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**Israeli Navy solves rudder cavitation problem with Ecoshield**



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Subsea Industries NV was founded in 1983 to take care of the design, development and marketing of an evolving line of underwater hull

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# Israeli Navy solves rudder cavitation problem with Ecoshield

The Israeli Navy turned to Ecoshield for protection of the rudders of four new corvettes. The rudders perform extremely well but are highly prone to cavitation damage. The Israeli Navy did not want to have to modify the rudders in any way for fear of losing speed or maneuverability. The designer of the rudders, Becker Marine, recommended Ecoshield from Subsea Industries to solve the problem.



Commander Sagy Hakoon, Head of Platform Branch in SA'AR 6 Department of the Israeli Defense Forces

## SA'AR 6 Project

Between 2020 and 2021, the Israeli Navy took delivery of four, new, German-made SA'AR 6-class corvettes. These corvettes were designed specifically to protect Israeli natural gas platforms in the Israeli exclusive economic zone (EEZ) and to defend Israeli shipping lanes in the Mediterranean.

These 90m, 2000-ton corvettes powered by four diesel engines, are capable of a maximum speed of



One of the new Israeli Navy SA'AR 6 corvettes on patrol in the Mediterranean.

around 26 knots and have a range of 4,000 nautical miles. They are also highly maneuverable as one would expect from a fast, naval craft of this type. They are to date the largest and most heavily-armed warships in the Israeli Defense Forces.

The first of the four ships, the *Magen*, was commissioned in 2020. This was followed by the *Oz*, the *Atzmaut* and the *Nitzachon* during the following year.

Built for speed and rapid maneuvering, the corvettes have twin propellers and rudders. It is the rudders specifically which are the subject of this article.

Commander Sagy Hakoon is Head of Platform Branch in SA'AR 6 Department of the Israeli Defense Forces, responsible for the technological and logistical support of the SA'AR 6 vessels. He was formerly part of the Naval Architect team

of the Israeli Navy stationed in Germany for the designing and building of the ships.

Commander Hakoon provided valuable feedback on the success of Ecoshield on the rudders of the SA'AR-6 corvettes.

## Rudder surprise

Commander Hakoon recalls, "We were originally using the same standard anti-fouling paint system for the rudders that was on the rest of the underwater hull: the primer layers were epoxy based, and the top layers were the active anti-fouling system."

"After the sea trials of the first ship, the *Magen*, we docked her," Commander Hakoon continues. "We witnessed severe damage of the coating on the rudder blades. The damage was shocking to everyone, from the shipyard designers, to the rudder





*The new Israeli Navy SA'AR 6 corvettes were designed to protect Israeli natural gas platforms in the Israeli EEZ.*

blade designers. The reason for the damage was very clear: cavitation phenomena. After some trials we made we saw that the cavitation begins at about 70% of the top speed without maneuvering, and begins even earlier when the rudder blade is not parallel to the ship's longitudinal direction, in other words, when the vessel maneuvers. The real surprise was that the cavitation was so aggressive that damage to the steel

was about to occur after only a few days of sea trials."

Cathodic protection on the rudder blades themselves was not an option, as Commander Hakoon explains: "The additional drag (geometrical resistance) resulting from the anodes is relatively high, and would reduce the vessel's maximum speed which is crucial for our Naval vessels. We had assumed anticorro-

sive paint would be sufficient. But this was not the case."

"Cathodic protection is not very relevant for the cavitation effect we have on the rudder," continues Commander Hakoon. "The sacrificial anodes would not last long enough. But I might change my view on this in the future, if we discover that one or two small areas on the rudder continue to suffer from cavitation damage."



*The rudder of one of the SA'AR 6 corvettes after a few days of sea trials with conventional hull coating on the rudder.*



*Rudder grit blasted to 2.5 SA cleanliness and a profile of 75µm ready for Ecoshield first coat.*

The designers and suppliers of the rudders, Becker Marine, evaluated the situation.

"One solution we had in mind was to replace the rudder blade with a newly-designed one," says Commander Hakoon. "This would of course require a major retrofit which would have taken a significant amount of time and effort. It was a solution that no one wished to face. First of all, time was very crucial to us. This kind of retrofit would take months if not longer, since a new design of a rudder would be required, and the manufacturing and





*Rudder being coated with Ecoshield. The first coat (white) is complete and stripe coating is being applied prior to the final coat (red).*

installation is a lengthy process. We needed to receive the vessels and sail them to Israel to begin the weapon integration. Secondly, the rudders' performance is very good. They maneuver the vessels excellently and they are not producing drag. If we changed to any other rudder, we would risk losing the high performance we currently have."

## **Ecoshield**

"We received a recommendation from Becker Marine Company, who designed the rudder blades," says Commander Hakoon. "After we reported the severe cavitation, they responded that the most efficient way they saw of handling the situation was to protect the rudder with a durable coating for cavitation. Based on their experience, they said Ecoshield from Subsea Industries showed durability and resistance to cavitation."

