Abstract

Spark erosion can occur if electrical potential in the crankshaft discharges through the main and thrust bearings, which if undiscovered can cause critical wear on the main bearings, and consequently severe crank train damage.

SPARK EROSION ON MAIN BEARINGS

A turning propeller is electrically insulated from the hull by the lubricating oil film in the bearings. Electrical potential is generated between the shaft and the hull and as a result the cathodic protection of the ship will not protect the propeller.

Electrical potential can cause currents in the bearings resulting in pitting of the bearing surfaces and I believe that many of you have heard about spark erosion and wonder what is it, how to discover and prevent it.

Spark erosion can occur if electrical potential in the crankshaft discharges through the main and thrust bearings, which if undiscovered can cause critical wear on the main bearings, and consequently severe crank train damage.

Nowadays the main bearings design is continuously improved through development of new lining material in order to improve lining fatigue strength. As an example for this reason, the white metal bearing lining thickness has been reduced from about 2.5 mm to 1.5 mm, but when lining thickness is reduced, the time from spark erosion onset until the situation becomes critical will also be reduced. Moreover, higher engine rating has led to a reduced minimum oil film thickness in the main bearings which can make an engine more sensitive to spark erosion.

In some cases of spark erosion have gotten out of hand because the main bearing wear was not noticed in time. The wear was found too late because the main bearing top clearance and crankshaft deflection measurements were compared to the maximum values in the manual instead of the reference values for the engine. As a recommendation a routine planned main bearing top clearance measurements and crankshaft deflection readings must be performed and the measured values must be stored for future reference. More frequent measurements will improve condition monitoring considerably.

Even when main bearings and thrust bearings are opened up for inspections, it can be hard to see signs of spark erosion. In this article, we have put together a set of photos that show where to look and what to look for to help you find and recognize early signs of spark erosion and situations where spark erosion is a risk.

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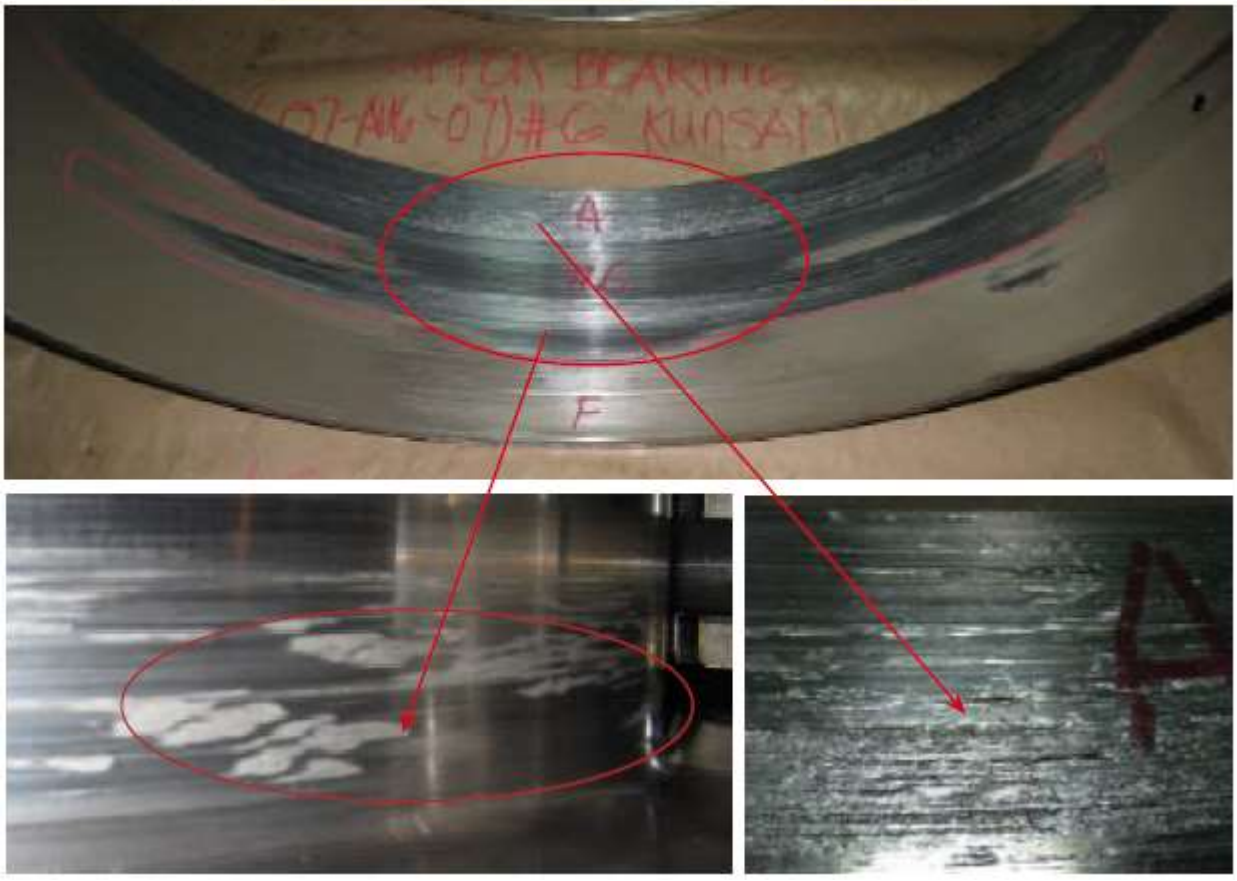
This is a journal, main bearings (AlSn40 Lining) and thrust collar with clear signs of spark erosion. Spark erosion signs are obvious, even in the upper main bearing shell. The bearing damage is irreparable, cannot be re-used and it has to be replaced.

