Dear Sir or Madam

This Service Letter contains guidelines on the recommended lubrication of cylinder liner and piston.

The combustion of very-low-sulphur fuel oil (VLSFO, <0.50% S) and ultra-low-sulphur fuel oil (ULSFO, <0.10% S) in dual-fuel engines has caused a shift in main focus from corrosive wear of cylinder liner and piston rings toward cylinder condition (cleanliness). The lowered fuel sulphur content and the resulting lowering of the cylinder oil feed rate also stresses the importance of always maintaining an adequate oil film.

For engines burning high-sulphur fuel, this Service Letter and SL2023-738/IKCA replace SL2014-587. For MC and MC-C engines with Alpha Lubricator Mk. 1 systems, SL2014-587, enclosure 4 should be used.

High-performing engines call for an increase of cylinder oil performance. Therefore, MAN Energy Solutions introduced Category II (Cat. II) cylinder oils with an improved cleaning performance in SL2022-728. The cleaning abilities of these oils match that of existing BN 100 cylinder oils, independent of their BN value. Category II contains cylinder oils: BN 40, BN 100, BN 140 and higher. All other cylinder oils approved by MAN Energy Solutions will be referred to as Category I oils. Cylinder oils with a BN value lower than 40 are no longer recommended.

Newer engines of MAN Energy Solutions, Mark 9 or higher, and particularly demanding engines of lower mark numbers, are recommended to use Cat. II cylinder oils.

- Cat. II cylinder oils are applicable for all engines
- Cat. I cylinder oils can be used on less demanding engines
- Cat. II BN 40 is the recommended cylinder oil for engines using low-sulphur fuels, including dual-fuel engines (0–0.50% S fuels, LNG, ethane, methanol, and LPG).

Yours faithfully

Susanne Kindt
Vice President
Engineering

Stig B Jakobsen
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Operation

Action code: WHEN CONVENIENT

Cylinder lubrication update

for operation on ULSFO, VLSFO, bio-fuel, LNG, LEG, LPG, methanol, and HSFO

SL2023-737/NHN
June 2023
(replaces SL2014-587/JAP and SL2019-671/JAP)

Concerns

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

Summary

- Monitor cylinder condition
- Analyse scavenge drain oil
- Ensure clean and free piston rings
- Cat. II cylinder oils for optimal cleaning ability
- Use BN 100 oils or higher for engines showing signs of corrosion

General guidance
Mark 9 and higher, and all dual-fuel engines:

- 0–0.50% S fuel: Cat. II BN 40
  ME-GI (pilot fuel 0–0.50% S): Cat. II BN 40
- HSFO >0.5% S: Cat. II BN 100–140+

Mark 8 and lower:

- 0–0.50% S fuel: min. Cat. I BN 40
- HSFO >0.5% S: Cat. I BN 70 or Cat. II BN 100–140+

References to other Service Letters

SL2014-587, SL2019-670, SL2019-685, SL2022-728, and SL2023-738/IKCA.
https://www.man-es.com/services/industries/marine/service-letters

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Introduction

This Service Letter gives guidelines on the recommended lubrication of liner and piston for operation on the fuels in Table 1.

1. Cylinder oils

Cat. II BN 40 cylinder oils (CLOs) are recommended for Mk. 9 engines and newer (higher Mark number) when burning low-sulphur fuels (0–0.5% sulphur), including dual-fuel alternatives. The Cat. II BN 40 oil is also recommended for earlier engines which require the Cat. II cleaning performance.

While most Mk. 8 engines or lower will perform well on Cat. I oils, Cat. II oils can always be applied for optimum cleanliness.

For any fuel type, it remains important to maintain a clean cylinder condition. Choosing the right cylinder oil is key to a good cylinder condition.

Service experience from low-sulphur fuel operation often shows that continuous use of a high-BN cylinder oil (Cat. I BN 70 or Cat. II BN 100) can be necessary to maintain good/clean cylinder conditions. Traditionally, high-BN oils contained more cleaning agents than low-BN cylinder oils.

Cat. II BN 40 cylinder oils have been developed to:

- Optimise cleaning performance
- Minimise ash and deposit levels in the exhaust gas system, including EGR, SCR, and WHR systems.