The Israeli Navy had never used Ecoshield or Ecospeed coating before. It has now been under evaluation on SA'AR 6 rudder blades beginning with the *Magen*. Her rudder

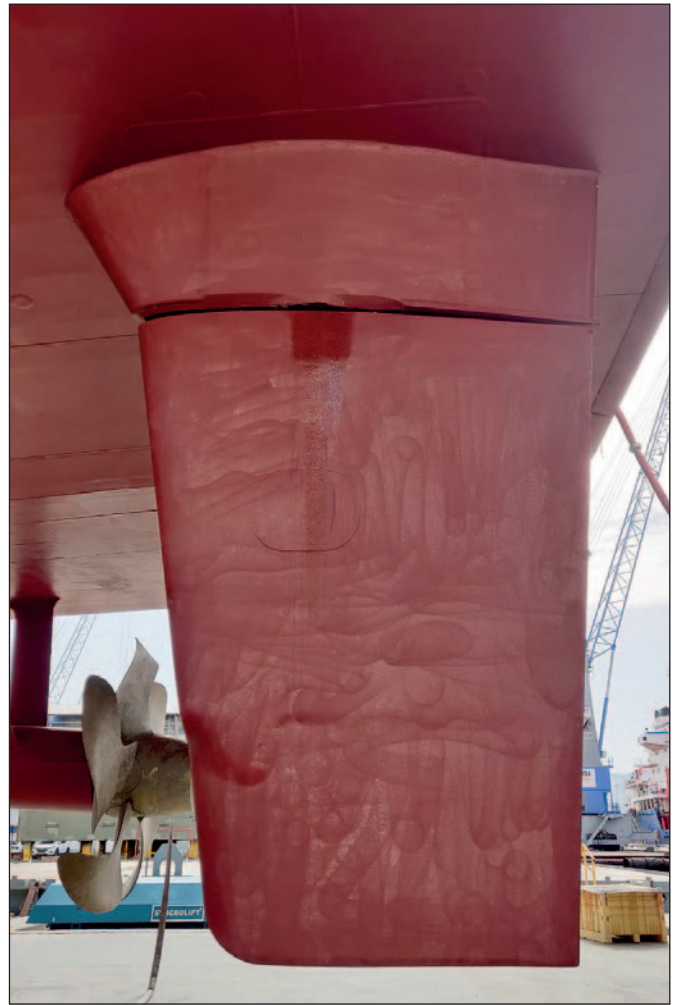
was coated with Ecoshield in July 2020 in Germany. The rudders of the other three corvettes have subsequently been protected with Ecoshield.



*Inspector from SCICONworldwide checking that the correct final DFT of at least 1000 µm has been achieved uniformly.*



*Finished rudder coated with two coats of Ecoshield for protection against cavitation.*



*The rudder of one of the SA'AR 6 corvettes after she sailed about half a year after Ecoshield was applied. Fouling has been cleaned off in drydock.*

The *Magen* went into drydock in the spring of 2022 and Commander Hakoon had a chance to check on the results up to that point.

“Overall, it looks very good,” he says. “On ship 1 (*the Magen*, the flag ship) there are some coating damages, but it is too early to decide what is the main cause since we have also replaced the rudder mechanism, which was causing abnormal vibrations in the rudder blades and magnifying the cavitation. This was remedied during the docking. Not much was required in the way of touch-ups. On ship 1 (*the Magen*), we had a peeling of the paint on one area, which exposed the bottom layer of two layers of Ecoshield. As mentioned, this may be a result of the vibration magnification of the rudder mechanism, which has now

been replaced. Up to now, it looks pretty promising. We need to inspect at the next dockings (2024 and 2025) to finalize our conclusions.

### **The future**

“Now I am looking to the next phase,” says Commander Hakoon. “If everything goes well and the Ecoshield is resilient enough, we would probably only renew the Ecoshield (local repairs for damages, general recoating for wear). If Ecoshield did not work, we would probably have to replace the rudder blades with newly designed ones. If Ecoshield is successful, we might extend it also to the struts of the vessel if needed. We will evaluate after the drydocking surveys on the vessels in the next couple of years.”

“The service from Subsea Industries has been very good. The engineers and the inspector I met in Kiel, Germany during the Ecoshield application on the vessels were very professional. I am sure I will need some more consultations in the future.”

“Our hope is that the use of Ecoshield will enable us to maintain our current drydock maintenance schedule. I am very optimistic.” ■

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# Corrosion damage very repair made ✓ easy



**S**ubsea Industries has a product for filling and building up a corroded and pitted steel surface to its original form prior to recoating with Ecoshield. Ecofix is as tough as the steel itself, machinable, and can be used to repair most pitting or corrosion damage on rudders, stabilizer fins, thrusters and other underwater gear.

Ecofix is used in combination with Ecoshield, the ultimate rudder protection coating. When a rudder or other piece of underwater ship gear has not been properly protected, the surface will become corroded.

Cavitation can cause severe pitting. The steel needs to be restored to its original shape with a smooth surface prior to recoating.

This is where Ecofix comes in. It is a superior, tested and proven filler. Because it uses the same basic resin as Ecoshield, the coating can be applied just one hour after the filler. The bonding and hardness are extraordinary. This is the effective alternative to very expensive fillers. And because it is part of the Ecospeed/Ecoshield family, it is fully compatible with our coatings.

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All products produced by Subsea Industries have the same goal in

mind: To keep the underwater part of your vessel in the best possible condition for its entire lifetime at the best possible performance.

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