Upper main bearing shell with signs of spark erosion



The journal must be polished to meet surface roughness specifications

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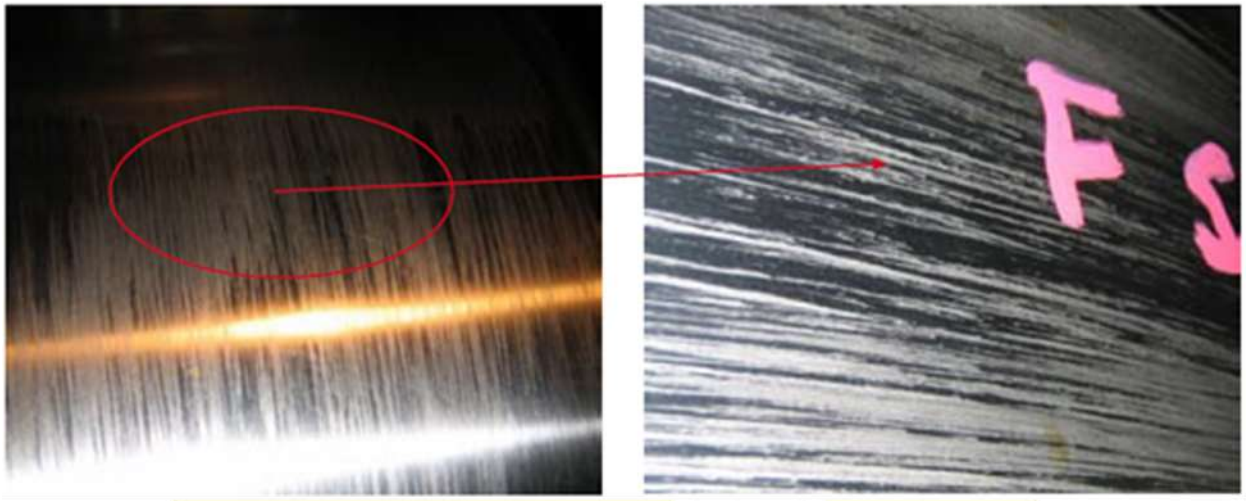
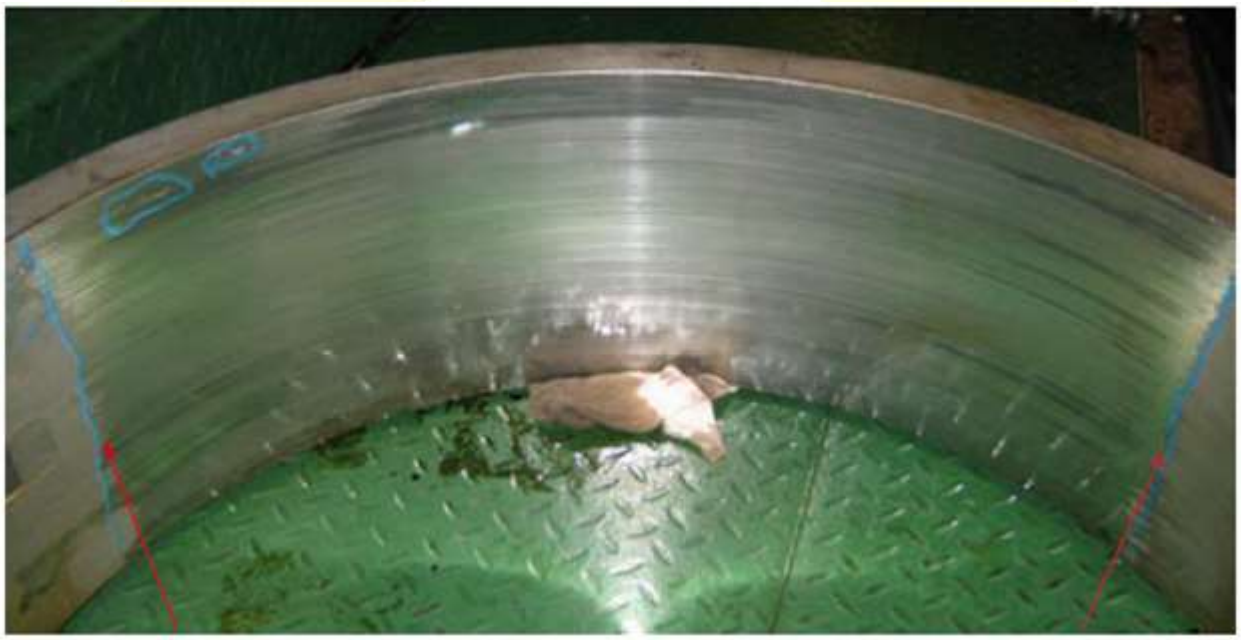
Below is a main bearing journal with signs of severe spark erosion.
