



Service Letter

SL07-483/HRR
August 2007

**Condition-based Piston Overhaul
MC/MC-C and ME/ME-C type engines
Container Vessels, Bulk Carriers and
vessels with similar trade pattern**
Action Code: WHEN CONVENIENT

Dear Sirs

The experience with our engines with the latest updated combustion chamber design, i.e. with Oros shape and the latest piston ring design, slide fuel valves and optimised temperature levels, counts more than seven years of operation. Against this background, we have gained valuable knowledge about the need for piston overhauls compared with earlier experience.

The "Guiding Overhaul Interval" for pistons, previously set to 12-16,000 hours, appears to have been set rather too conservatively. Normally, the need for piston overhaul does not arise until much later, and extensions up to 32,000 hours are a possibility.

However, the fact is that the scatter is large, and many factors are decisive for the need for overhaul.

This calls for a Condition-Based Overhaul (CBO) strategy, the objective being to obtain the highest number possible of safe running hours. Preferably, overhauling should only be carried out when necessary.

The most important factor in a CBO strategy is the evaluation of the actual condition, by means of regular scavenge port inspections and logging of wear and hot corrosion. All the decisive factors for piston overhaul can be checked via inspections through the scavenge air ports.

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Most important factors for piston overhauls (see also Fig. 1):

- Piston ring wear (ref. instruction book).
- Max. amount of hot corrosion of piston top allowed on the centre part (where it is normally highest) is 9/12/15 mm on, respectively, 80/90/98-bore engines.
- Ring groove clearance.
Max. recommended clearance is 1.0 mm on the 80 and 90-bore engines, and 1.1 mm on 98-bore engines
- Sticking, broken or collapsed piston rings or leaking pistons.
- Macro-seizures on piston ring running surfaces.

(see the instruction book for data for other engine types)

Inspection intervals and logging

Inspection and logging of the actual cylinder condition and wear should be performed regularly to become familiar with the wear-and-tear development in the cylinder. At the beginning, intervals should be short, e.g. every second to third week. The intervals can be prolonged as confidence builds up.

Top piston ring wear, defined by measuring the remaining depth of the CL grooves, ring groove clearances, measured with a feeler gauge, and estimated piston burnings on large-bore engines, measured by means of a template via the scavenge ports, should be recorded. Our standard sheets "Cylinder Condition Report" and "Inspection through Scavenge Ports" can be used, forming the ideal documentation for later review and for making trend curves for future wear forecasts (see the example in Fig. 2).

How to visually evaluate the actual running condition of piston rings

The running surfaces of the piston rings are the best indicators of the cylinder condition in general. If the ring surfaces appear to be in good condition and free from scratches, micro or macro-seizures, the liner will also be in good condition, see Figs. 3-8.

Conversely, if the liner appears damaged by active seizures (if the wave-cut pattern has disappeared on the lower cylinder part being visible through the ports), the rings will also be affected, and most likely the unit has to be overhauled.

The wear on the top piston rings can be determined by measuring the remaining depth of the CL grooves using a Vernier gauge, as mentioned above, but the wear can also be estimated visually simply by checking the size of the remaining rounding on the upper and lower edges of the running surfaces. From new, the rounding has a radius of 2 mm on 80/90/98-bore engines.



Thus, a simple visual inspection through the scavenge ports confirming that the rounding is still visible or partly visible, is an indication that the wear limit has not been reached, and that many more hours are left before piston overhaul is necessary.

The estimate of the remaining rounding should be logged in the "Cylinder Condition Report", indexing tab "Top piston ring condition". This Excel document can be downloaded at our Extranet, <https://extranet.manbw.dk>, via the page [2-stroke Associated Instructions](#) under the heading *Performance and Inspection Sheets*. It can also be downloaded from the Internet at the following address: www.mandiesel.com/cylinderCondition

Access to our Extranet can be obtained by contacting Birgitte Larsen via email <mailto:BirgitteA.Larsen@man.eu>.

How to react if micro or macro-seizures are discovered

The key factor in establishing and maintaining a good cylinder condition is a correct low cylinder lubrication. This is ensured by following our latest Alpha ACC lubricating guidelines, as specified in our most recent service letter on this subject. Too high lubrication can cause bore polish of the liner surface, which has a devastating impact on the cylinder condition and on the overall economy of the diesel engine.

However, in case micro or macro-seizures have developed, the normal hydrodynamic oil film build-up between the liner and rings has broken down. In such a case, extra oil should be added according to the newest Service Letter.

In case of micro-seizures (mz), lubrication should be increased temporarily according to the standard lubrication guidelines. However, it is important to lower the lubrication to normal as soon as the active mz-attack is stopped. It should be noted that old, not active, mz-marks remain visible long time after the attack has stopped, which does not call for increased lubrication. Figs. 4 and 7.

A micro-seizure attack is followed by a temperature increase due to the increased friction. This can be observed on the liner temperature monitoring system by way of elevated and fluctuating temperatures.

The extra lubrication should be maintained until temperatures have stabilised.

