

Piston Crown Maintenance

On the morning of October 11, 1994, a 33,037 dead weight ton, 12-year-old, bulk cargo vessel lost propulsion while inbound in Admiralty Inlet. The vessel was forced to shut down her main engine because of low lube oil pressure and high exhaust gas temperature. A crack developed in the crown of piston number two, allowing the lube oil that was cooling the piston, to leak into the cylinder. The vessel was 2,880 yards from Foulweather Bluff when the engine was shut down. She was towed to Seattle, Washington for repairs.

The main engine is a Mitsubishi 6UEC 60/150 H rated at 10,800 horsepower. The engine is a uniflow scavenged, turbo-charged, two stroke, single acting, cross-head type design. This particular engine has two injectors for each cylinder.

The vessel had just completed an eighteen day transit from China and arrived at the Port Angeles pilot station at approximately 0100 hrs. At midnight, engineering personnel switched from heavy fuel oil to diesel oil. At approximately 0405 hours, the engineer on duty received a main engine low lube oil pressure alarm and a high exhaust gas temperature for number two piston. The main engine was slowed to determine if the oil pressure and/or exhaust gas temperature would change. When the pressure and temperature did not change the main engine was stopped.

Once the number two piston was removed and cleaned, a small crack in the piston crown was found. Close observation of the piston crown in the area where the forward injector spray pattern impinged on the crown surface revealed thermal corrosion. The corrosion was in the form of etching and grooving that created a pitted surface with small local cavities.

During the casualty investigation, the preventative maintenance schedule and maintenance procedures for the pistons were discussed with the Chief Engineer. The piston overhaul procedures appeared to be limited to visual checks of all exposed surfaces. A dye checking procedure is not used unless abnormalities are seen first. Furthermore, the piston

WHY IT MATTERS

This bulletin was prepared to share lessons learned with industry and the interested public. Prevention recommendations are also made to prevent similar occurrences. Sharing lessons learned is important if Washington State is to achieve its "zero spills" goal.

WEBSITE INFORMATION

<http://www.ecy.wa.gov/programs/spills/spills.html>

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crowns were not removed for inspection during the piston overhaul periods.

Measures have been introduced by Mitsubishi to improve the performance of piston crowns. These measures will reduce thermal corrosion and wear on the flame side of crowns. However, if carbon is allowed to build up and adhere to the cooling surface side of the piston crown, the build-up will decrease the cooling effect of the cooling oil and may result in failure of the crown.

To prevent thermal corrosion caused by accumulated carbon sludge on the cooling side surfaces of the piston crown, Mitsubishi recommends that the piston crowns be removed and cleaned every two to four years depending on initial inspection observations. If the first inspection reveals considerable buildup of carbon sludge, then a shorter inspection period is warranted.

In addition, Mitsubishi recommends two other measures to prevent thermal corrosion. The first process requires the build-up of the crown surface with a special steel alloy; and the other measure is a jet-cooling system that enhances the cooling of the piston crown. The jet-cooling system replaces the existing piston inner piece and piston rod inner pipe. This system directs part of the cooling oil to the cooling surface at a right angle jet stream, making the adhesion of carbon to the cooling surface difficult. The jet-cooling system can be installed relatively easily during a piston overhaul period.

Ecology strongly urges each company to review their preventative maintenance policies and procedures for piston overhauls. Piston crown failures due to

thermal corrosion can be prevented by using one or more of the engine manufacturer's recommendations.

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