Action code: WHEN CONVENIENT

Lifetime of Fixed Cylinder Pressure Sensors

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Concerns
Owners and operators of MAN B&W two-stroke marine diesel engines fitted with online cylinder pressure monitoring

Summary
High-quality pressure measurements and a long sensor lifetime can be achieved with the proper precautionary measures and actions recommended by MAN Diesel & Turbo.

Kistler sensor on engine in operation

Dear Sirs

Service experience gained from permanently installed pressure sensors is generally very good and with a low failure rate. However, during the past few years we have recorded an unacceptably high failure rate on a few specific vessels in service.

The cylinder pressure sensors are designed to withstand the high temperatures they are exposed to at any engine operating condition. Nevertheless, incorrect installation, lack of maintenance or irregular use may result in higher sensor temperatures beyond the design limit, which can lead to faulty measurements, reduced sensor lifetime and sensor damage.

This service letter specifies precautionary measures that will ensure high quality measurements and a long lifetime of the sensors.

Yours faithfully

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Recommended measures

To ensure a long sensor lifetime and valid online pressure measurements, it is recommended to apply the following overall precautionary measures:

Indicator valve and cylinder pressure measuring

- Blow through the indicator valve when turning the engine by air.
- Do not blow through the indicator valve at high load, before making manual measurements.
- Do not disassemble the sensor from the sensor block (Kistler).
- With engine running, ensure that there are no exhaust gas leaks at the valve and indicator pipe arrangement.
- Ensure that the indicator pipe arrangement is insulated.

Service test

To pinpoint the causes of the sensor element failures reported, an extensive service test was carried out on a vessel with a history of repeated sensor failure claims since delivery.

A 12K98ME engine was fitted with temperature sensors in the sensor block. Simultaneous measurements of sensor temperatures and cylinder pressures were performed, recording some 30 million continuous combustion cycles.

The sensor housing temperature increases dramatically when the indicator valve is open. This causes drifting of the sensor signal or even damage to the sensor if the period with blowing through is excessively long. Depending on the actual engine load and the duration of a previous period of blowing through of the indicator valve, the measuring results can be influenced up to 10 minutes after the indicator valve has closed and, therefore, they are potentially incorrect during this period.

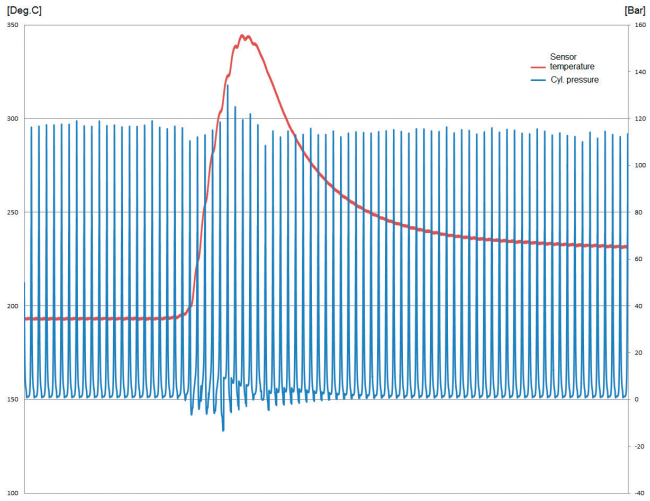

Fig. 1: Sensor core temperature and pressure signal during indicator valve blow through

