Action code: **WHEN CONVENIENT**

Exhaust Valve Condition

In Relation to Low Load Operation

SL2013-573/JAG
August 2013

Concerns
Owners and operators of MAN B&W two-stroke marine diesel engines.
Type: MC/MC-C and ME/ME-C/ME-B

Summary
Long-term low load operation down to 10% engine load is generally possible with appropriate precautions and without major modifications. However, in some cases, the thermal load profile causes the need for extra inspections and overhauls.

Dear Sirs

Since we issued the three Service Letters, SL2008-501, SL2009-511 and SL2011-544, describing low-load operation down to 40% and 10% load, we have gained valuable experience on the exhaust valve condition during low-load operation.

In our 2008 Service Letter (SL08-501), we informed that an increase of the exhaust valve temperature may lead to higher exhaust valve spindle wear and shorter exhaust valve overhaul intervals, i.e. shorter time between disc rewelding.

With reference to the previous market situation, MAN B&W two-stroke engines were designed for continuous operation in a high engine load range and, accordingly, the designs and materials of exhaust valves were optimised for this range. Also, overhaul intervals and expected lifetimes were stipulated for engines operating in a high load range. However, long-term low-load operation down to 10% engine load is generally possible when taking appropriate precautions, such as more frequent inspections and overhauls of exhaust valves.

In order to counteract this increased cost on exhaust valves for operation at low load, we have reviewed the possibilities for rewelding of exhaust valves and have confirmed that up to three times instead of the present standard with maximum rewelding two times is possible. Furthermore, we have for large bore engines increased the burn-away limits.

Yours faithfully

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Contents

Low-load benefits and additional costs

Operation down to 10% load is feasible for all ME/ME-C/ME-B and MC/MC-C engines without requiring engine modifications.

The optimisation of engine operation at low load has put focus on improving the fuel oil consumption at these low loads. Retrofit of turbocharger cut-out systems has become popular. And for new projects, optimisation with exhaust gas bypass, and low-load and part-load tuning methods (especially for the ME engines) will change the thermal load on the exhaust valves.

Due to thermal load changes, especially when it comes to exhaust valve components, continuous operation at low load will require more attention to the engine condition and overhaul intervals.

However, this cost increase is, as described in previous low load Service Letters, easily outbalanced by the savings gained in fuel and cylinder oil consumption per nautical mile.

Operation condition and thermal load

Continuous operation at low engine load requires more attention from the owner or operator. Frequent inspections are paramount to follow the condition of the engine components. Furthermore, planning of maintenance is crucial.

A higher thermal load on the exhaust valve components must be expected when operating the engine in the load area just above the cut-in point of the auxiliary blowers. During long time low-load operation, the average temperature of the spindle disc underside will be higher and, as a consequence, high-temperature corrosion and the calculated burn-away rate will also be higher.

Fig. 1 illustrates exhaust valve disc bottom and spindle seat temperatures on an 8K90MC-C engine as a function of the load. As can be seen, when operating at lower loads without T/C cut-out, the temperature increases when the load decreases (red and blue curves). However, in this case, temperatures increase (green and black curves) when loads increase when operating with T/C cut-out. This situation will differ depending on the engine type, size, layout point and tuning method applied. Therefore, the only way forward in case of prolonged low-load operation is to inspect more frequently in order to learn the specific burn-away rate for the engine in question with the specific low-load operation pattern.

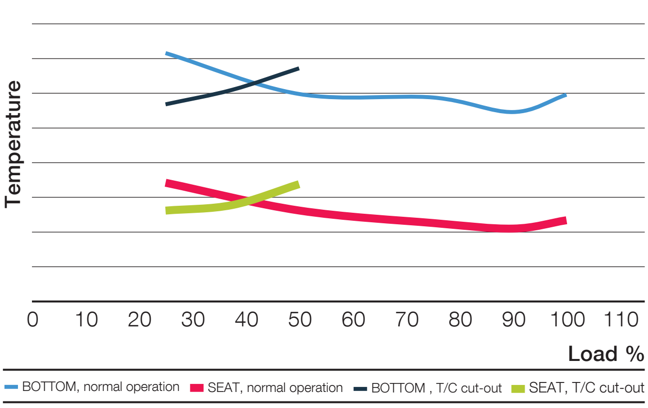

Fig. 1: Exhaust valve temperatures, 8K90MC-C

Fig. 2 illustrates exhaust valve disc bottom and spindle seat temperatures on a 10S90ME-C9.2 engine as a function of load. As can be seen, the temperature decreases on both the exhaust valve disc bottom and disc seat when reducing from 25% load to 10% load. The influence of the auxilliary blower on/off at 25% load can also be seen. We can only repeat our recommendation to inspect exhaust valves when operating in the low-load range in order to schedule reconditioning in due time.

