

Action code: **WHEN CONVENIENT**

**Low Load Operation**  
10% to 40% Engine Load

SL09-511/MTS  
May 2009

**Concerns**

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

**Summary**

Long-term low load operation down to 10% engine load is generally possible with appropriate precautions and without major modifications.  
For application with 3-4 turbochargers, MAN Diesel recommends installation of a turbocharger cut-out system.



Dear Sirs

Our Service Letter SL08-501 has triggered an interest for continuous running of MAN B&W engines below 40% engine load. This service letter outlines our recommendation for MC/MC-C and ME/ME-C engine operation in the load area 10% to 40% engine load. In this load area, ME/ME-C engine performance parameters will be superior to those of the MC/MC-C engines, thanks to the hydraulically actuated fuel injection and variable exhaust valve timing.

MAN B&W two-stroke engines are designed for continuous operation at 100% engine load, but with the appropriate precautions, safe and reliable continuous engine operation down to 10% engine load is possible.

However, more frequent inspections, and appropriate reaction to these, must be accepted by operators, as not one recommendation or solution is applicable to all two-stroke propulsion plants.

Basic requirements:

- Slide-type fuel valves
- Monitoring of exhaust gas ways for fouling.

Furthermore, electronically controlled cylinder lubrication is advisable.

An important factor during low-load operation is that the operators give sufficient attention to the condition of engine, turbocharger and exhaust gas boiler. For further advice and information, operators are welcome to contact MAN Diesel in Copenhagen by e-mail at Primeserv-cph@mandiesel.com.

Yours faithfully

  
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## Introduction

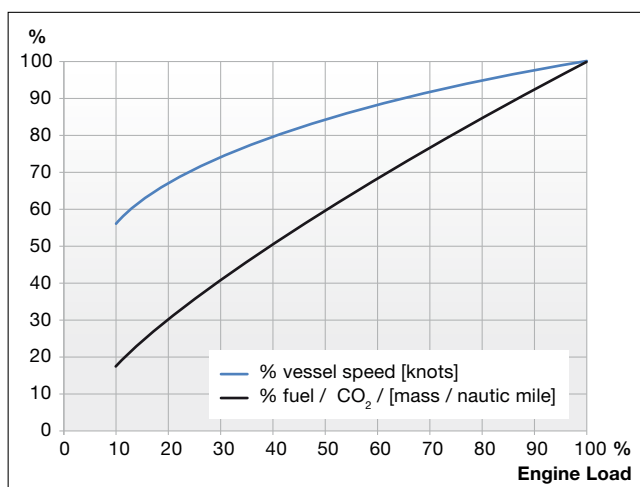
This Service Letter is issued in continuation of SL08-501 and is a supplement to SL07-480.

Until recently, engine operation down to 10% load has not been significantly practiced. However, based on the latest service feed back from engine operators, we find low-load operation acceptable, in the general case, in order to adapt vessel operation to market conditions.

## Benefits

Low-load operation between 10% to 40% engine load is possible, with a few exceptions, for ME/ME-C and MC/MC-C engines without any engine modification. Appropriate precautions must be taken to monitor the engine and exhaust system condition closely, and the operator, based on such observation, must take the necessary action.

As described in SL08-501, a power reduction will decrease fuel consumption to a higher extent than the actual vessel speed reduction. A further reduction in engine power will decrease fuel consumption and speed as illustrated in the graph below. The reduction in fuel oil consumption corresponds to an equivalent reduction in greenhouse gasses (CO<sub>2</sub>).



Generally, exhaust gas emissions (i.e. NO<sub>x</sub> and SO<sub>x</sub>) will decrease proportionally to the fuel/CO<sub>2</sub> per nautical mile.

A load reduction will also decrease the cylinder lube oil consumption per nautical mile.

The graphs will differ depending on vessel type and layout of vessel, but the tendency will be the same.

The possibility to reduce engine load down to 10% will further increase the operator's possibility to optimise fuel consumption and fleet capacity, in order to adapt to market conditions.

When long-term operation at between 20% to 40% engine load is expected, it is recommended, and beneficial, to install a flexible turbocharger cut-out system to improve engine performance in this load area. This will also be beneficial in the load range 40-60% engine load. Applications with 3 or 4 turbochargers, in particular, would benefit from a turbocharger cut-out system, while other solutions should be evaluated for applications with 1 or 2 turbochargers.

