Anders of Chicago Bridge & Iron (CB&I) and the commercial development of underwater electrodes began.

Hydrex has been at the forefront of wet welding for well over 40 years. In this period we have regularly in-



Hydrex has been at the forefront of wet welding for well over 40 years.



¹ *How Waterproof Electrodes Changed Our World: Wet Welding History*, <https://waterwelders.com/underwater-welding-history>, accessed June 14 2018.

Hydrex under-water inspections



Underwater inspections are an essential aspect of ship repairs. Building upon conventional technical skills and know-how while also taking advantage of the latest technology, Hydrex offers a unique hull monitoring service to its customers. This gives ship owners total control of the underwater hull and the underwater gear of their vessels. An informed decision can then be made concerning any required follow-up action. Catching problems early can save you much money in the long run.

Hydrex diver/technicians can carry out inspections underwater and on-site very swiftly without disturbing the vessel's sailing schedule.

With fuel costs amounting to 40% of operational expenses and continuing to rise, reducing fuel consumption is a vital concern of ship owners. This is the reason why hull monitoring pays for itself. Underwater hull roughness, marine fouling, bent propellers and poor paint condition are all factors that will increase fuel usage due to the drag or inefficiency created by the damaged or affected area. The data gathered can then be used to see if actions are required.

Our diver/technicians are trained for a wide range of operations and they can carry out the inspections in port or at anchor anywhere in the world.



Damaged aft bulkhead area of drill ship.



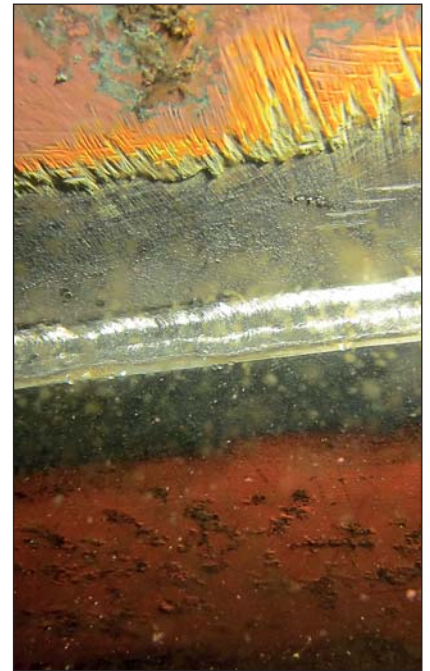
Disconnected transit flap brought to shore.



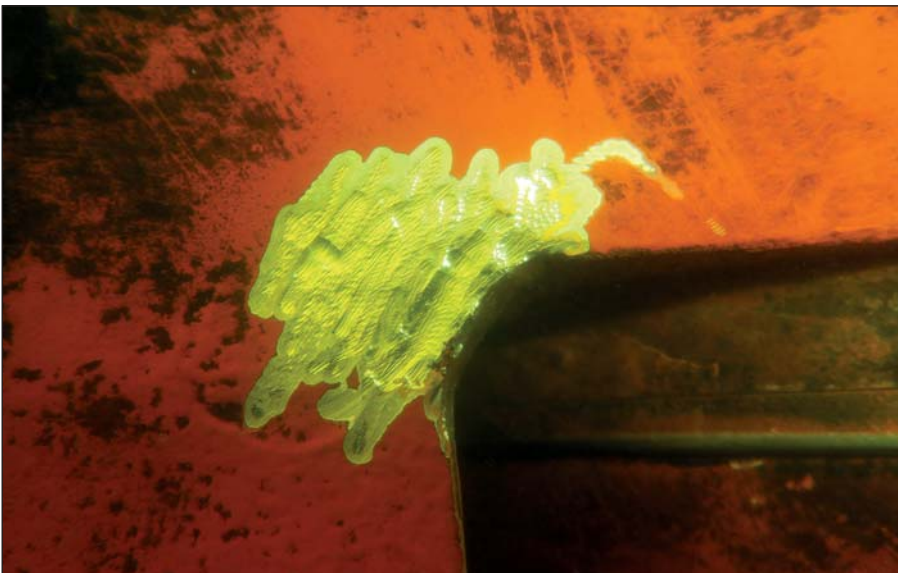
Hydrex diver/welder getting ready for repair on drill ship.