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

Yours faithfully
MAN Diesel A/S


f. Carl-Erik Egeberg


Stig B. Jakobsen

Encl.

When is piston overhaul necessary?

- Before piston burning reaches the max. allowed
- Before ring groove clearance reaches the max. allowed
- In case of macro-seizures on the rings (scuffing)
- When the wear on the top piston ring has reduced the CL-grooves to the minimum

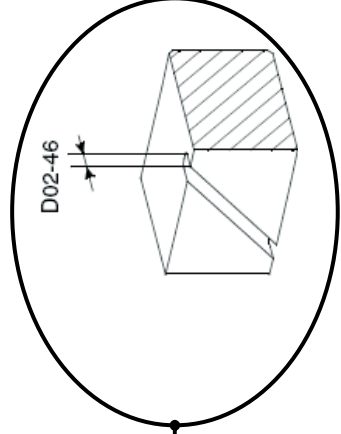
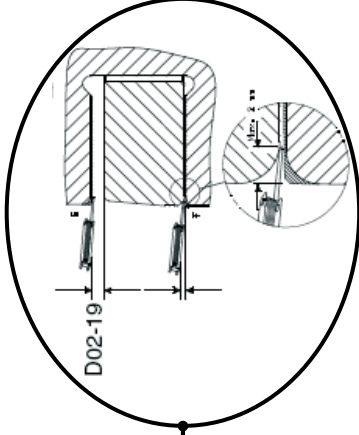


Fig. 1



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Encl. 2 for
SL07-483

How to judge, example from a 10K98MC-C with 23,500 running hours without overhaul

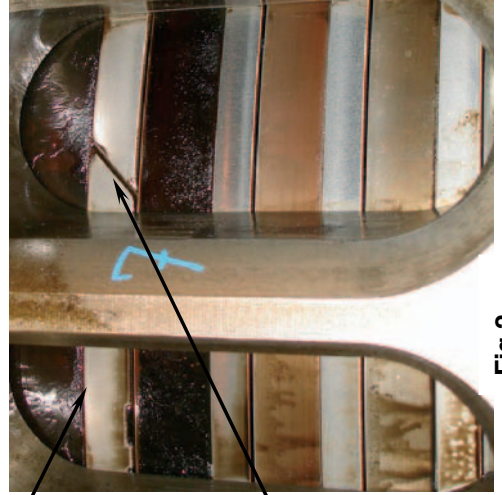
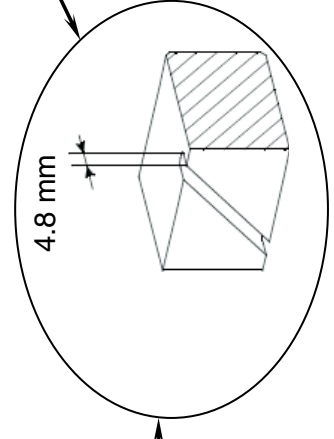
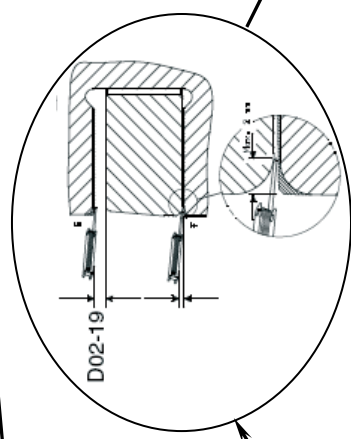
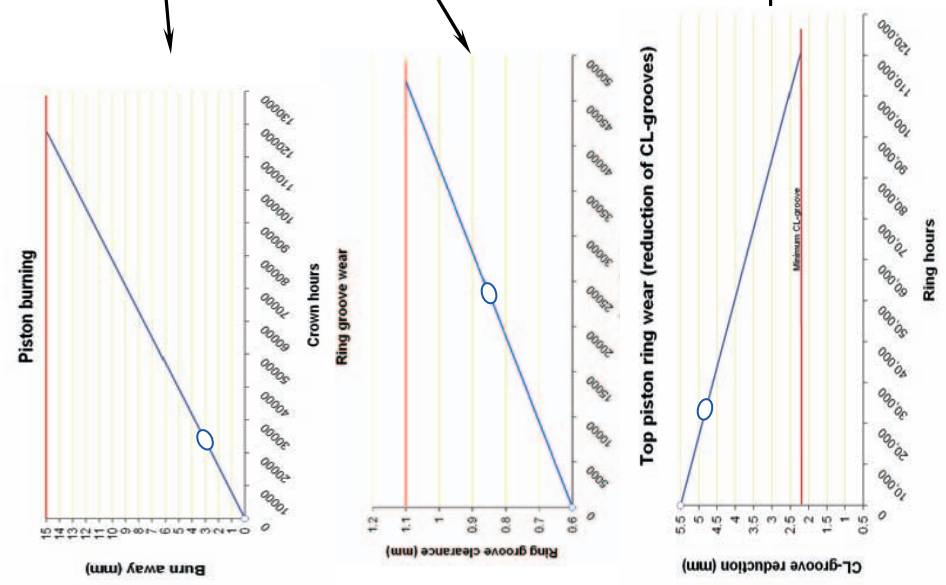