2. Operation on low-sulphur fuels (<0.50% S)

See the recommendation valid for all engine types in Fig. 1 for an overview.

Selecting the cylinder oil

Engines Mk. 9 and higher, including dual-fuel engines Mk. 8 and higher (ME-GI, ME-GIE, ME-LGIP, ME-LGIM, and ME-GA)

- Cat. II BN 40

Engines Mk. 8 and lower

- Cat. I or Cat. II BN 40
- Cat. II BN 100, if it has been used with success previously
- ACOM mixed Cat. II BN 100 and Cat. I BN 40/70, for engines which have previously used this CLO mix successfully.

Alternating between high- and low-BN CLOs

SL2019-671 describes alternating between high- and low BN CLOs as an alternative lubrication procedure to a mixing unit (ACOM).

Fuels	Abbreviation	Comment
Less than 0.10% S	ULSFO	ME-C single fuel engines Pilot fuel for dual-fuel engines
Less than 0.50% S	VLSFO	ME-C single fuel engines Pilot fuel for dual-fuel engines
Biofuels covered by MAN Energy Solutions' two-stroke guidelines. Sulphur content depends on fuel blend - stock	FAME, HVO, biofuel, etc.	Fatty acid methyl esters (FAME) Blends with ISO 8217 compliant DM and RM grades Similar FAME-type fuels and hydrotreated vegetable oil (HVO)
Liquefied natural gas	LNG	ME-GI and ME-GA
Liquefied ethane gas	LEG	ME-GIE
Liquefied petroleum gas	LPG	ME-LGIP
Methanol	MeOH	ME-LGIM
Above 0.50% S (and lower than 3.5% S) - high-sulphur fuel oil	HSFO	Scrubber installed

Table 1: Fuel types covered in this Service Letter

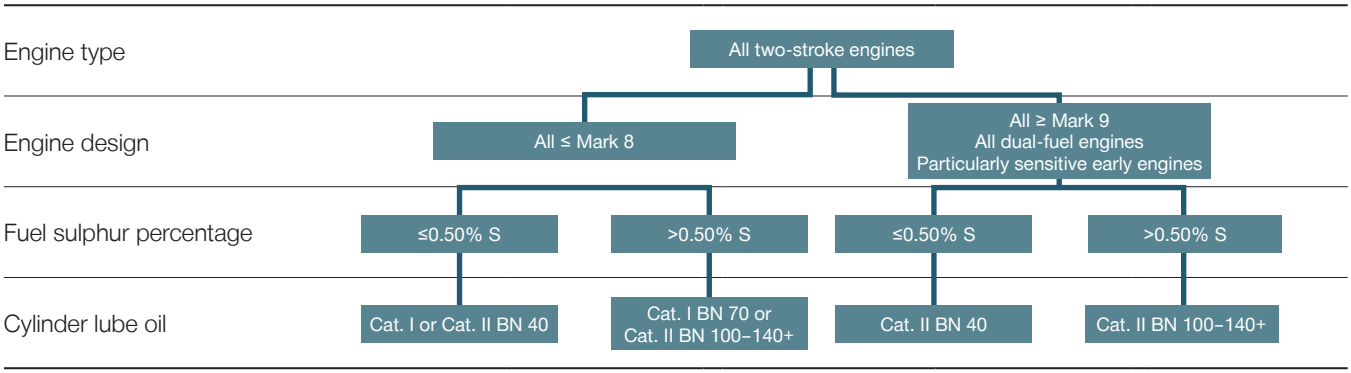


Fig. 1: Recommended cylinder oils for MAN Energy Solutions' two-stroke engines

During 2019–2022, a high-BN oil had to be used more frequently than a low-BN oil to get acceptably clean cylinder conditions in several cases. In these cases, MAN Energy Solutions advised to use the high-BN oil continuously.

With the introduction of Cat. II BN 40 oils, alternating between high- and low-BN cylinder oils is no longer necessary.

Mixing of cylinder oils

In the past, CLOs have been mixed to optimise the cleaning performance of an oil to the level required by a specific engine, or specific operating conditions. For example, by mixing a Cat. II BN 100 oil with a less efficient BN 40–70 oil.