One of six doubler plates installed in Trinidad.



Our divers are all certified welders.



Some of the cracks on the vehicle carrier could be grinded away and filled with clad welding.



Hydrex teams consist of experienced diver/welders.

roduced new welding techniques. We have also developed new equipment that makes it much easier to monitor and test the weld seams. This has been done by our in-house R&D department who cooperate closely with our diver/technician teams. Together they help us invest in the research required to keep evolving the available welding techniques.

Training of our divers consists of both theoretical classes in the course room and practical drills on our pre-

mises. There they have access to a wide range of underwater tools and various other equipment, including a dry welding training area and three dive tanks in which to practice underwater welding. Welding exams are taken in-house in attendance of a representative of the class.

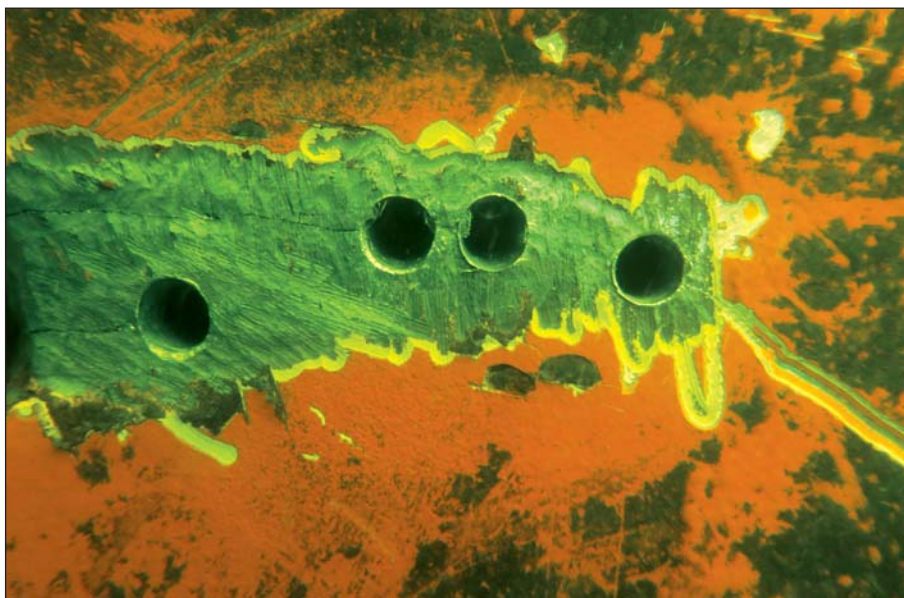
New divers also get the opportunity to assist veteran team members during operations. The training enables them to become experienced divers/technicians and take advantage of the technical know-how and

practical knowledge we have accumulated over the last 45 years.

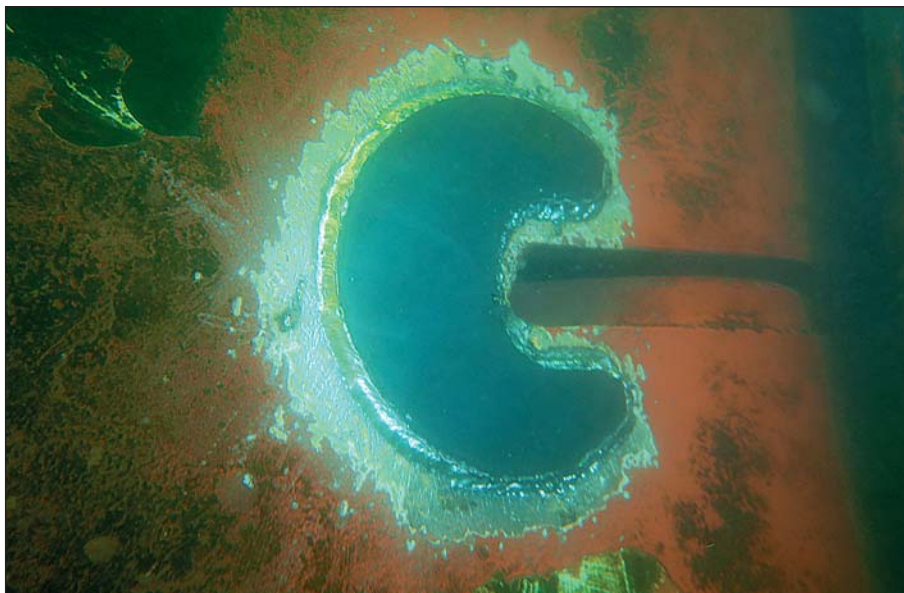
Below we give a summary of just a few of the many underwater welding repairs that we carried out over the last couple of months.