Part-load optimisation and engine de-rating will not have significant relevance in these load areas.

## Operation recommendation

Continuous operation at low engine load will require more attention from the operator. Frequent inspections are paramount to follow the fouling condition of the engine. Certain load areas may have to be avoided so as not to thermally overload engine components and increase fouling due to lack of air for the combustion.

If turbocharger efficiency drops significantly in the load area above auxiliary blower cut-in, continuous operation in this area should be avoided, or the auxiliary blower should be forced in 'Manual On'. Indication for this will be increased exhaust gas temperatures.

Below approx. 30% engine load, excessive cylinder lubrication can occur and may require adjustment of the cylinder lubrication.

When operating engines in the range between 10% power and 40% power, the following recommendations and prerequisites apply:

- The engine must be equipped with slide-type fuel valves in good working order and overhauled according to recommendations.
- The engine should preferably be with an electronically controlled lubrication system.

- Installation of asymmetric piston cleaning rings should be considered in connection with installation of new cylinder liners. This in order to minimise oil film scrape down during engine load up.
- Frequent inspection of the scavenge air receiver and cylinder condition must be performed. Early detection and removal of soot build up, coke and unburned fuel and lubricating oil is important to avoid scavenge air fires and jeopardising of the cylinder running condition. Residues inside the scavenge air receiver should be removed frequently.
- The exhaust gas receiver, exhaust valves and turbocharger inlet grids must be inspected frequently.
- Auxiliary blowers running continuously during operation are subject to more wear than anticipated by designers. Consequently, the bearings should be frequently lubricated, if not of the closed-type, and should be inspected for wear (further information in section below).
- Cleaning of turbochargers:  
Fouling of the turbocharger gas side must be avoided by regular loading up of the engine according to the TC maker's recommendations, and the turbine side must be cleaned with soft blast (i.e. nutshells) according to the maker's instructions.
- Cleaning of exhaust gas boilers:  
Boiler maker's recommendations must be followed with regard to cleaning. Special attention should be made with water tube boilers, as this type of boiler is more sensitive to soot build up. An exhaust gas boiler by-pass installation could be necessary based on the maker's recommendation.
- The cylinder lube oil feed rate should preferably be kept below 1.2 g/kWh in order to avoid over-lubrication and fouling of the scavenge air space. Increased feed rate only applies during load changes and manoeuvring, or if the cylinder condition deteriorates.
- The exhaust gas temperature must be kept below the alarm limits. It might be necessary to avoid engine load areas just above auxiliary blower cut-in/out. If the desired engine load is in this area, it is recommended to switch the blowers into 'Manual on', so as to reduce the exhaust gas temperatures.

**Inspections**

The operator must monitor the engine condition closely and take the necessary precautions if excessive fouling is observed.

Enclosed is a proposal for a 'Two-stroke Low-load Operation – Inspection report template'. The intention of this template is to make a standard reporting tool to be used in the communication between the vessel and the operator's office, thereby gathering information and experience from the specific vessel during its low-load operation.

**Engine load-up/down**

Engine load up must be minimised when running on low-load. Based on experience from the specific vessel, engine load-up frequency to clean the exhaust gas ways should be minimised as much as possible. Frequent load-up could jeopardize the cylinder condition.

When it is necessary to increase the engine load significantly, after an extended period of low-load running, the following procedure should be followed.

Manual load-up procedure	Duration
Load up, 10 → 40% load	30 minutes
Load up, 40 → 75% load	60 minutes (SL08-501)

In addition, the latest MAN Diesel recommendation regarding the load-up program under normal running conditions must be followed (SL09-503).

**Auxiliary blowers**

If the engine is to be operated in the start/stop area of the blowers, avoid frequent start, stop of the auxiliary blowers, and activate the blowers in 'Manual On'.

For continuous engine operation in the load area 35% to 45% it should be considered to operate the auxiliary blower in 'Manual On' in order to decrease exhaust temperatures. Maximum current for the auxiliary blowers must be considered in this running condition.

