MAN B&W Diesel

Service Letter

SL05-460/NHN
November 2005

Crosshead Bearing Condition
Action Code: AT FIRST OPPORTUNITY

Dear Sirs

The purpose of this service letter is to inform about the risk of suffering crosshead bearing damage due to excessive water contamination of the lube oil system and the relevant countermeasures.

Water in the lube oil system may lead to corrosive wear of the overlayer and, eventually, mechanical damage to the crosshead bearing, with high costs as a consequence. We therefore recommend that you follow the below guidelines to avoid crosshead bearing damage.

Corrosion of the overlayer

If the oil system becomes contaminated with an amount of water exceeding our limit of **0.2%** (0.5% for short periods), see the Operation Manual, **Chapter 708-04, *Maintenance of the Circulating Oil***, acute corrosive wear of the crosshead bearing overlayer may occur. The higher the water content, the faster the wear rate. A water content higher than 1% could lead to critical damage within a few days in operation.

The overlayer in crosshead bearings consists of a thin, soft lead-tin-copper galvanic alloy covering of the bearing lining metal. It is used in both white-metal and AlSn40 (tin-aluminium) lined crosshead bearings.

In AlSn40 bearings, the overlayer is always bonded to the bearing metal by a very thin interlayer of Ni (nickel), or Ag (silver). There is no interlayer in white-metal based bearings, but the risk of corrosion is still present.

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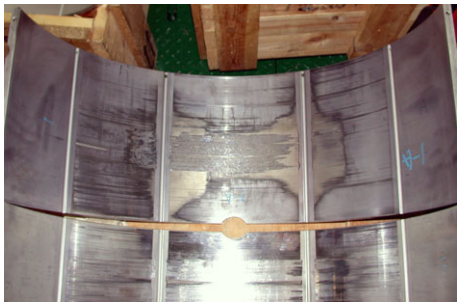
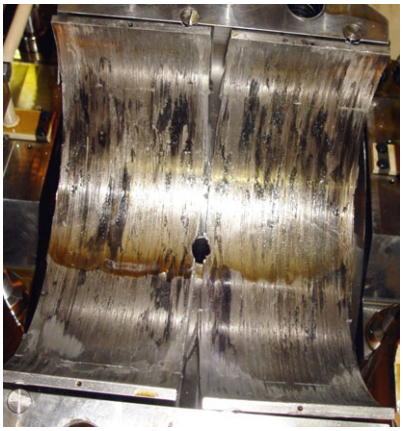
Wear of the overlayer changes the geometry of the bearing surface and, thereby, the intended “embedded arch” geometry. A change in the bearing geometry will obstruct the oil film formation, which is critical for the correct functioning of the crosshead bearing.

Furthermore, excessive wear of the overlayer in AlSn40 bearings could, eventually, expose the interlayer to nickel-to-steel contact with the crosshead pin, and result in scuffing action between the pin and the bearing shell.

The photos below show the stages of corrosive wear of the overlayer.



Initial scuffing of Ni-layer



Bearing metal worn out, steel-steel contact

In addition to damaging the components, there is, in extreme cases, a risk of a crankcase explosion.

Inspection of crosshead bearings

As described in earlier service letters (SL87-219, SL90-272 and SL90-273), AlSn40-based crosshead bearings must urgently be replaced as soon as possible if an open-up inspection shows more than 5% of the nickel layer exposed. If one bearing unit has more than 5% of the Ni-layer exposed, it is very likely that all the other units suffer from a similar extraordinary wear, and they should therefore be replaced as well.

To decide which bearings to inspect first, all top clearances should be measured and compared with the shop test/sea trial records. If large deviations are found, and/or if bearing “dust” is found in the surrounding area in the frame box, those bearings should be the first to be inspected.

Countermeasures against corrosion – Lube oil system

The water content in the lube oil system is normally not measured on a regular basis. However, to prevent water from accumulating in the lube oil and, thereby, causing damage to the bearings, the oil should be monitored manually or, alternatively, automatically by means of an oil condition monitoring system.

Manual oil monitoring can be carried out, e.g. visually, as the oil changes in appearance when mixed with water. Portable equipment can be used as well, but to ensure efficient and constant monitoring, use of a continuous measuring sensor can be used.

A water monitoring system should trigger an alarm when the water content exceeds 0.2%, and preferably again when exceeding 0.5%.

If 0.2% water (0.5% for short periods) contaminates the lube oil, the water leakage should be found, and the source of the water contamination (e.g. separators, heat exchangers, cooling water leakage, etc.) should be inspected and rectified if defect.

For online monitoring of the water-in-oil content, we are currently testing a large number of different types of equipment. We have found that some of the equipment in use in the industry today does not work as expected with the prevalent system oils. At this relatively early stage, we recommend four products which are suitable for all system oil conditions, and another two seem suitable for most situations, see the enclosed table of on-line water monitoring equipment.