With Cat. II BN 40 oils on the market, mixing of CLOs is no longer recommended. Instead, the Cat. II BN 40 cylinder oils should be used.

3. Operation on high-sulphur fuels (>0.50% S)

Selecting the cylinder oil

Engines Mk. 9 and higher

- Cat. II BN 100–140+
- ACOM mixed Cat. II BN 40 and Cat. II BN 100 or 140+, depending on the fuel sulphur content and corrosion sensitivity.

Engines Mk. 8 and lower

- Cat. II BN 100–140+
- Cat. I BN 70
- ACOM mixed Cat. I BN 40/70 and Cat. II BN 100/140+, depending on the fuel sulphur content and corrosion sensitivity.

For some engines running on HSFO (scrubber applied), it has been difficult to suppress corrosive wear to acceptable limits when using a BN 70 oil, and in some cases also when using BN 100 oil.

If the feed rate factor (FRF, earlier referred to as ACC) has to be set higher than 0.32 g/kWh*S% to reach acceptable wear levels, it is advised using an oil with higher levels of neutralisation (higher BN). See Fig. 2.

Such oils are typically Cat. II BN 100–140+, and they can be used as the high-BN oil together with a lower-BN oil, preferably, a Cat. II oil when ACOM is applied.

A typical mixed-CLO BN level for ACOM and HSFO burning engines is 120. But it varies between BN 80–140+ for acceptable wear rates, time between piston overhauls, and the minimum acceptable feed rate.

For general HSFO operation and adjustment of the feed rate factor using scavenge drain oil sampling and wear rate analysis, see SL2023-738/IKCA about scavenge drain oil analysis.

4. Cleanliness of engines

Just as some engines have higher corrosive levels than others, some engine types are more prone to deposit formation if the cylinder oil and feed rate used are not suitable. Operating pattern, ambient conditions, and the condition of the components can also influence the condition.

We recommend performing a monthly inspection of the cylinder condition according to the instruction manual, and more frequently when reducing the CLO feed rate.

5. Feed rate

The target is to optimise the cylinder oil feed rate by balancing consumption, cleanliness, wear, and avoiding hard contact (micro-seizures) which potentially can lead to scuffing on piston rings and cylinder liners.

A reduction of the feed rate should always be done in small steps (0.05–0.1 g/kWh) and only after confirming a good condition and acceptable iron (Fe) levels in scavenge drain oil samples.

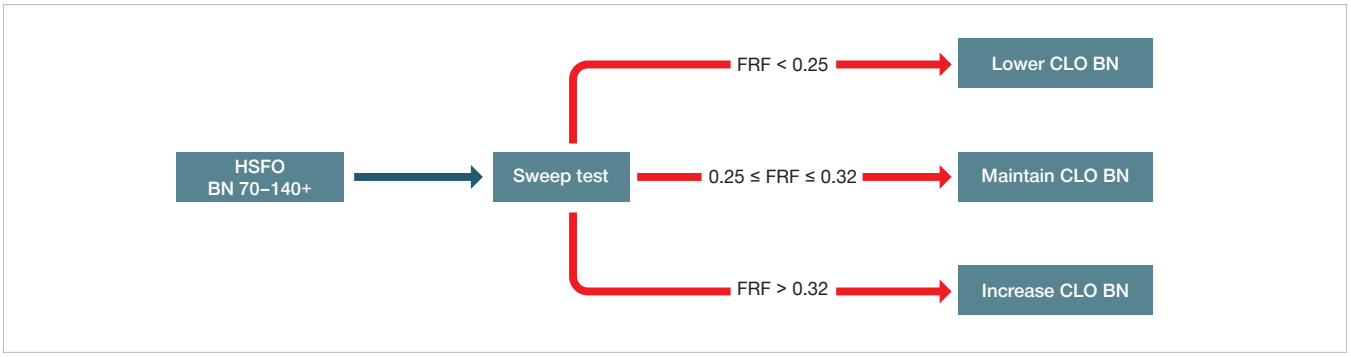


Fig. 2: Adjusting the CLO BN running on HSFO

For low-sulphur fuels, the general feed rate should be controlled by the “Minimum Feed Rate” setting. It is important to make a daily measurement of the cylinder oil consumption and compare it with the calculated oil consumption as shown in the MOP interface, or Alpha HMI. The actual oil consumption should be within 0–10% of the MOP values.