Fig 2

Visual inspection of piston rings (cermet-alu coated top ring)

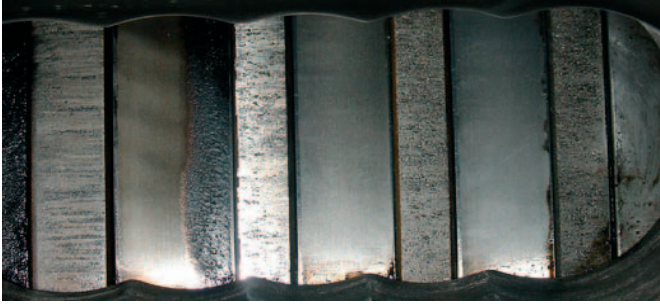


Fig. 3. Totally scuffed unit. Lubrication should be increased to maximum until overhaul is convenient with regard to the schedule of the ship. Due to the friction heat developed, the piston rings get hardened, and the wear rate of the liner increases significantly. However, the hardening protects the rings, which is why the operation may be continued safely until next convenient port stay.



Fig. 4. Unit with micro-seizures on the top ring as a result of metal-to-metal contact. Should be counteracted by temporarily increased lubrication. It is important to lower the lubrication to normal as soon as the active mz-attack is stopped. Note that old, not active, mz-marks remain visible long after the attack has stopped and do not call for increased lubrication.

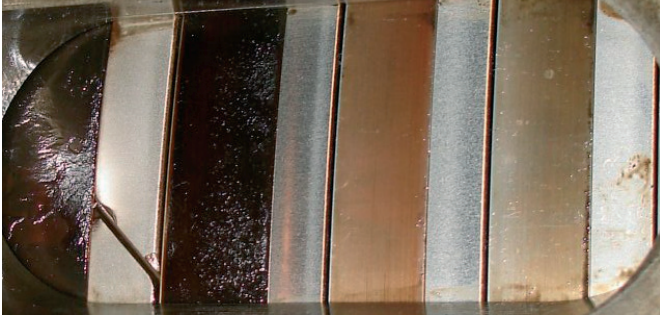


Fig. 5. Unit with 23,500 hours without piston overhaul. Note that most of the rounding is still intact, indicating that only $\frac{1}{4}$ of the wear potential is used. Further, the measurements above from the same unit shows that only $\frac{1}{2}$ of the ring groove wear potential is used, and the rate of burrings on the piston top is insignificant. Consequently, overhaul of that unit is not needed at this stage.

Visual inspection of piston rings (all alu-coated)



Fig. 6. Totally scuffed unit. Lubrication should be increased to maximum until overhaul is convenient with regard to the schedule of the ship. Due to the friction heat developed, the piston rings get hardened, and the wear rate of the liner increases significantly. However, the hardening protects the rings, which is why operation may be continued safely until next convenient port stay.

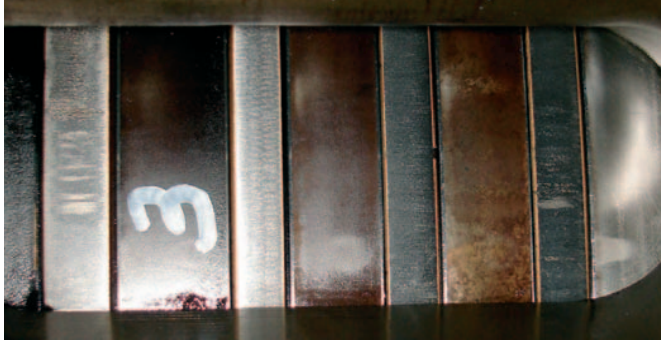


Fig. 7. Unit with micro-seizures on the top and bottom rings as a result of metal-to-metal contact. Should be counteracted by temporarily increased lubrication. It is important to lower the lubrication to normal as soon as the active mz-attack is stopped. Note that old, not active, mz-marks remain visible a long time and do not call for increased lubrication.

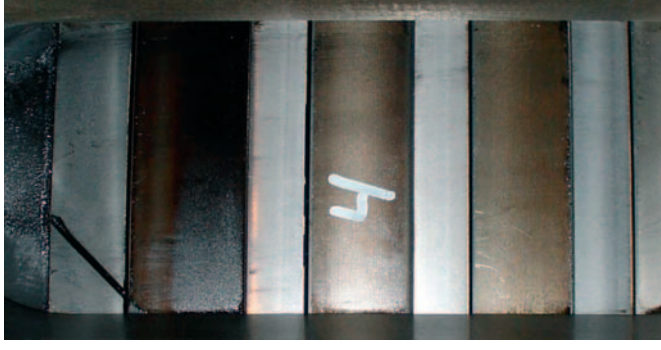


Fig. 8. Unit running very well after 20,021 running hours. Note that the last remains of the alu-coat are still visible on the lower edge, indicating remaining rounding left. This means that the ring wear is less than 2 mm out of possible 3 mm. Consequently, many more hours are left from the point of view of wear.