

## Expert underwater cold bending of propeller blades

The world of underwater repairs and maintenance has come a long way since hull cleaning first became popular in the early 1970s. Hull cleaning operations were soon followed by specialist propeller polishing work, aimed at reducing the amount of fouling on an underwater hull and increasing fuel efficiency. Today, however, hull cleaning operations have been hit by increasing environmental legislation worldwide, which has meant that hull cleaning is no longer allowed in certain ports. The resulting effect has been an increase in business for underwater maintenance companies operating in certain ports where hull cleaning is still allowed.

With the recent ban on the application and use of TBT-containing antifouling and the emergence of new generations of TBT-free coatings and non-toxic low-surface-energy products based on the 'non-stick frying pan' approach, underwater hull cleaning is again becoming popular. Specialist underwater repair and maintenance companies around the globe have responded to the market changes by offering new and innovative underwater services. The following articles report on the latest systems, technologies, and services.

THE science of underwater repairs and maintenance has evolved dramatically since its early days, particularly in the case of propeller repairs. US West Coast-based specialist Subsea Propeller Inc (SPI) has pioneered the cold bending of propellers underwater, a process which is difficult to master.

SPI holds the exclusive worldwide licence from John Crane-Lips for the provision of underwater propeller repair services, including the use of Lips' technology, for cold bending of propeller blades. Lips has been performing the cold straightening of propeller blades for more than 40 years, with the first generation bending equipment developed in the early 1960s in-house at Lips' USA facility, but it was not until the late 1980s that technology was developed to carry out the process underwater.

In 1987 this method really began to 'take off', after Kimo Mackey, managing director of SPI, designed a new generation of equipment for Lips. This incorporated several design improvements including features which made it possible to apply the technology underwater. Lips Subsea was formed to offer underwater cold bending of propellers for the first time, and the company also provided full underwater propeller repair services. Ten years later, in 1997, Lips Subsea became SPI.

Working in close cooperation with John Crane-Lips, SPI has developed a worldwide network of diving companies to support it in serving operators. Principal members of SPI's network, all of which have received intensive training in the cold bending of propellers underwater, include All-Sea Enterprises in Vancouver, Canada; Trident BV in Terneuzen, The Netherlands; Miami Diver, in Miami, USA; Curacao, The Netherlands Antilles; and UMC in the UK and UAE. Three of these diving companies, All-Sea, Trident, and Miami Diver, are licensed to use SPI and Lips' technology.

Since 1987 Kimo Mackey has supervised the successful underwater straightening of hundreds of bent propellers, repairing distortions from just a few millimetres in from the edge, to bends exceeding 600mm from the edge. In each case, whether the bend is only 20deg or over 100deg, straightening involves an assessment of the propeller material and condition and then the measured use of straightening devices to restore original geometry. Usually, repairs are completed at a vessel's scheduled port of call.

As a result of its experience, SPI has improved the equipment and the methods for underwater propeller blade straightening, including the manufacture of new generations of straightening devices. SPI currently has six portable devices located worldwide. In addition to straightening equipment, it has also developed underwater tools featuring high-tech components for evaluating blade geometry. Proper evaluation of blade geometry and damage is necessary in restoring blades to their original manufactured shape.

However, the key to SPI's success is not its equipment, but the co-ordinated and extensive training of selected personnel from SPI's network of diving companies. This training, says Kimo Mackey, is essential to insure that propeller

repairs performed underwater are 'shop quality' and are executed without injury to the divers or the propellers. Training is especially critical in propeller blade bending. The craft of cold straightening is complex and dangerous due to the extremely high forces involved; the work involves applying tremendous pressure to a very slick surface in a concentrated area.

Knowledge of the properties of the propeller material and skill in using the bending equipment are necessary to prevent the propeller blade from cracking and the equipment from injuring the diver. Consequently, even in an organisation as experienced as Lips, the number of people who have become 'expert' in cold straightening has always been low.

SPI provides specialised training to selected divers at Lips' facility in Drunen, in The Netherlands, and underwater on site. To qualify to perform underwater cold straightening without direct (in water) supervision, divers must complete a lengthy apprenticeship to become propeller technician divers. They must be able to demonstrate knowledge and skill in propeller metallurgy, propeller geometry, identifying micro-fractures, assessing the impact of blade geometry on propeller performance, and safe operation of the straightening equipment.

Essentially, SPI is not a diving company - it is a propeller repair company that works underwater. Currently, there are just three propeller technician divers who are fully qualified to direct underwater cold straightening of bent propellers. Each has completed more than six years of training, involving classroom and in-situ instruction. Several other propeller technician divers from All-Sea Enterprises, Trident BV, and Miami Diver are now completing training. In a typical propeller straightening job, one fully trained propeller technician diver supervises the straightening in

The straightening of bent propeller blades underwater by such leading exponents as Subsea Propeller Inc (SPI), John-Crane Lips and Miami Diver has led many owners and operators to reap substantial savings in time and money.

