Cylinder Liner Cavitation Erosion On Diesel Engines

The AERA Technical Committee offers the following information on cylinder liner cavitation erosion on diesel engines. This information should be considered anytime maintenance is being performed on a diesel engine.

The cavitation erosion that is found in diesel engines on the exterior side of the cylinder liners (wet) has been a theme of investigation by engine and corresponding component manufacturers, even though no definite manner of eliminating the problem has been found. See Figure 1.

Figure 1. Severely Eroded liner

The degree and size of erosion or decay as well as its form and distribution on the affected zones can vary from engine to engine and inclusively from cylinder to cylinder within the same engine.

The affected areas form vertical strips or patches sometimes in alignment with the thrust face of the piston within the cylinder, or also formed immediately over the top sealing ring of the liner. The erosion can penetrate the wall of the cylinder and permit the flow of antifreeze/coolant to the oil or vice-versa.

The cavitation erosion is caused by excess in harmonic vibrations of the engine and in some cases by loose fitting liners that result in a fast formation and implosion of small vapor bubbles within the coolant which attack the cylinders' liner wall. The vibration in combination with collapsing bubbles produces an

erosive effect over the surface of the liner's exterior face. This occurs as the piston moves up and down within the cylinder causing vibration especially over the area of thrust in the cylinder liner.

We can say that the wall of the sleeve, which comes in contact with the coolant, quickly moves inwards and outwards striking these vapor formations. During this process, tiny bubbles are formed that implode or collapse violently producing shock waves against the liner's wall. The results of these implosions at the impact area of the liner's wall have been calculated to reach over 10,000º F with pressures of over 10,000 psi.

A specific material, which would prevent cavitation erosion within reasonable cost, has not yet been found. Nevertheless, some coatings can be applied to delay cavitation erosion until it is time for major engine repairs.

In order to reduce or prevent cavitation, manufacturer recommendations should be followed.

In many cases, cavitation can be avoided by reducing harmonic vibrations. For example, by making sure the injection complies with the manufacturer's specifications, the engine's speed is governed according to the manufacturer's data and that the control functions. Also, do not underestimate the importance of correct clearances between liner and cylinder blocks; incorrect liner fit is a serious contributor to liner vibration resulting in cavitation erosion.

Engine manufacturers have specific additives for the coolant called SCA (supplementary cooling additive). These additives will form a protective coating over the cylinder liner, which is exposed to the coolant, therefore reducing cavitation damage. With time, additive concentration reduces in the system, consequently making it necessary to follow system maintenance recommendations in order to keep the adequate levels.
The following points will be supplied:

1. pH control to avoid corrosion
2. Water hardness control to avoid mineral deposit formation
3. Cavitation protection

In all cases, it is required that all manufacturer's recommendations regarding coolants, base additives, additives, coolant filters as well as maintenance schedules should be strictly adhered to or followed at all times.