If the actual consumption is lower than the MOP figures:
- Increase to the safe setting: 1.2 g/kWh
- Investigate and resolve the issue.

New ships entering service must follow the guidance in Appendix I, II and III during initial running-in of the components. Monitor the deposit formation. Feed rate reductions require an acceptable cylinder condition.

Vessels in service, which have not yet optimised the feed rate for low-sulphur fuel operation for a given cylinder oil, should:
- Start at the current feed rate, or 1.0 g/kWh
- Reduce the feed rate based on inspections until an acceptable - or absolute minimum feed rate of 0.6 g/kWh, has been reached.

If signs of hard contact or micro-seizures on the rings, ring land deposits, or other abnormalities are observed during the feed rate reduction period, increase the feed rate to the previous setting which resulted in good cylinder conditions. See Appendix V, C3 and C4.

For engines Mk. 9 and higher burning low-sulphur fuels, the minimum feed rate of 0.6 g/kWh may be acceptable considering wear or hard contact. However, a minimum feed rate up to 0.8 g/kWh may be required to maintain cleanliness and to lower the risk of hard contact, or micro seizures.

6. Feed rate factor (FRF)

The feed rate factor is relevant only for high-sulphur fuels, where the basic feed rate is altered automatically according to the sulphur content of the fuel. For low-sulphur fuels, the FRF*S% will be lower than the absolute minimum feed rate of 0.6 g/kWh and therefore not relevant.

For the initial running of an engine, the feed rate factor should be kept at 0.40 g/kWh*S% and only lowered based on sweep test results. See the separate Service Letter (SL2023-738/IKCA) about scavenge drain oil analysis. If the feed rate factor is lowered without making a sweep test and following-up with a drain oil analysis it may lead to excessive liner and piston ring wear. If the piston ring coating is worn away, potentially liner scuffing could occur. See Appendix III.

7. Scavenge drain oil analysis

Continuous evaluation of scavenge drain oil analysis results is recommended. For engines running on HSFO, the evaluation primarily concerns corrosive wear elements (iron-oxides), while for low-sulphur fuels, abrasive or adhesive wear elements (iron in metallic form) can be expected.

Onboard analysis kits can be used to supplement laboratory analysis and frequent condition monitoring. However, after lowering the feed rate, the onboard analysis should always be confirmed by a laboratory analysis.

A guideline on iron levels, BN value, etc. can be found in SL2023-738/IKCA about scavenge drain oil analysis.

8. Operating in and out of SECAs

It is possible to use the same cylinder oil in sulphur-emission controlled areas (SECA) operating on 0.10% S, as when operating outside of SECAs.
For engines operating only on low-sulphur fuels, Cat. II BN 40 is the only oil required.

For engines operating on HSFO, the use of only one high-BN cylinder oil for HSFO, VLSFO, VLSFO, and ULSFO should be based on experience from the actual engine. It should be assessed from scavenge port inspections before entering and after exiting the SECA during the first couple of roundtrips.

