



Service Letter

SL08-495/KNB
May 2008

**Condition Based Overhaul of Crank-train Bearings
MC/MC-C and ME/ME-C Type Engines**
Action Code: WHEN CONVENIENT

Dear Sirs

The purpose of this service letter is to inform about MAN Diesel's introduction of relevant bearing monitoring systems. When installed, open-up inspections on a routine basis can be avoided or decreased in frequency. Such monitoring systems therefore form the ideal basis for carrying-out "Condition Based Overhaul" (CBO) on crank-train bearings (main, crankpin and crosshead bearings).

By introducing such monitoring systems, severe bearing damage resulting in consequential damage to the crankshaft, bedplate and crossheads can be avoided, and long and costly repair time can be minimised.

Background

The function of a lined plain bearing shell is to withstand the dynamic loading from combustion and mass forces without suffering from fatigue and wear. At the same time, the lining provides a safety zone, in which unexpected wear can occur without the risk of suffering major damage to the crankshaft and bearing housing. In this way, the risk of oil mist formation caused by overheating is suitably delayed in the event of a bearing incident.

Bearing wear and damage, evolving into steel-to-steel contact between the journal and shell, may result in repair periods counted in weeks or even months. With crankshaft related failures, off-size machining of journals is typical, which can result in notations in the class-book, influencing the market value of the vessel negatively.

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Recent experience support statistics showing that there is an increased risk of damage to a healthy bearing after a *regular un-provoked open-up inspection*. In particular main bearings are vulnerable to mis-assembly, dirt, scratches, etc.

Water In Oil is a major contributor to a poor bearing condition, and worst for crosshead bearings having a lead-based overlayer featuring a nickel interlayer. In a number of cases, we have learned that with water contaminating the system oil, rapid wear from corrosion can lead to scuffing between the pin and the nickel-interlayer, which can lead to steel-to-steel contact in a matter of hours (see SL87-219, SL90-272, SL90-273 & SL05-460).

Spark Erosion is another risk element to bearings, which over the years has been recognized as being critical for main bearings (see SL83-193 & SL86-213). A recent case where a defect shaft line earthing device led to extreme and relatively fast occurring wear of the main bearings eventually failing, resulted in a major repair of the engine. A new SL concerning *spark erosion* will soon be sent out.

Further to the above described problems, other damage causes still exist, such as fatigue of white metal lining, incorrect assembly, filter burst (SL07-481), oil contamination, broken-off oil pipes, foreign matters entering the oil way, etc. Some of these incidents can typically occur following the above-mentioned regular open-up inspections.

All of the above damage causes have been known in the industry for a long time. However, port stays are very short nowadays, leaving only minimum time for routine inspections. As a consequence, the possibility of discovering an evolving bearing damage in good time is correspondingly smaller.

Precautions

Oil Mist Detection (OMD) will trigger a slow down, but in most cases the slow down will be triggered too late to avoid harm to the bearing journal or housing.

Bearing Temperature Monitoring (BTM) by oil temperature measurement has been an option on all MAN B&W engines for some years now.

For all bearings, the temperature will rise before steel-to-steel contact occurs if the oil supply fails, but for most BTM systems, the oil supply is also the transmitter of bearing temperature to the sensing element. Therefore, we have experienced cases, where a BTM system failed to alarm in spite of severe wear of a bearing, even with steel-to-steel contact. This is particularly the case with crosshead and crankpin bearings, where the sensing element relies on splash oil hitting a collector for a limited period of a cycle.

Main Bearing Temperature Monitoring (MBTM) systems have proven to have a higher rate of success in alarming before severe damage to the main journal becomes a reality.

Bearing Wear Monitoring (BWM) systems connected to the alarm system and work by measuring the position of the crosshead assembly in bottom dead centre position relative to the crankcase structure at each revolution. A BWM system measures wear above a certain threshold value for all three principal bearings simultaneously, making changes in the loaded shell thickness recognisable safely before steel-to-steel contact occurs (see Enclosure 1).

Water In Oil Monitoring (WIOM) monitors the water content directly at the system lubricating oil inlet on the engine, and can be connected to the alarm system.

Shaft line earthing device avoids spark erosion and monitors electrical potential, and can be connected to the alarm system.

Systems that facilitate condition based open-up inspections

BWM, MBTM and WIOM systems are being introduced for new engines and can be retrofitted on vessels in service. When retrofitted, MAN Diesel will accept a change in the maintenance programme as outlined below.

Shaft line earthing devices must be kept working and be equipped with monitoring connected to the alarm system.

Bearing inspection schedule

Due to the higher safety against major failure, MAN Diesel considers it feasible to completely omit regular open-up inspections of any of the three crank-train bearings featuring an approved BWM system connected to the alarm and slow-down system.

For engines comprising an approved MBTM system, regular open-up main bearing inspections can be omitted.

If the BWM, the MBTM system or other alarm indications for an abnormal bearing condition are triggered, investigations must follow and, eventually, extraordinary open-up inspections should be carried out according to the findings.

Such inspections should include:

- “feeling over” by hand for abnormal high temperature
- bearing edge feeling with wire feeler
- measurement of top and bottom clearance changes compared with earlier records
- crankshaft deflection changes compared with earlier records (in case of main bearings)
- search for bearing debris in oil pan and oil filter
- lead (Pb) and water (H₂O) in system oil (see SL05-460).

When the reason for the alarm has been found, and the cause has been resolved, the bearing in question may have to be exchanged with a new spare bearing before

continuation of the voyage. However, on a vessel featuring BWM, it is obvious that the crew is in a much better position to judge the severity of the bearing situation (degree of wear). This will most likely make it possible to sail to a safe place at reduced speed, without risking unnoticed wear-through of the lining.

