Diesel engine bearing monitoring
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Why Bearing Monitoring?

Facts about 4-stroke diesel engine seizures:
• Approx. 30% of all seizures reported to classification societies relate to bearings
• More than 50% of all bearing seizures occur shortly after major overhauls or maintenance work

Facts about 2-stroke diesel engine seizures:
• Approx. 20% of all seizures reported to classification societies relate to bearings
• Approx. 70% of all bearing seizures happen shortly after overhaul or open-up inspections

➢ Oil Mist Detection does not protect engine components from seizures
➢ An extension of Bearing Open-Up Intervals is expected
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Diesel engine seizure statistics

MEDIUM SPEED MAIN ENGINE DAMAGES

Based on statistics from Det Norske Veritas in the period from 1990 to 1996
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Diesel engine seizure statistics

Based on statistics from Det Norske Veritas in the period from 1990 to 1996
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Engine protection

Crank Case Protection
Bearing Temperature Monitoring:
- Monitoring of crank-, main- and crosshead bearings
- Feasible for all 2- and 4-stroke engines
- Replacing Oil-Mist Detection (OMD)

Extension of Bearing Open-Up Intervals
Bearing Wear Monitoring:
- Providing wear data from any of the three crank-train bearings
- Feasible for all 2-stroke engines
- Extending open up inspections
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Oil Mist Detector vs. temperature monitoring

Abstracts from report made by D. Paro, G. Liljenfeldt, T. Blomberg, Wärtsilä

Main Bearing Temperature

Oil Mist

<table>
<thead>
<tr>
<th>Time (Min)</th>
<th>Alarm from temperature sensor</th>
<th>Alarm from oil mist</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cutting the oil supply</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Alarm limit</td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td></td>
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</tbody>
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(°C)

100 200 300 400

1 2 3 4 5
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MAN Diesel - Engine design update

MAN Diesel - new monitoring standard

• All vessels having ME-C, MC & MC-C engines (bore 46 cm and above) ordered after 1. March 2008, have bearing wear monitoring system (BWM) as standard

• For engines not covered by BWM, main bearing temperature sensors will be standard

• All MAN Diesel two-stroke engines will have “Water in Oil” (WiO) sensors as standard
MAN Diesel - new monitoring standard

• Intended effect is to prevent damage of crankshaft and bedplate in case of severe bearing failures
• Over time the intention is to accept fewer open-up inspections during service of engines equipped with BWM (when accepted by class societies)
• Signal processing and alarm handling is specified by MAN Diesel
• BWM system must be connected to alarm- and to safety system
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Bearing monitoring - Summary

**Recommended for 4-stroke engines:**
- Temperature sensors on main- and crank (big-end) bearing

**Recommended for 2-stroke engines:**
- Temperature sensors on crosshead-, crank- and main bearings
- Bearing Wear Monitoring (BWM)
- Combinations of Bearing Wear- and Temperature Monitoring
- Water in Oil sensor
Bearing Wear Monitoring System
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Bearing Wear Monitoring

- Monitors the actual combined wear of the main-, crank- and crosshead bearings
- Can be fitted in both MAN Diesel- and Wärtsilä two-stroke engines
- Two sensors installed per cylinder (fore and aft)
- Measures how far down the crosshead guide shoe comes in Bottom Dead Center (BDC)
- MAN Diesel has recently decided to standardize on Bearing Wear Monitoring on several engine designs
2 sensors one fore and one aft in each cylinder

- Measuring at bottom dead center (BDC)
- Sensors between cylinders are connected on same CAN cable
- System split into two segment for safety
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Bearing Wear Monitoring: Standard features

- Field bus (CAN Open) sensor output
- Fully integrated with Kongsberg automation system (AMS)
- Signal processing performed inside sensor
- Measures bearing wear and splash oil temperature
- Individual sensor compensation for
  - Engine speed/load
  - Ambient temperature inside crank case
  - External mechanical influences caused by manoeuvring etc.
Sensor data is collected via the CAN field bus network.

Data viewed and stored in the operator station.

Trend data reports are generated to document the bearing integrity.
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Bearing Wear Monitoring: Simple Installation
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Bearing Wear Monitoring: MAN Diesel 12K98MC
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Bearing Wear data from large container Vessel

- Vessel turns into the Read Sea
- Bearing Wear raw data values changes
- What happens?
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Bearing Wear Monitoring: REFIT – “no problem”

Kongsberg Maritime can do refit installations of complete bearing monitoring packages without interfering with the vessel schedule
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**Bearing Wear Monitoring: References (March 2008)**

Seapartner AB (Sweden)
- 1 vessel MAN Diesel 12L45GF

Matson Navigation (USA)
- 3 vessels MAN Diesel 8K80MC-C
- 1 vessel MAN Diesel 8L80MC

Dalian Maritime University (China)
- 1 vessel MAN Diesel 6S35MC-C

Costa Mare (Greece)
- 5 vessels MAN Diesel 12K98MC

Pasha Hawaii Transport Lines LLC
- 1 vessels MAN Diesel 7S50MC-C Jean Ann
- 1 vessels MAN Diesel 7S50MC-C Endeavour

ConocoPhillips Company
- Mitsui ship yard
- 4 vessels MAN Diesel 12K98MC-C
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Bearing Wear Monitoring - Stand alone installation
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Bearing Wear Monitoring - K-Chief 500 integration

K-Chief Integration
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Bearing Wear Monitoring - Topology add-on systems

Operator Station

E.C. room

Engine room

Cylinder Liner

Crosshead

Crank Bearing

Main Bearing

Bearing Wear
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Benefits of k-Chief integration

- **One supplier of all automation equipment onboard, thus:**
  - All existing process data available on one screen
  - Easy to compare and evaluate data from several process segments/sources (better system overview)
  - Higher degree of communication redundancy (dual CAN)
  - Fewer system components and fewer system layers
  - Local time stamping follows the data all the way thru
  - All process data available on the administrative network
  - Common infrastructure, less spare parts necessary on stock
  - Single point of contact for service

- **All together: Improved decision support**