

Action code: WHEN CONVENIENT

Low-load operation

5% to 40% engine load

SL2021-714/PXN

June 2021

Concerns

Owners and operators of MAN B&W two-stroke marine combustion engines. Type: ME/ME-C and dual-fuel engines.

Summary

Long-term low-load operation down to 5% engine load is generally possible with appropriate precautions and without major modifications. For application with 2-3-4 turbochargers, we recommend installation of a turbocharger cut-out system.



Dear Sir or Madam

This service letter outlines our recommendations for operating ME/ME-C and dual-fuel engines on low-sulphur fuel oil (LSFO) in the load area from 5% to 40% engine load.


In this load area, ME/ME-C and dual fuel 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. Additionally, our ME concept features a low-load optimising function that allows balancing of the mean indicated pressure (MIP) for each cylinder at low load.

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 5% engine load is possible. However, operators must accept more frequent inspections, and appropriate reaction to these, as not one recommendation or solution is applicable to all two-stroke propulsion plants.

The most important factor during low-load operation is that the operators pay sufficient attention to the condition of the engine, the turbocharger(-s) and the exhaust gas boiler.

For further advice and information, operators are welcome to contact MAN Energy Solutions in Copenhagen by email at DT-CPH@man-es.com.

Yours faithfully


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Introduction

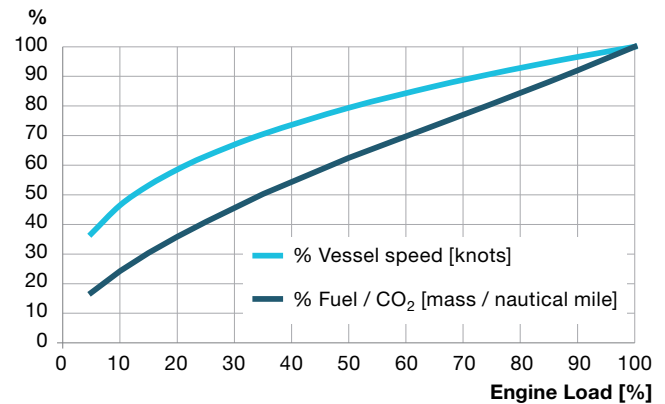
This service letter replaces SL09-511-MTS.

We have gained positive experience with extremely low low-load operation from ships during lightering procedures, during dynamic positioning at offshore loading facilities, and during low speed passage awaiting final cargo destination. Ships powered by one of our ME/ME-C or dual fuel engine types have operated smoothly at down to 2-3% load for up to four days and between 5-40% load for extended periods.

Our long-term experience with low-load operation down to 5% load for longer periods has shown that the following parameters are important:

1. The ME fuel injection system operates excellently at low loads, and the ME engine offers a feature called low-load adjustment of the mean indicated pressure (MIP) for improved low-load operation. ‘Low-load offset’ can be used to adjust the MIP dedicated at low loads. MIP is measured by the PMI-system.
2. Exhaust valves are exposed to a slightly higher heat load during operation at 20-40% load.
3. During low-load operation, the engine does not require a minimum exhaust gas temperature.
4. Downstream the engine, it is necessary to keep the temperature above the sulphur condensation level to avoid corrosion in the exhaust gas boiler. Keep the minimum temperature specified by the boiler maker.
5. Follow the pressure drop across the exhaust gas boiler and adjust the cleaning interval accordingly as the gas flow through the exhaust gas boiler is reduced.
6. Short load-ups at regular intervals may be necessary to follow the turbocharger cleaning intervals.

Generally, exhaust gas emissions (i.e. NO_x and SO_x) will decrease proportionally with the fuel consumption and CO₂ emitted per nautical mile covered.



A load reduction will also decrease the cylinder lubricating 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 5% 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 20-40% 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 40-60% engine load range. 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.

For planned operation, we recommend the following turbocharger cut-out values:

Turbocharger cut-out	Maximum load
1 of 2 turbochargers	35%
1 of 3 turbochargers	65%
1 of 4 turbochargers	70%

The values do not apply in the event of emergency operation

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 be able to follow the fouling condition of the engine.