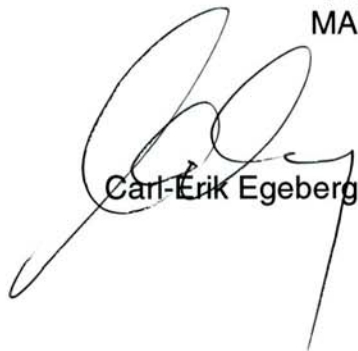
The above-described change in the regular bearing open-up intervals will be included in the latest editions of the manuals.

The major classification societies have a positive attitude towards the new criteria for bearing performance evaluation.

You can contact our PrimeServ department (primeserv.cph@mandiesel.com) for further information about retrofit bearing monitoring systems, or see the list of makers in Encl. 2.

Questions or comments regarding this SL should be directed to our Dept. LEO (leo@mandiesel.com).

Yours faithfully
MAN Diesel A/S



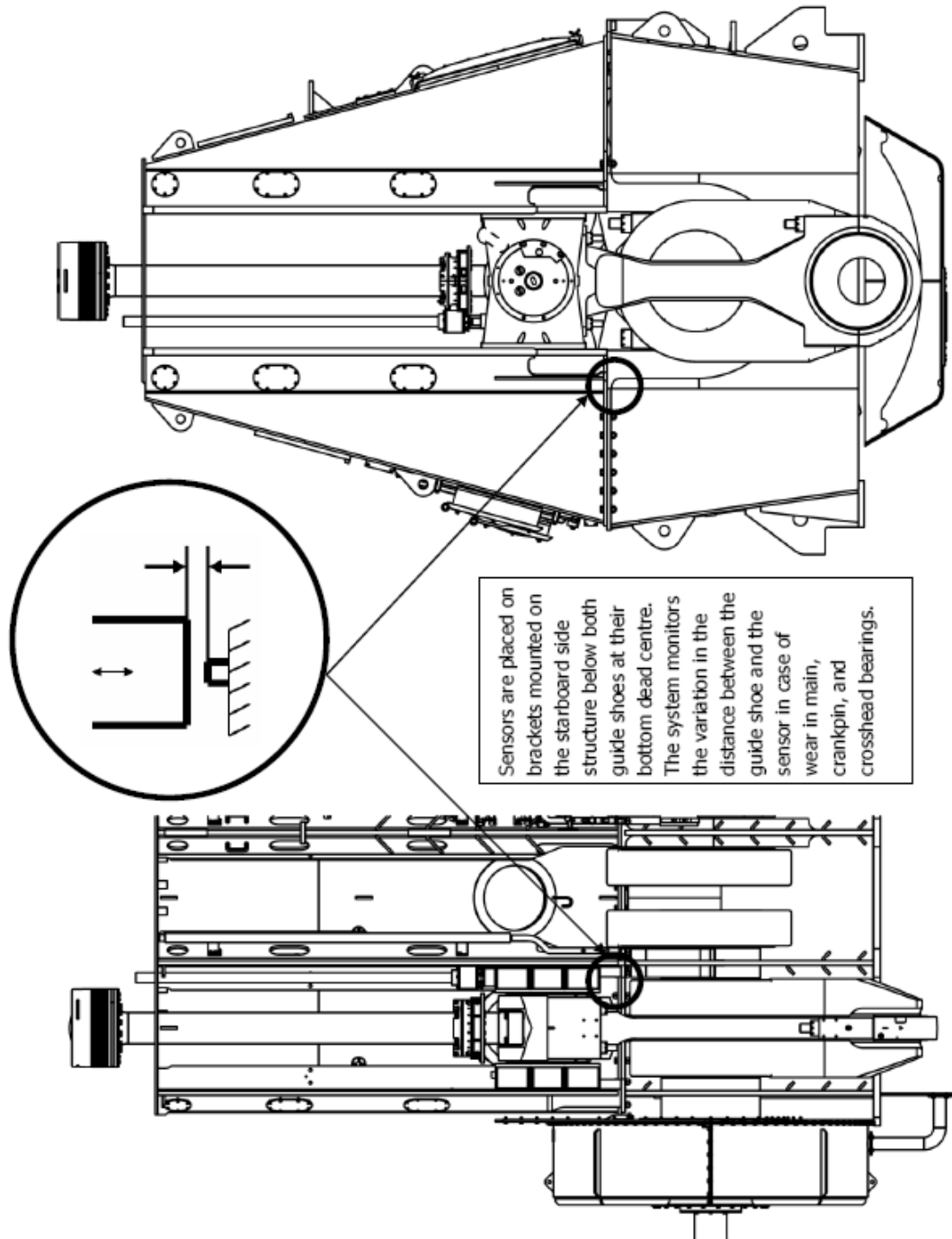
Carl-Erik Egeberg



Stig B. Jakobsen

Encl.

Principal sketch of Bearing Wear Monitoring system





Monitoring system makers

At present, MAN Diesel cooperates with four makers of MBTM and BWM systems. The makers listed below provide systems that are approved by MAN Diesel to as standard equipment for new engines as well as for engines in service.

All the systems listed are available from MAN Diesel, and can be installed and commissioned through the MAN Diesel PrimeServ organisation. In spite of the differences in the makers' interface and features, they all provide the necessary output that forms part of our approved bearing monitoring package, providing alarm and slow down output to the safety system.

- Amot www.bearingwear.com
BWM system: XTS-W
- Dr. E Horn <http://www.dr-e-horn.de/>
BWM system: BDMS
MBTM system: BTMS
- Kongsberg <http://km.kongsberg.com>
BWM system: Bearing Master
MBTM system: Bearing Master
- Rovsing Dynamics <http://www.rovsing-dynamics.dk/>
BWM system: OPENPredictor