Hull repair on drill ship

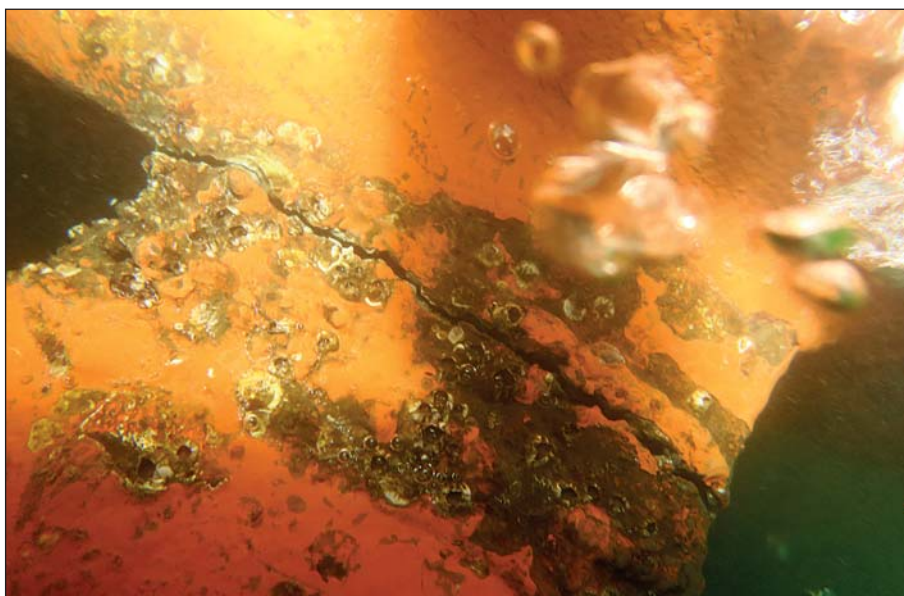
The transit flap of a 225-meter drill ship came loose and started swinging dangerously. This caused damage in the aft bulkhead and a leak in the ballast tank situated behind



Crack arrest were made on all ends of the larger cracks in the rudder.



A C-shaped doubler was installed over each of the three larger cracks in the rudder.



Two thruster brackets of a container ship were almost completely cracked.

the moonpool hull. The vessel was located in Dakar. A fast solution was needed to prevent further damage.

We mobilized a team of diver/technicians. After an inspection of the damage, they disconnected the transit flap. It was then brought to shore, cut in three pieces and taken away. The divers also took all the measurements needed to design a repair plan for the second phase. Because of the instable condition of the flap, it was essential to keep to the highest safety standards, especially during this first part of the operation.

The second part of the operation consisted of the installation of six doubler plates over the damaged areas in the aft bulkhead. Constructed with the exact measurements taken during a detailed inspection, they were positioned and secured underwater by our certified diver/welders. All water was then emptied from the damaged ballast tank. The crew performed an inspection of the tank and confirmed that the compromised hull was once again fully sealed.

Thanks to the installation of the doubler plates the ship could safely start its contract. A permanent solution can now be planned at a more opportune time.

Wet welding repairs of rudder and thruster cracks

A 228-meter vehicle carrier had several cracks along the hinges connecting the rudder flap to the main rudder blade. Fortunately most of those could be repaired by grinding them away and filling the area with clad welding.