Appendix I

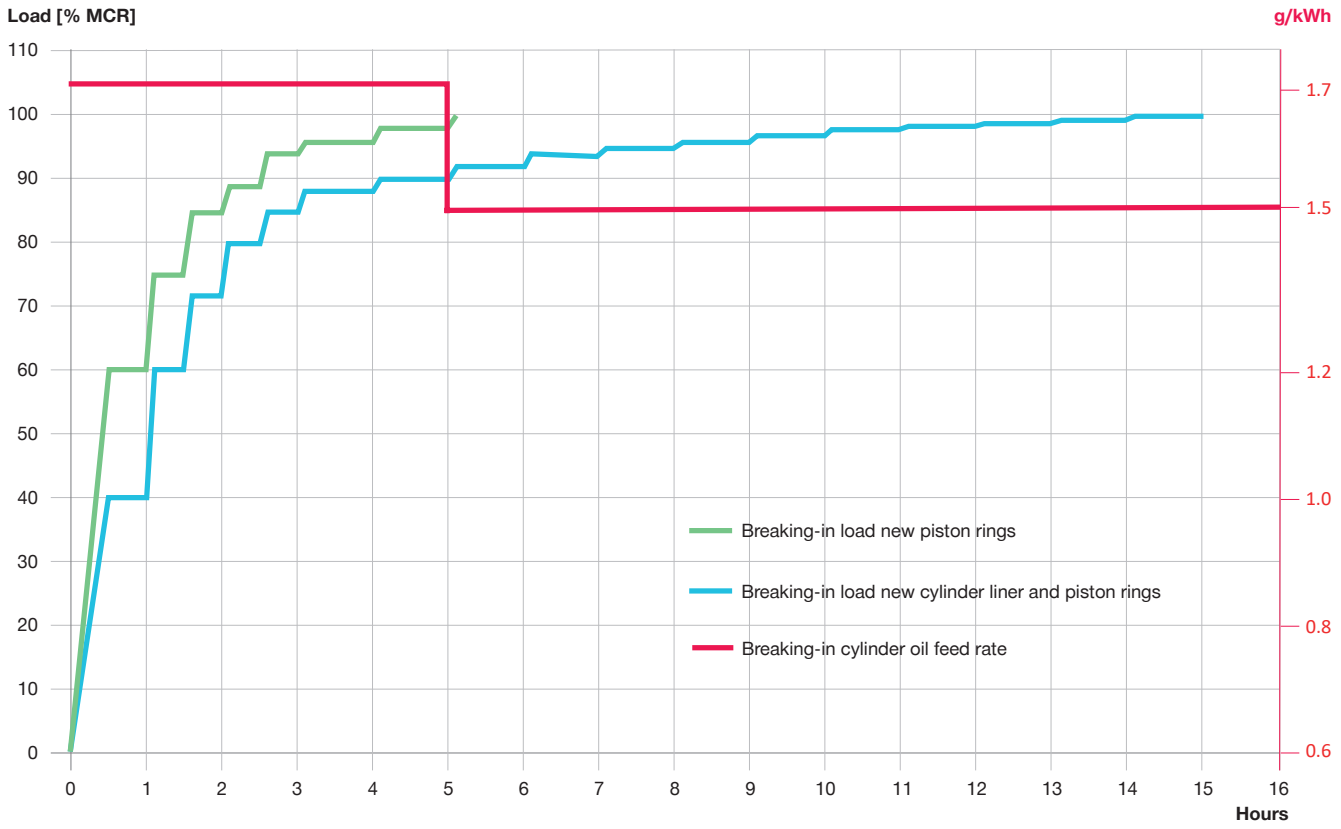
Guiding cylinder lubricating oil (CLO) feed rates when operating on 0–3.5% sulphur fuel