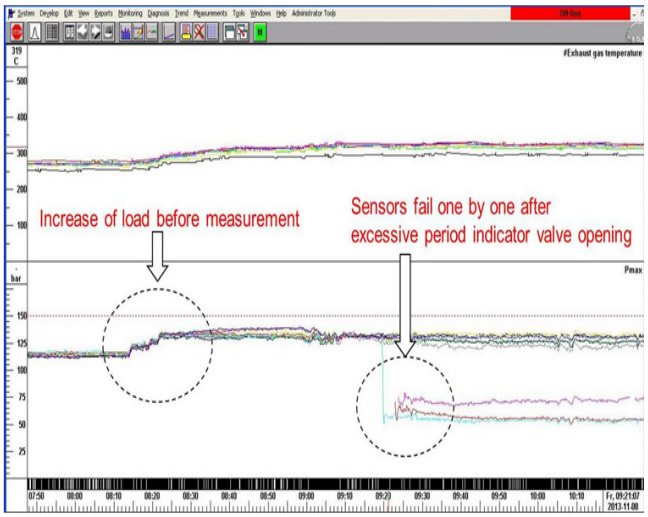

Fig. 2: Incorrect measuring procedure where the engine load is first increased, followed by an excessively long period with open indicator valve

Advised actions

Use of indicator valve

Blowing through the indicator valve for more than one engine revolution or a leaking indicator valve may lead to faulty measurements, reduced lifetime of the sensor and even sensor failure.

In general, it is recommended only to open the indicator valve while the starting valves are open and the engine is turned by air. Indicator pipes and valves clogged with exhaust/soot deposits should be cleaned manually before starting the engine.

Do not to blow through the indicator valve right before taking a manual calibration measurement. If clogging is suspected, blow through the indicator valve at low load for maximum 1 engine revolution. Disassemble and clean the valve manually if it is still clogged.

Wait for minimum 10 minutes after the indicator valve has been blown through, before mounting the handheld pressure transducer to take a calibration measurement.

It is important to note that when cleaning the indicator pipe arrangement, the sensor element should not be dissambled from the sensor block for cleaning of the sensor itself (Kistler). A thin layer of soot on the sensor membrane does not influence the measurement result, and it is therefore not necessary to dissamble it. Only heavy exhaust deposits should be removed, for example by dissolving the deposits in sparkling water.

Retrieving cylinder pressures

In general, the measuring results from the permanently installed pressure sensors are more robust and give higher quality results compared to manual (offline) measurements. The evaluation of the engine performance should therefore always be based on the online system.

Manual (offline) measurements are only intended for calibration of the fixed sensors at 6-12 months intervals. It is neither necessary nor recommended to take offline measurements at shorter intervals, except in connection with troubleshooting.

Service experience - corrosion of Kistler sensors

Due to reports of extremely short lifetimes of Kistler sensors on two sister vessels, an investigation of the defective sensors was launched, including a visit to one of the vessels in service.

Investigation of the sensors returned to Kistler showed signs of extreme corrosion of the stainless steel, both on the sensor element itself and also on the sensor adapter.