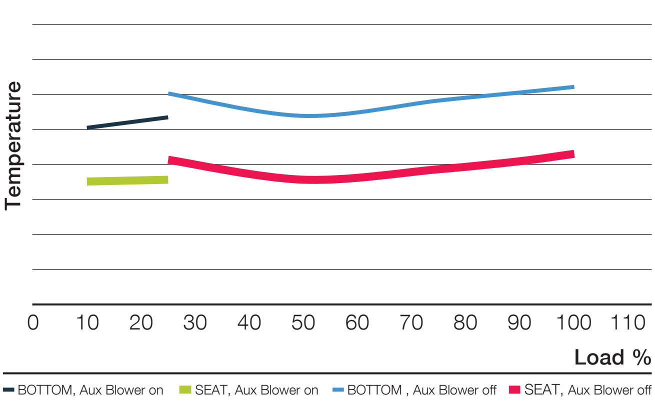

Fig. 2: Exhaust valve temperatures, 10S90ME-C9.2

Engine type	Burn away	Running (hrs.)	Burn away rate	Spindle lifetime
K98ME	9 mm	14,000	0.64	61,000 hrs.
S60MC-C	11 mm	26,000	0.43	64,000 hrs.
K98MC-C	7.5 mm	15,000	0.50	78,000 hrs.
S90MC-C8	14 mm	15,000	0.93	39,000 hrs.

Burn away rate = mm / 1,000 hrs.
Normal lifetime = 100,000 hrs. including reconditioning of spindle

Table 1: Previous spindle lifetimes (examples)

Table 1 illustrates some examples of burn-away rates observed during low-load operation in relation to the previous standard for overhaul.

We have changed our max. burn-aways as follows:

Engine type	Previous	New
60	9 mm	Unchanged
70	10 mm	Unchanged
80	11 mm	14 mm
90	12 mm	17 mm
98	13 mm	20 mm

Table 2: Maximum burn-aways

With these new limits, three times reconditioning and new limit for burn-away, the spindle lifetimes illustrated in Table 1 will be as follows:

Engines	Burn away	Running hours	Spindle lifetime
K98ME	9 mm	14,000	124,000 hrs.
S60MC-C	11 mm	26,000	85,000 hrs.
K98MC-C	7.5 mm	15,000	160,000 hrs.
S90MC-C8	14 mm	15,000	73,000 hrs.

Table 3: Updated spindle lifetimes (examples)

As can be seen, three times reconditioning combined with new burn-away limits will, to a large extent, mitigate the shortening influence of low-load operation on the exhaust valve spindle lifetime.

Table 4 shows the calculated burn-away rate with a spindle lifetime of 100,000 hours.

Values can change if other contributing factors have an influence on engine performance.

	Burn-away rate per 1,000 hrs.	
Engine size	Previous	New
60	0.27 mm	0.36 mm
65	0.30 mm	0.40 mm
70	0.30 mm	0.40 mm
80	0.33 mm	0.56 mm
90	0.36 mm	0.68 mm
98	0.39 mm	0.80 mm

Table 4: Allowable burn-away rates

Fig. 3 shows an exhaust valve on an S60MC-C8.1 engine inspected after 26,000 hours after long-time low-load operation. The burn-away rate is more than 11 mm and, according to the instruction manual, the maximum burn-away for rewelding on this engine type is 9 mm. Again, in view of low load, this calls for a more frequent inspection interval and planning of maintenance.

Fig. 3: Exhaust valve, S60MC-C8.1

Recommendations

In case of prolonged low-load operation, more frequent inspections are called for to judge the burn-away rate on the exhaust valve bottom. In general, it is not possible to give overall guidelines for overhaul intervals at low load, as the points listed below are factors contributing in a mixture to give different burn-away rates for a given vessel:

- full or derated engine layout
- type of fuel valves (we recommend to use slide-type fuel valves running at low load).
- type of turbocharging system layout
- auxiliary blower's switch-off point
- fuel oil quality
- turbocharger cut-out.

Depending on the use of fuel optimisation methods at low load, different loads can be more or less critical

If running at a load very close to and just above the auxiliary blower cut-in point, we recommend to change the load slightly to keep the blower running. Alternatively, the auxiliary blower could be switched to "manual on".

For any questions regarding the content of this Service Letter, please contact our Operation department, LEO, at leo@mandieselturbo.com.