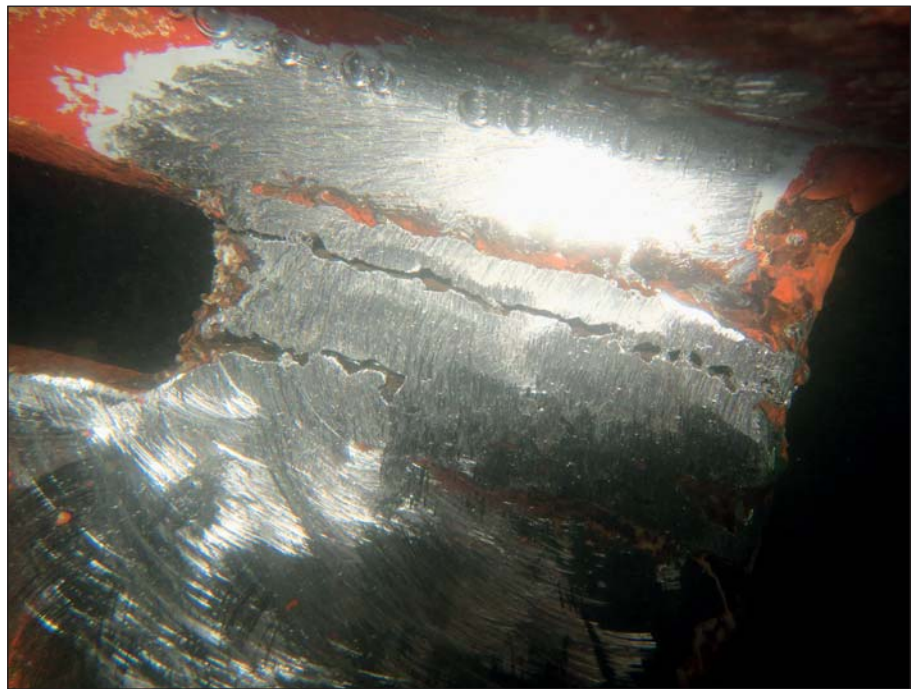
Three of the cracks were too big and needed a different approach. Our

diver/welders first drilled arrests on all sides of these cracks to prevent them from spreading. They then positioned a C-shaped plate over each of the cracks and secured it with wet welding.

This allowed the owner to sail the vessel without having to worry about the condition of the rudder. He can have a permanent repair carried out during the ship's next scheduled drydock visit at a more convenient time and location.

Luckily the cracks on the rudder were spotted during an underwater inspection before they caused problems for the ship. This once again shows the benefits of having regular inspections carried out by competent divers, followed by comprehensive and accurate reports. Our teams can detect any problem so that they can be corrected early and prevent the more costly repair which neglect and further damage would bring about.

This was illustrated when the damage to two of the thruster brackets of a 278-meter container ship was not discovered in an early stage. Both brackets were almost completely cracked. In communication with the class surveyor we proposed



The cracked brackets were first prepared for installation of the steel plates.



One plate was installed on the top of each crack and one on the bottom.

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a temporary underwater repair plan that would keep the thruster safe from further harm. The plan consisted of the installation of four steel plates: one on the top of each crack and one on the bottom.

This meant that the owner could keep his schedule without the hassle and financial setback of an unplanned drydock visit.

Summary

When we send a team out on the road we know that they can perform underwater welding work to the highest quality standard and this on a daily basis. This is very important because our customers pay to get the best result without any unnecessary loss of time. So that is what we deliver. Always. ■

Underwater rudder inspection and follow up repair steers owner clear of trouble

Early on a Tuesday morning we received a call on our 24/7 emergency number from the owner of a tanker that experienced steering troubles with its rudder. The vessel was performing cargo operations in Antwerp and needed a fast on-site solution that would allow it to sail on after commercial operations were complete without losing time and with a fully functioning rudder. Offering fast underwater solutions is what we do best, so we immediately mobilized a team to the vessel's location to assist.

To make an accurate assessment of the situation, our divers started with a thorough underwater inspection of the rudder. This allowed them to communicate the exact situation and the nature of the damage to the owner and our technical department.



The rudder flap was almost completely detached from the rudder.