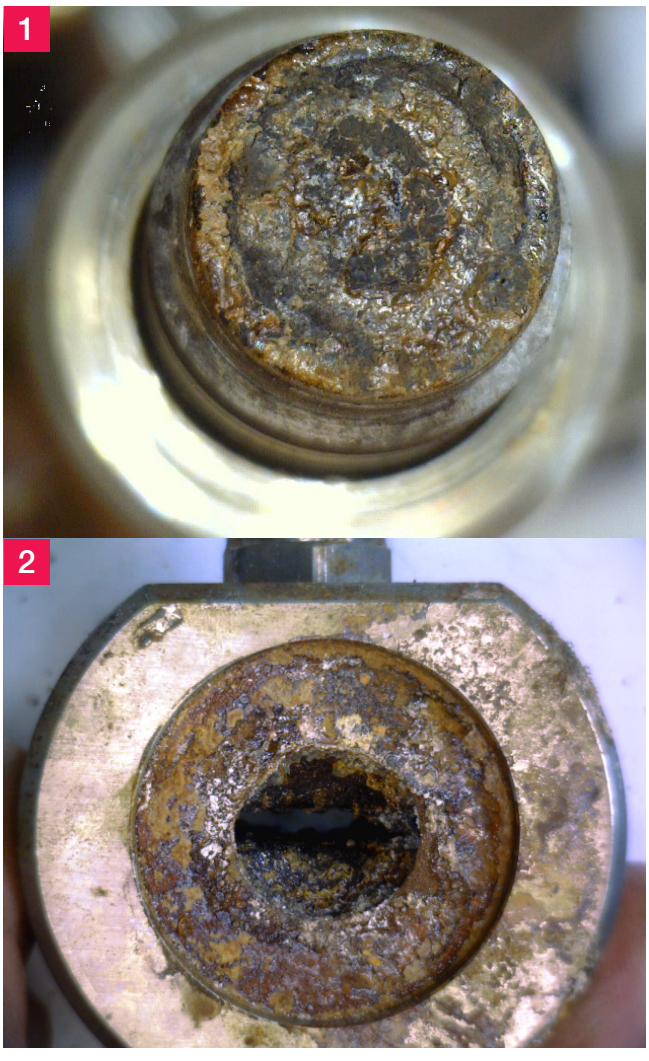

Fig. 3: Corroded sensor (1) and adapter (2)

Service investigation

An inspection of the sensors and indicator pipe arrangements on board the vessel showed severe corrosion on all parts in the indicator pipe arrangement, including sealings, sensors and adapters. The inspection on board revealed that the vessels in question were mainly operating the engine at low load, and this load pattern combined with missing insulation on the indicator pipe arrangement led to low temperatures in the indicator pipe, in this way causing condensation of water with a high level of sulfuric acid. This was confirmed by temperature measurements on board, and further investigations of deposits performed by MAN Diesel & Turbo.

On-board measurements at low load also showed that insulation of the indicator pipe arrangement increased the temperature of the sensor by approximately 20 degrees. Furthermore, the cylinders for which most failures were reported were located directly below the fresh air blower, leading to further cooling of the indicator pipe arrangement.

Advised actions

Indicator pipe insulation

Ensure that the indicator pipe arrangement is insulated at all times in order to raise the temperatures above the acid dew point.

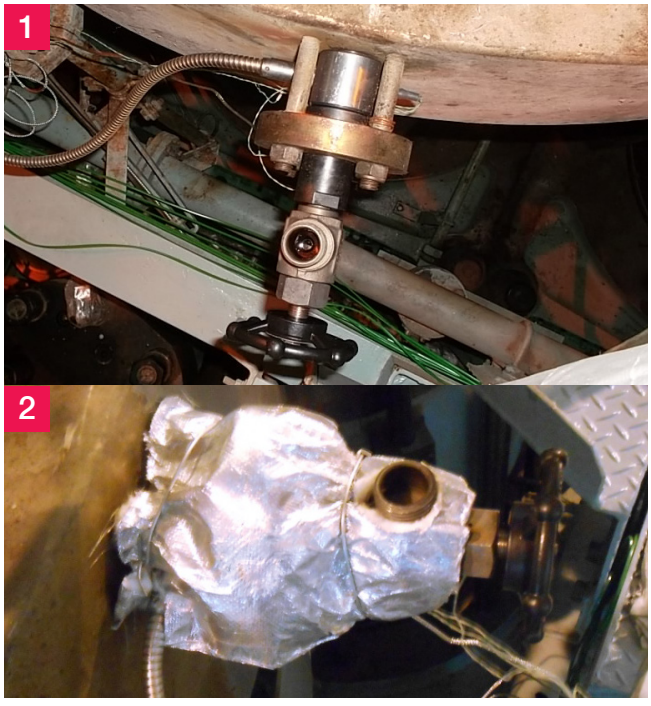

Fig. 4: Indicator pipe with water condensation (1) and with insulation (2)

Fresh air blower inlet

Divert the air from the blower inlet away from the cylinder covers on the engine.

Questions or comments regarding this SL should be directed to our Dept. LD (e-mail: ld@mandieselturbo.com).