The condition was not discovered in time, so this main bearing cannot be saved and is has to be replaced. The journal can still be used, but has to be polished to meet surface roughness specifications.

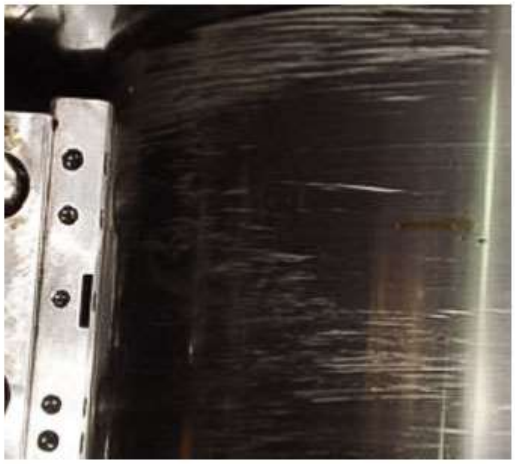


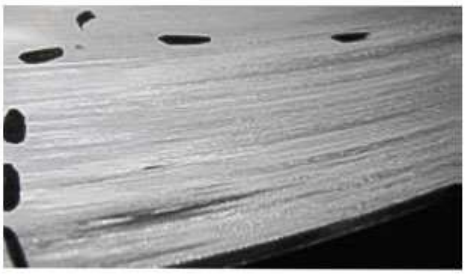
The journal must be polished to meet surface roughness specifications