During this survey the vessel could continue her cargo operations without any hindrance.

The inspection revealed that the rudder's flap was almost completely detached from the rudder. This caused serious troubles during steering. The top hinge had come loose completely. The weight of the flap had severely bent the pin that attached it to the rudder at the bottom hinge and was just barely keeping it from falling off. The edge of the rudder was also cracked and deformed next to the lower hinge.

Because of this deformation, removal of the flap was not straightforward. Many years of experience and technical expertise allowed our technical department to come up with a repair plan within a matter of hours. This solution would allow the owner to continue his vessel on its schedule without any noticeable delay, so he gladly accepted.



The edge of the rudder was cracked and bent.

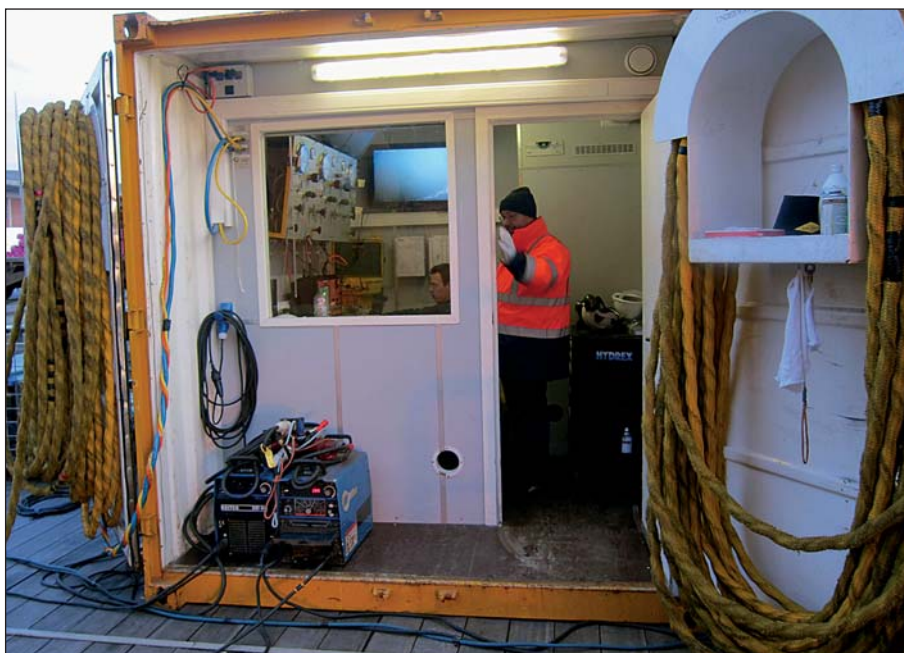


Hydrex workboat next to tanker during rudder operation.

Fast, high quality solution

We have a large stock of equipment available in our fast response center for our repair teams at all times. They could therefore load all the needed gear onto one of our workboats immediately after the repair plan was approved and mobilize to the tanker early in the afternoon of the same day.

After arriving next to the vessel, the diver/welders started the operation by securing the rudder flap with chains. Next they burned off the area of the flap that connected it to the bent pin. Once this was done, the divers left the water and the crew of the tanker slowly moved the rudder's position until the flap disconnected from the rudder and came to rest completely on the chains.



Hydrex team members in monitoring station on workboat.