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 5% power and 40% power, the following recommendations and prerequisites apply:

- More frequent inspection from the scavenge air space must be performed. Early detection and removal of soot buildup, 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 lubricating oil feed rate should preferably be adjusted to 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 and avoid frequent start-stop of the auxiliary blowers.

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. Additionally, we recommend to inspect the exhaust valve gas channel for possible cold corrosion.

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 jeopardise 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, 5 → 40% load	30 minutes
Load-up, 40 → 75% load	60 minutes*

*Note that additional load restrictions may apply if one or more turbochargers have been cut out

In addition, the latest recommendation from MAN Energy Solutions regarding the load-up program under normal running conditions must be followed.

Engines equipped with HPSCR or LPSCR (high-pressure and low-pressure selective catalytic reduction)

SCR is disengaged during operation at very low loads. During uploading of the engine, the SCR engages at 10% load if the exhaust gas temperatures required for SCR operation have been reached. During downloading of the engine, the SCR disengages as default when the load drops below 7%. At such very low load, it will not be possible to achieve the temperatures necessary to operate with the SCR system engaged, i.e activate dosing.

Dual fuel engines operating on second fuel

The engines are able to operate down to 10% load in second fuel mode without any modifications. Below 10% load, and down to 5% load, fuel-oil-only mode is recommended.

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.

Avoid the specific load point where the flap valves inside the scavenge air receiver are repeatedly opening and closing at a high speed.

Basically, the auxiliary blowers are not designed for continuous running, but service experience obtained so far shows reliable performance. Bearings with a 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

The 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.

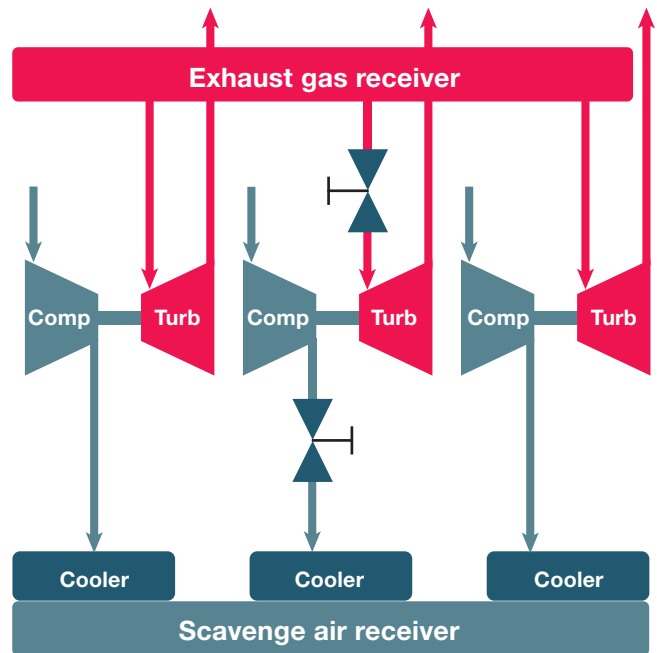
The turbocharger cut-out will improve the specific fuel oil consumption, and can reduce the heat load on, especially, the exhaust valves. The installation will also move auxiliary blower cut in/out to a lower load area and, thereby, reduce the electrical power consumed by the blowers.

In most cases, MAN Energy Solutions can 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. Depending on the current turbocharger installation, a possible retrofit on an 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 Retrofit2S@man-es.com for further information and a quotation for specific applications.

Below is shown a layout drawing of a turbocharger cut-out system for a 12G95ME-C with three turbochargers.



Example:

Turbocharger cut-out will save 2-3% in specific fuel oil consumption on a 12G95ME-C engine, with 3 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.