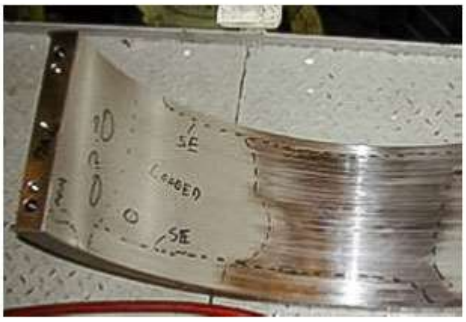


Corresponding main bearing lower shell with wide spread journal imprint. 0.5 mm of the shell is worn off between the two distinct, visible lines.

Below there is a main bearing with moderate spark erosion, discovered in time to save the bearing shell. This bearing can be re-used after dressing up. The journal must be polished to meet surface roughness specifications.

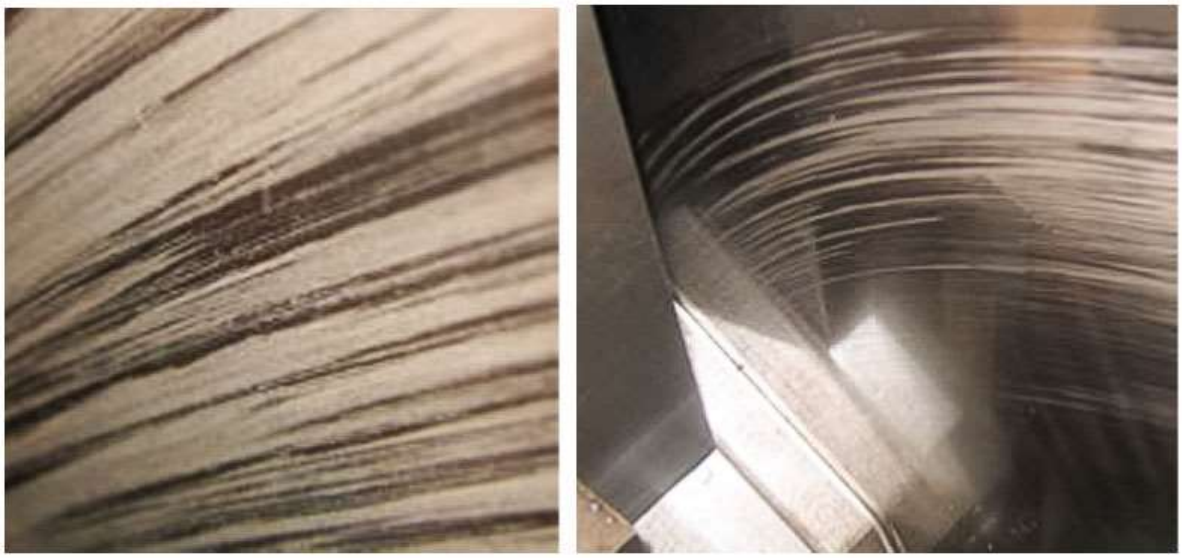






Corresponding lower bearing shell. Visible spark erosion, but no or limited wear can be measured.

Below is a thrust collar face with clear signs of spark erosion. Spark erosion may not be visible on the entire surface. When inspecting the thrust collar surface or the main bearing journal, remember to slowly turn the engine 360˚ / 1 revolution, and inspect the entire surface very carefully.