Fast underwater propeller blade straightening

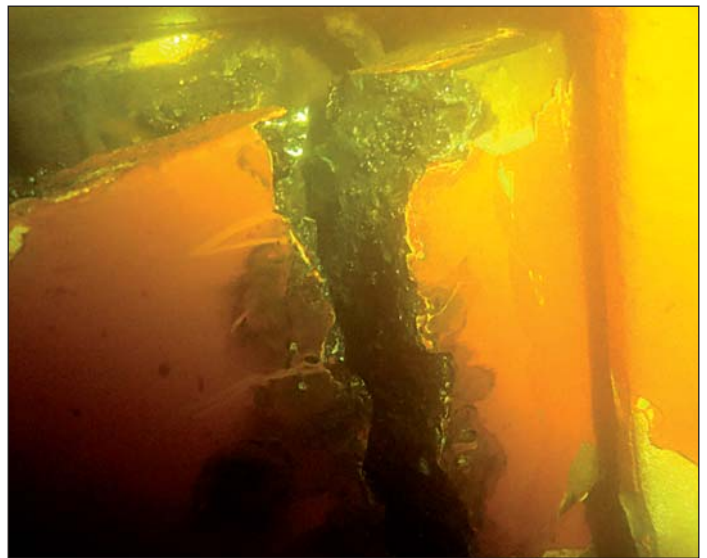
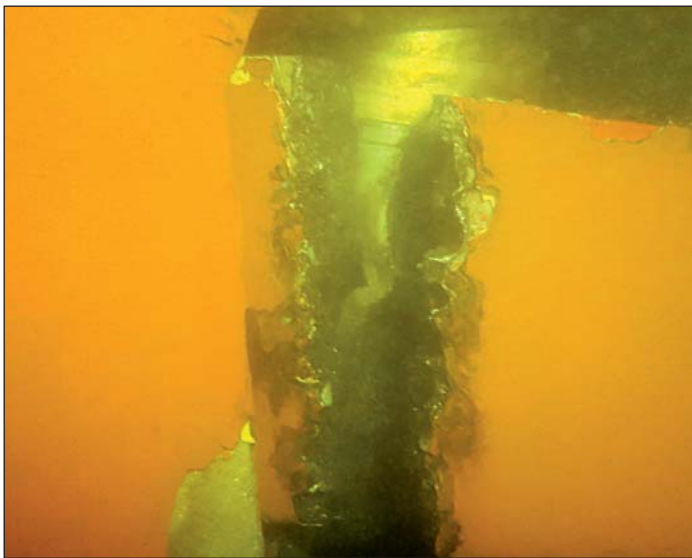


In its quest to provide cost effective services to customers, Hydrex developed procedures to address different kinds of damage to propellers. This research led to the design of the Hydrex cold straightening machines first used in 2002.

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.

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The part of the rudder flap that was still connected to the bent pin was burned off.



Rudder flap brought onto the workboat.



The rudder flap was brought to our workshop and later transported to the OEM.

The flap was then lifted onto our workboat and brought to our workshop. By doing this the vessel could immediately sail on to her next scheduled stop. The flap was later transported to the OEM to be repaired. It will be ready to be reinstalled when the tanker will dock at a convenient time and location that fits the schedule of the owner.

In less than 24 hours we were able to mobilize a team to the vessel, perform a detailed inspection to assess to situation, devise a fast underwater solution and carry out the repair. This is a good example of the start-to-finish services we offer our customers. You can call us with any problem you have with your vessel and we will take the worries out of your hand and take care of every step of the operation. ■

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In-water bow thruster repairs



The Hydrex lightweight flexible mobdocks are designed to be easily transported around the world and are used to close off the thruster tunnel on both sides, allowing divers to perform repairs and other operations in a dry environment around the bow thruster unit.

This technique enables them to reinstall the propeller blades of an overhauled thruster inside the thruster tunnel after the unit has been secured or replace the blades or seals and perform repair work on a specific part without removing the unit.

Since the development of this flexible mobdock technique, numerous

thruster repairs have been carried out by Hydrex diver/technicians around the world.

There is no need to send the vessel to drydock as all operations can be carried out in port or while the vessel is stationary at sea. Normal commercial activities can therefore continue without disruption.

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Always on time



Hydrex offers turnkey underwater repair solutions to shipowners wherever and whenever they are needed. Hydrex's multidisciplinary team will help you find the best solution for any problem encountered with your ship below the water line. We will immediately mobilize our diver/technicians

to carry out necessary repair work without the need to dry-dock.

Hydrex performs complex permanent underwater repairs to thrusters, propellers, rudders, stern tube seals and damaged or corroded hulls. By creating drydock-like conditions around the affected area

we can carry out these operations in port or at anchor.

All the projects we undertake are engineered and carried out in close cooperation with the customer and any third party suppliers, relieving the customer of all the hassle of coordination, planning and supervision.



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