Basically, the auxiliary blowers are not designed for continuous running, but service experience obtained so far shows reliable performance. Bearings with lubrication nipple must however be lubricated more frequently and checked for wear.

As a safety precaution, it is recommended to have a complete spare auxiliary blower on board. A spare electric motor alone may be sufficient, but the disassembly of blower wheel and motor could be troublesome and time consuming due to sticking parts.

**Performance optimisation**

Running condition in the load range between 20-60% engine load can be improved significantly by increasing the scavenge air pressure.

Turbocharger cut-out is applicable for engines with 3 or 4 turbochargers and, in special cases, for engines with 2 turbochargers.

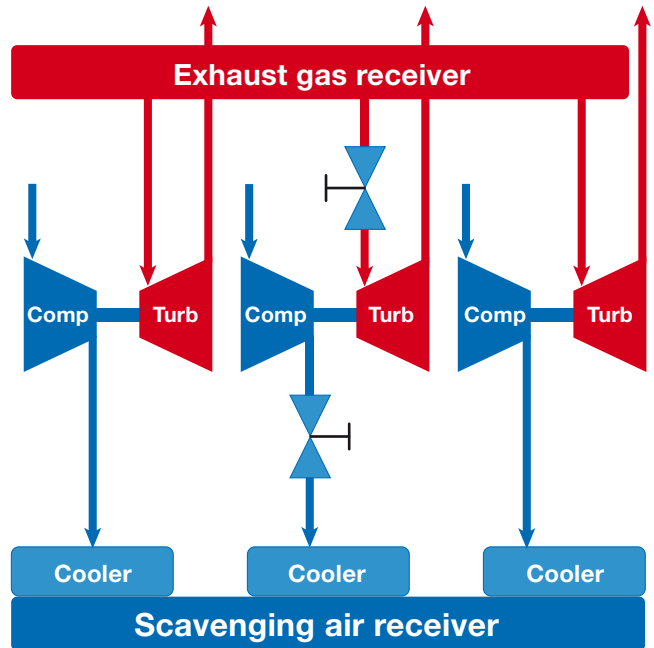
The turbocharger cut-out will improve the specific fuel oil consumption, and can reduce the heat load on, especially, the exhaust valves. The installation will also move auxiliary blower cut in/out to a lower load area and, thereby, reduce the electrical power consumed by the blowers.

MAN Diesel can, in most cases, provide a package solution for a flexible turbocharger cut-out with necessary classification, specifications and hardware. The flexible turbocharger cut-out makes it possible to manually activate and deactivate the turbocharger cut-out for optimal operation of the vessel.

For engines with 1 or 2 turbochargers other solutions are available to increase the scavenge air pressure. The installation of a variable nozzle ring could be applicable. Depending on the current turbocharger installation, a possible retrofit on existing turbocharger application may be possible. Alternatively, new turbocharger(s) must be installed. Re-matching of existing turbochargers, in combination with an exhaust by-pass, could also be beneficial.

Please contact [PrimeServ-cph@mandiesel.com](mailto:PrimeServ-cph@mandiesel.com) for further information and a quotation for specific applications.

Below is shown a layout drawing of a turbocharger cut-out system for a 12K98ME with three turbochargers.



Example:

Turbocharger cut-out will save 2-3% in specific fuel oil consumption on a 12K98ME engine, with three turbochargers, running in the load area of 25-50% engine load.

## Two-stroke low-load operation – Inspection report template

The purpose of this report is to define the necessary inspection areas in order to follow and document the service experience gained during continuous engine operation below 50% engine load.



The report should be used to optimise low-load operation procedures with regard to engine load-up for cleaning of boiler and turbocharger, cleaning of scavenge and exhaust space, and cylinder lubrication optimisation.

The report should be made, preferably, before and after the low-load operation period, or 3 to 4 times a month. This may be reduced based on experience and unchanged load pattern.