All MAN B&W two-stroke engines with electronically controlled lubrication system

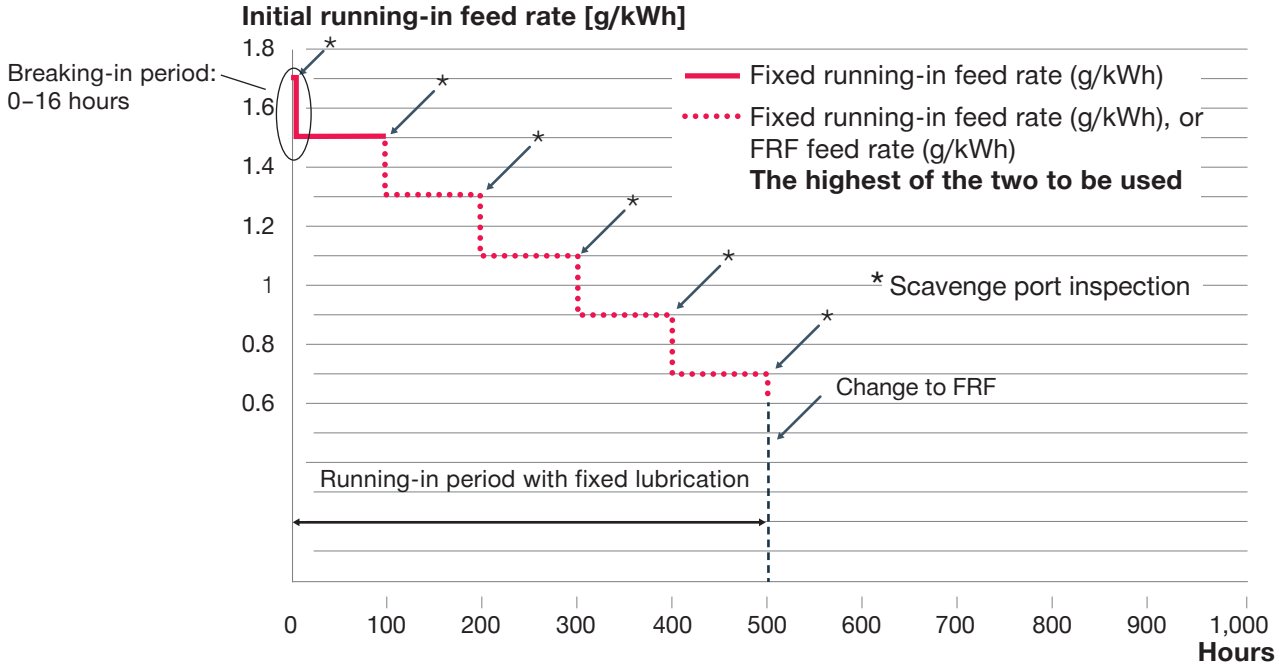
Operating conditions	Mk. 9 and higher (dual-fuel Mk. 8 and higher)	Mk. 8 and lower
Viscosity range	SAE50 (min. 18.5 cSt @ 100°C)	SAE50 (min. 18.5 cSt @ 100°C)
CLO for VLSFO, including LNG, LEG, LPG, methanol, FAME and HVO	Cat. II BN 40	Cat. I or Cat. II BN 40
CLO for ULSFO	Cat. II BN 40	Cat. I or Cat. II BN 40
CLO for HSFO	Cat. II BN 100–140+	Cat. I BN 70 or Cat. II BN 100–140+
CLO for shop test	Cat. II BN 40	Cat. II BN 40
CLO for sea trial on VLSFO or ULSFO	Cat. II BN 40	Cat. II BN 40
CLO for sea trial on HSFO	Cat. II BN 100–140+	Cat. I BN 70 or Cat. II BN 100–140+
Minimum feed rate	Absolute minimum: 0.60 g/kWh Fixed pitch propeller (FPP): Normal 0.6–0.8 g/kWh Controllable pitch propeller (CPP): Normal 0.8 g/kWh	Absolute minimum: 0.60 g/kWh FPP: Normal 0.6–0.8 g/kWh CPP: Normal 0.8 g/kWh
Maximum feed rate	1.5 g/kWh continuously @ MCR	1.5 g/kWh continuously @ MCR
Breaking-in and running-in new or reconditioned liners and new piston rings	**Feed rate** First 5 hours: 1.7 g/kWh (in service), see Appendix II From 5 to 16 hours: 1.5 g/kWh (in service), see Appendix II From 16 to 500 hours: Stepwise reduction from 1.5 g/kWh to normal feed rate (see Appendix II and III) **Engine load** In service: 50% to max. load in 14 hours (see Appendix II). If running is paused during the running-in process, resume from the highest obtained load level.	
Running-in new rings in already run-in and well-running liners	**Feed rate** 1.7 g/kWh, 0–5 hours 1.5 g/kWh, 5–12 hours 1.2 g/kWh, 12 hours - first inspection hours Provided the inspection shows good results, set the feed rate back to normal **Engine load** From 50% to max. load in 4 hours (see Appendix II)	
Load change dependent – LCD **See manual 6645-0260-0021-5**	During starting, manoeuvring, and load changes, LCD increases the feed rate by 25% of the normal feed rate and keeps it at the elevated level for 30 minutes after the load has stabilised. On (normal): LCD enabled; Off: LCD disabled	
Part load control **Breakpoint** **See manual 6645-0260-0021-7**	Part load control handles the feed rate below and above a specified “Breakpoint”. “Power” (above breakpoint): Feed rate is proportional to engine load. “RPM” (below breakpoint): Feed rate is proportional to engine speed (rpm). “Breakpoint” setting in fuel index %: FPP: Normal value 40 CPP: Normal value 63	
Lubrication of cylinders that show abnormal conditions	Frequent scavenge port inspections of piston rings and cylinder liners are very important for maintaining a safe cylinder condition. Cylinder lube oil consumption should be checked on the MOP/HMI. The MOP/HMI value should be within 10% of the service tank daily consumption. If the consumption deviates excessively, raise the feed rate for all units and check the lubrication system before reducing the feed rate again. If there are high liner temperature fluctuations, suspected scuffing, or other abnormalities, increase the feed rate to the previous setting which resulted in good cylinder conditions or the safe setting of 1.2 g/kWh. If there is excessive build-up of deposits on the ring lands: 1. Change to a CLO with higher detergency, i.e. Cat. II BN 40–140 2. Increase the feed rate to 1.00 g/kWh.	