Today, the water content can be measured manually with an on-board analysing kit from the available equipment makers on the market, such as *Kittiwake* or *Unitor*. The oil companies will normally be of assistance and provide similar equipment. However, we recommend, as a minimum, that manual equipment be acquired at first opportunity.

The laboratory analyses performed by the oil suppliers at regular intervals provide important information on an on-going or previously encountered over-layer corrosion, because the lead content will build up as lead compound dissolved in the oil.

These elements will not be removed by filters or purifiers, and they will there-fore appear in the elementary analysis normally provided in the analysis results. When observing the regular analysis results, it is possible to monitor and alarm for an evolving corrosion condition of the overlayer, by evaluating the lead content in the oil system.

The following values for the **lead content** in the oil system can be used as a guideline:

- **0-4 ppm**
  Normal
- **5-10 ppm**
  Inspect filters and crankcase for bearing debris, and prepare inspection of crosshead bearings when convenient
- **>10 ppm**
  Inspect filters and crankcase for bearing debris, and prepare inspection of crosshead bearings as soon as possible.

It is important to note that in case of a corroded overlayer, the lead, once corroded and thereby contained in the system oil, is un-removable by non-chemical means, and the lead content will remain high until new clean oil is added.

Note:

The above values should be considered as relative values compared with the values that were recorded when the condition of the bearings was well known, e.g. when newly built. The lead content of a new oil may vary as much as 4 ppm (0-4 ppm), which should also be considered when observing the relative lead values as a guideline for any active corrosion of the overlayer.

By observing the above guidelines, a slow corrosion of the overlayer can be revealed, however, this technique does not reveal any sudden water increase in the oil system.

Note:

Corrosion of the overlayer is a potential problem only for crosshead bearings, because only crosshead bearings are designed with an overlayer. Main and crankpin bearings may also suffer from water contamination, but the damage mechanism would be different and not as acute as with overlayer corrosion damage. Problems referring to water contamination and main and crankpin damage are not covered in this service letter.

We recommend that a copy of this service letter be placed in the Operation Manual, Chapter 708, Bearings.

Questions or comments regarding this SL should be directed to our Dept. 2300 or 4100.

Yours faithfully

MAN B&W Diesel A/S

Carl-Erik Egeberg

Stig B Jakobsen

Encl.:
Water-in-oil monitoring systems for MAN B&W two-stroke engines
Photos of cases of crosshead bearing overlayer corrosion

Water-in-oil Monitoring Systems
Suitable for MAN B&W Two-stroke Engines

Manufacturer	**Product**	ppm or % indication	Water in-rush sensitive	Suitability for all oils Scale 1-3 (3 is best)	Alarm relay output	Price US$ (approx.)
Lubrizol	Fluipak	No	Yes	1	No	330
Dr. E. Horn	FRG	No***	Yes	1-2**	Yes	490
Parker	MS 100	No	Yes	1	Yes	475
E+E Elektronik	E+E 36	Yes*	Yes	2	Yes	1,610
Vaisala	HMP 228	Yes*	Yes	2	Yes	1,940
Gertsen & Olufsen	Survey Model 2	Yes	Yes	3	Yes	5,400

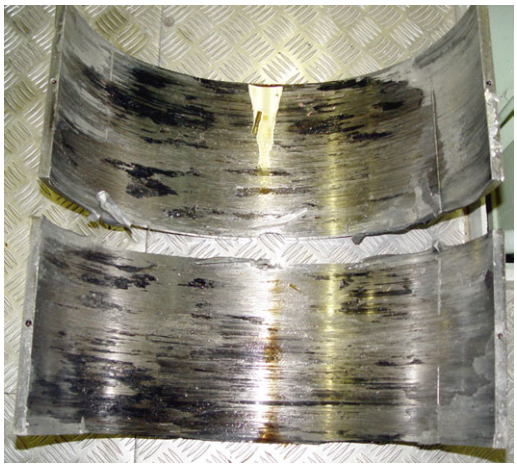
* Only if calibrated at regular intervals
** Under development
*** Possible if used together with a PC

As an alternative to the above systems, the relative humidity in the crankcase / crankcase breathing pipe close to the engine can be monitored using a suitable humidity sensor. Tests have shown that if the relative humidity is below **70-80%**, the water in oil can be expected to be below the **0.2%**, which is our stated maximum value. However, such a system will not react quickly on water in-rush.