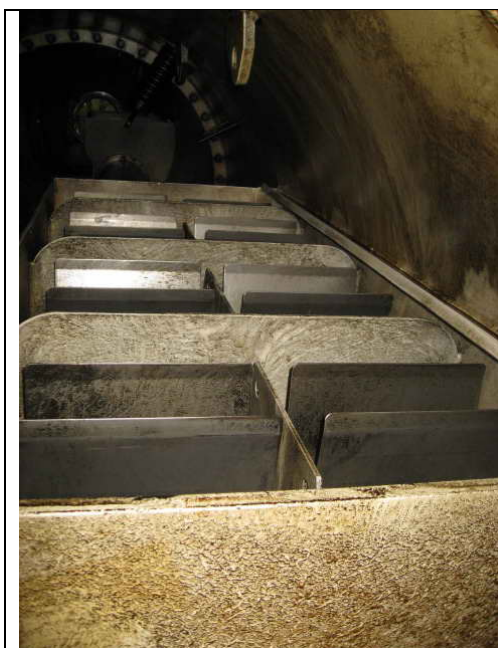
The report should be used to optimise low-load operation procedures with regard to engine load-up for cleaning of boiler and turbocharger, cleaning of scavenge and exhaust space, and cylinder lubrication optimisation.

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:

Date of inspection :
Vessel name :
IMO number :
Engine Builder / Number :
Engine Type: :
Main engine running hours: :
Load range [%]: :

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

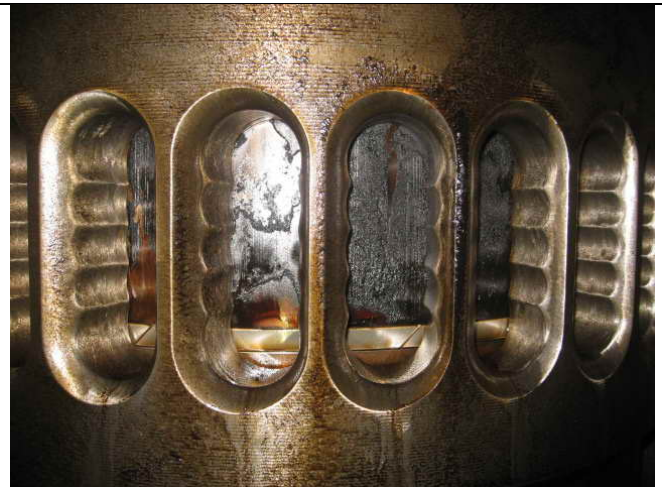


Inspection area No. 1: take photo of non-return valves in scavenge air receiver.
Comment:

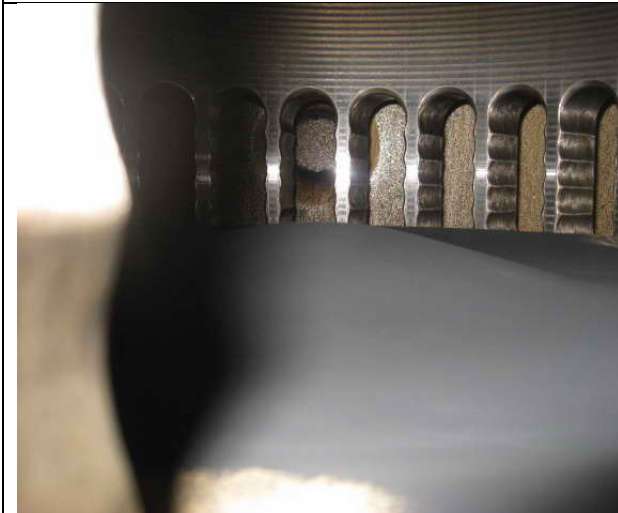
Inspection area No. 2: take photo of buffer space area.
Comment:



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



Inspection area No. 4: take photo of piston ringlands and topland.
Comment:



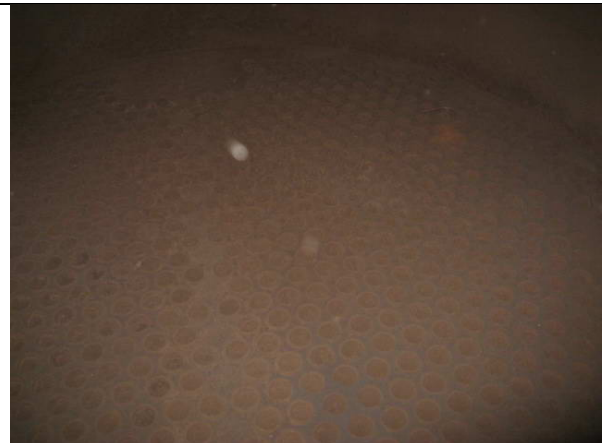
Inspection area No. 5: take photo of piston crown.
Comment:



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.