The greyish stripes on this thrust collar face indicate spark erosion

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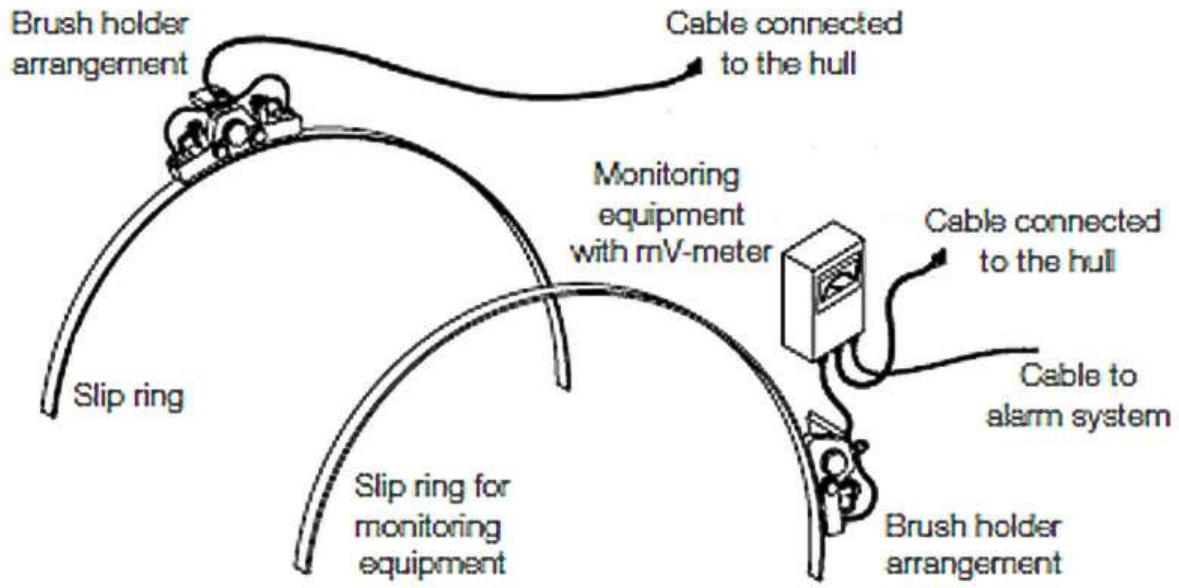
In order to prevent and protect against spark erosion is to use a correctly installed and well maintained shaft line earthing device.

The shaft line earthing device is installed on the propeller shaft, close to the main engine and if shaft generator is installed, the device is installed forward of the generator, between generator and the engine flywheel.



Shaft line earthing device

The shaft line earthing device consists of two silver slip rings, two arrangements for holding brushes including connecting cables and monitoring equipment with a mV-meter and an output signal for alarm. The shaft line earthing device should be able to keep the electrical potential difference below 50 mV DC, and there must be installed a shaft to hull monitoring equipment with a mV-meter and with an output signal to the alarm system so that the potential and thus the correct function of the shaft line earthing device can be monitored.

When the shaft line earthing device is working correctly, the electrical potential will normally be within the range of 10-50 mV DC. The alarm set-points should be 5 mV for low alarm and 80 mV for high alarm. The alarm signals with alarm delay of 30 seconds and alarm cut-off, when engine is stopped, must be connected to the alarm system.

Maintenance

- It is recommended to keep the shaft-line earthing device clean and dry at all times and to make a visual inspection of the shaft-line earthing device on a regular basis.
- Cables and cable connections are to be checked. Damaged cables or connectors have to be replaced.
- If the brushes are worn-out, they have to be replaced with new brushes.
- If the silver layer on the slip rings is worn-out or if the silver layer is partly missing the slip rings have to be replaced with new ones.
- If the mV-meter on the monitoring device indicates more than 80 mV DC after the inspection of the mechanical parts of the earthing device and all parts have been found in good condition, it is recommended to dismount the slip rings and clean and polish the shaft and apply new preservation oil. The slip rings back side should be cleaned and polished, if they are not replaced with new before remounting.
- When maintenance work of the earthing device has been carried out, it must be checked that the monitoring equipment is working properly.

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Ref.:

- ***MAN Diesel & Turbo Service letter SL2008-498***