MAN B&W Diesel

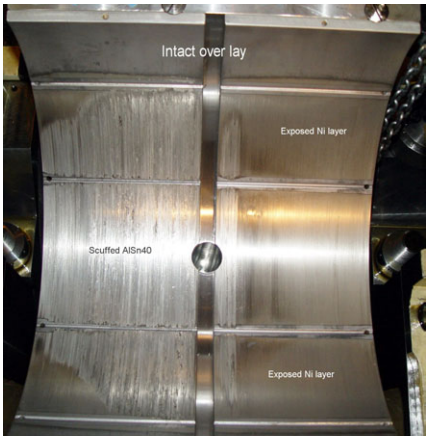
Enclosure 2 for
SL05-460/NHN

Cases of Crosshead Bearing Overlayer Corrosion

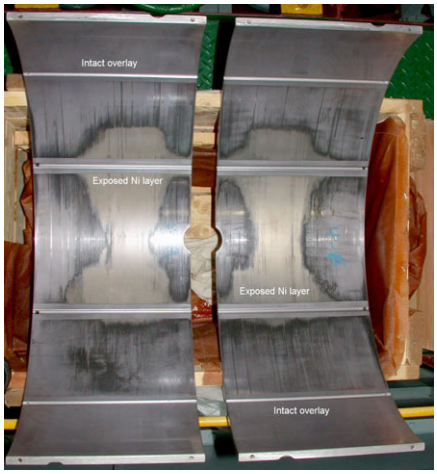


Steel to steel contact, severe damage to XH pin and conrod. **Not** acceptable.

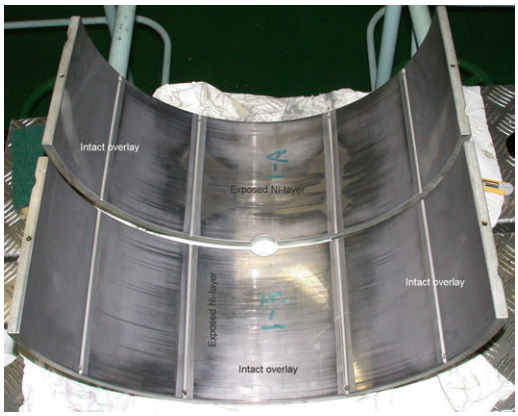
Overlayer completely corroded away, partly scuffing between Ni-layer and pin, partly steel-to-steel contact.
Not acceptable.



Overlayer completely corroded away, Ni 100% exposed, partial scuffing between Ni-layer and pin.
Not acceptable.



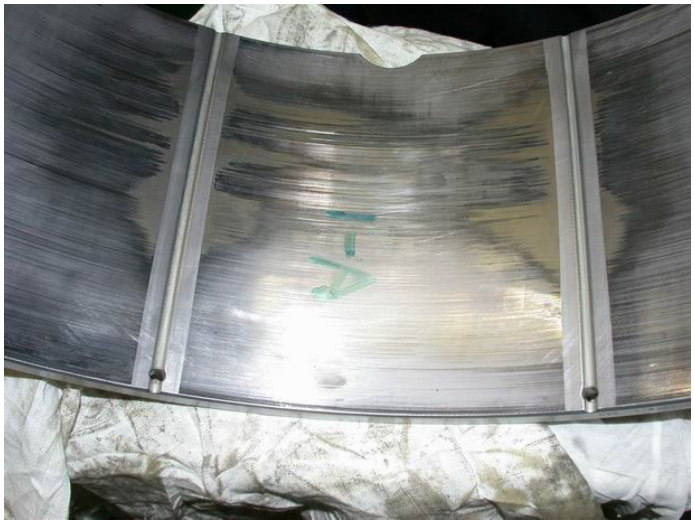
Partially corroded overlayer, not yet scuffed.
Not acceptable.



Partially corroded overlayer, not yet scuffed.
Not acceptable.

Fully intact overlayer.
Acceptable!

Close-ups:

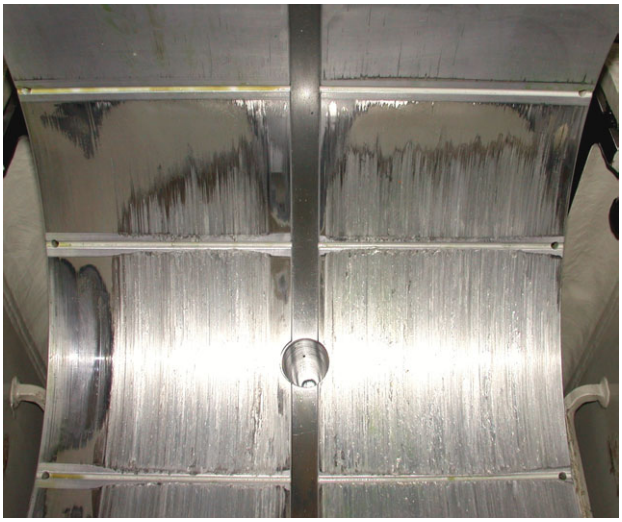


Partially corroded overlayer,
not yet scuffed.

Not acceptable.

Almost completely corroded-off
overlayer, severe scuffing
between Ni-layer,
AlSn40 lining and XH-pin.

Not acceptable.



Upper pad: intact overlayer.
Lower pad: 100% exposed Ni.

Not acceptable