As a minimum, the below items should be noted and inspected:

<b>Date of inspection</b>	: 2000-01-01
<b>Vessel name</b>	: M/V xxxx
<b>IMO number</b>	: 90xxxxxx
<b>Engine Builder / Number</b>	: xxxx / xxxx
<b>Engine Type:</b>	: 12K98MC-C
<b>Main engine running hours:</b>	: 50,000 hours
<b>Load range [%]:</b>	: 22%

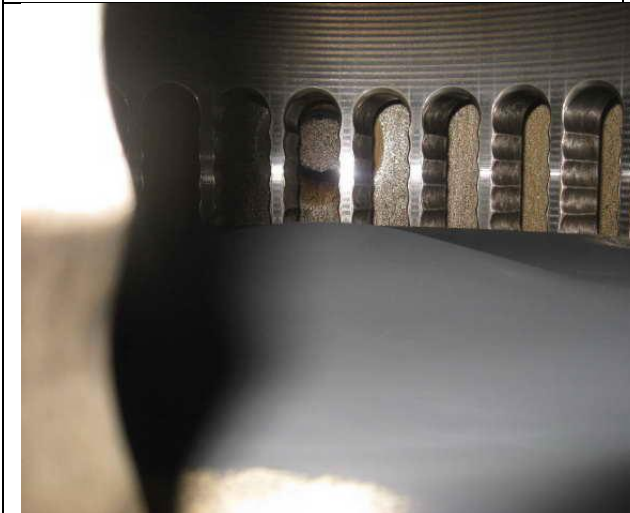
Photos, shown as examples, should be inserted in the report, and relevant comments should be added.

	
<p><b>Inspection area No. 1:</b> take photo of non-return valves in scavenge air receiver. <i>Comment:</i></p>	<p><b>Inspection area No. 2:</b> take photo of buffer space area. <i>Comment:</i></p>



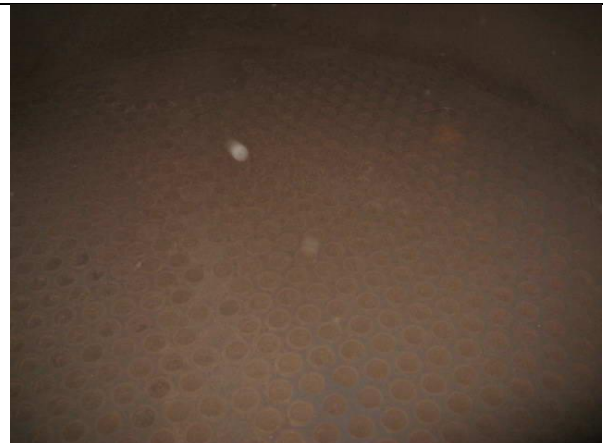
**Inspection area No. 3:** take photo of drain line from the buffer spaces.  
*Comment:*

**Inspection area No. 4:** take photo of piston ringlands and top land.  
*Comment:*



**Inspection area No. 5:** take photo of piston crown.  
*Comment:*

**Inspection area No. 6:** take photo of exh. receiver.  
*Comment:*



**Inspection area No. 7:** take photo of exh. valves from the exh. gas receiver side.  
*Comment:*

**Inspection area No. 8:** take photo of top part of the exhaust gas boiler.  
*Comment:*



Photo examples from turbochargers are not available, but in some cases, it is possible to get a view of the nozzle ring, and maybe the turbine blades from the exh. gas receiver side, through the safety grid. Include such photos when possible.

Information regarding operation, maintenance and observations during low-load operation:

- During low-load operation for extended periods, were changes in engine load made to 'clean' the engine and exhaust gas ways?  
*Answer: aa*
- Was it necessary to increase maintenance intervals during low-load operation? (Cleaning of receivers, turbochargers, boilers, etc.)  
*Answer: bb*
- If temperature indication is available after the boiler, this should be reported in order to evaluate acid corrosion in the boiler and funnel.  
*Answer: cc*
- What was the specific cylinder lube oil consumption, and was the level of cylinder lubrication satisfactory?  
*Answer: dd*
- Are the auxiliary blower(-s) running at the stated engine load?  
*Answer: ee*
- Were any changes made to HFO temperature/viscosity?  
*Answer: ff*
- Were any problems experienced during low-load operation?  
*Answer: gg*
- Based on your experience, do you have any recommendation regarding low-load operation?  
*Answer: hh*

A performance observation at the stated load and a full scavenge port inspection (photo report of all cylinders) would be expedient for further evaluation, however, this should be based on the time available and the necessity as judged by the crew.