

## IVR damage prevention leaflet

### Watch your closed cooling water system with box-cooler

Water leakages from below the cylinder head; cracked cylinder liner collars.

We are talking here about a phenomenon that can occur on engines with a closed cooling water system with box-cooler. It concerns mainly semi-speed engines with already many running hours on the counter before this problem occurs. Suddenly such kind of water leakage appears. It starts with one cylinder. Somewhat later another cylinder followed by others, etc.

After each repair and during a running tests at the berth, all temperatures and pressures appear to be within the limits described by the engine manufacturer. During the investigation it also appears that the engine block air vent pipes are in a good condition and not blocked; these vent pipes are not at the basis of the problem.

One is living in the dark regarding the cause of the damage.

Mostly, one tends to conclude that a cooling water overheating occurred in the past which led to starting cracks in the cylinder liner collars which grew later on till the water leakage appears. But this conclusion is not supported any longer as from the moment that it appears that a repaired liner is leaking again after a while.

In some extreme cases, also heavy cavitation pitting was found on the engine block walls and on the outer surface of the liners notwithstanding evidence of a good cool water treatment could be transmitted.

At the occasion of such damage case, an intensive investigation was carried out on this water leakage phenomenon. On each cooling water device, such as the air after cooler, oil cooler, box-cooler and cooling water pump, a pressure gauge and a temperature gauge was fitted on both the cooling water inlet and outlet. A sea trial was carried out with a fully loaded ship at several engine rates. At the full load trial, it was noted that there was a negative pressure (depression) at the suction side of the cooling water pump and that the pressure difference over the box-cooler was significantly higher than what the box-cooler manufacturer allows.





The box-cooler has been removed from the ship and an investigation on it was carried out.

The pipes of the piping bundle appeared to be soiled at the inside.

### Damage mechanism

The internal pollution of the box-cooler created a too high pressure difference over the cooler. Consequently, a depression occurred at the suction side of the cooling water pump. Because of this negative suction pressure, the cooling water pump was not functioning any longer according its design curves and delivered consequently a too low rate. The too low rate created an insufficient cooling of the engine. This led to cracked cylinder liner collars and water leakages. The lower cooling water rate also changed the flow pattern of the cooling water inside the engine block (pressure, speed) which caused the existence of the cavitation phenomenon.

### Prime cause

The damage mechanism starts with the internal pollution of the box-cooler. This pollution has been analysed in a laboratory. The analyses result reveals that the pollution is a deposit of calcium phosphate and calcium silicate. The chemical compounds arise by the presence of calcium in the cooling water and the inhibitor. Over time (years), the cooling water inhibitor thus produces chemical compounds which settle at the inside of the pipes of the box-cooler, leading to blockage of the pipes.

### Necessary loss prevention measures to be taken

- install permanently pressure gauges at the inlet and outlet of the box-cooler and observe regularly the pressures (especially during sailing at full load). The pressure difference may **never** be higher than the value described by the box-cooler manufacturer. In case of too high pressure difference, the box-cooler inside needs to be thoroughly cleaned.

Ask the box-cooler manufacturer for the exact maximum allowed pressure difference.

- install permanently a pressure gauge at the cooling water pump suction. The pressure may **never** be lower (negative) than zero millibar. A depression as such is not allowed at the suction of the cooling water pump.

In case that the pressure difference over the box-cooler is within accepted values and that there is nevertheless a depression at the cooling water pump suction, contact the engine manufacturer for advice.

This damage prevention leaflet has been made in close co-operation with MSc. C. Maenhout.