Appendix II

Breaking-in and running-in load programme and cylinder lubrication settings for new liners and piston rings

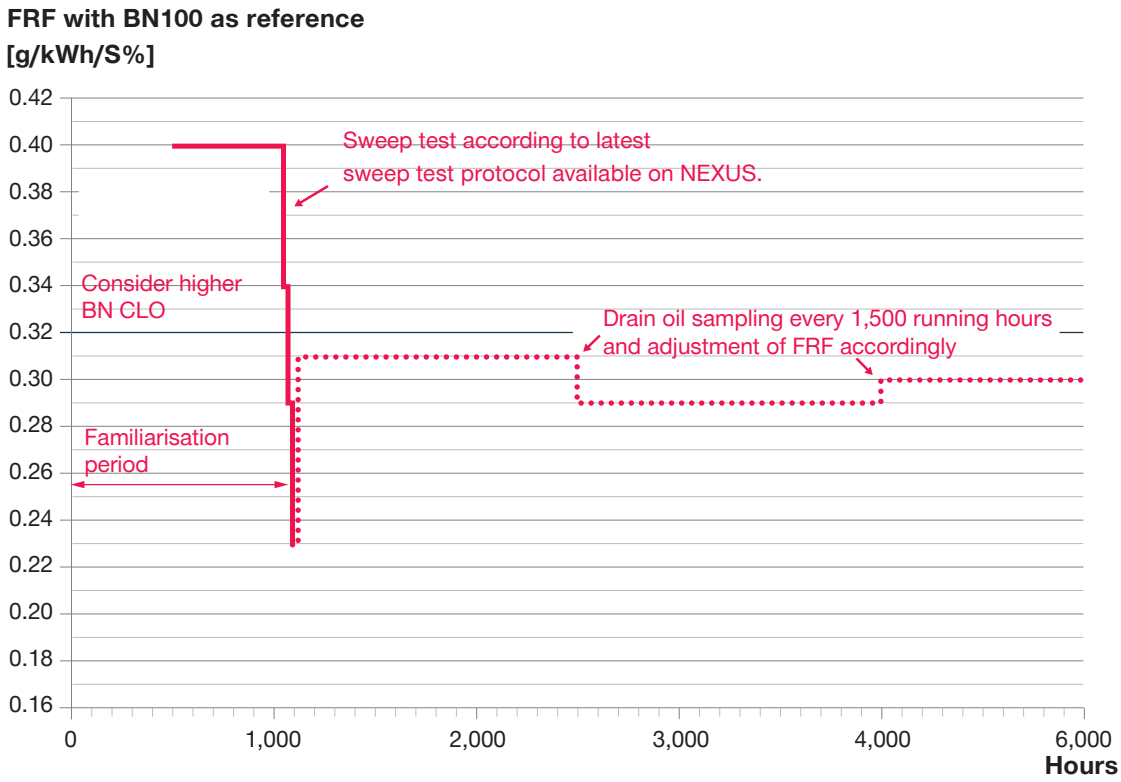


Running-in new liners



Appendix III

FRF running-in schedule for liner and piston rings, Mk. 8 and newer.



Appendix IV

Deposit on ring lands (D.*)

D.1

Clean condition

Description:

No deposits found on the ring land

Action:

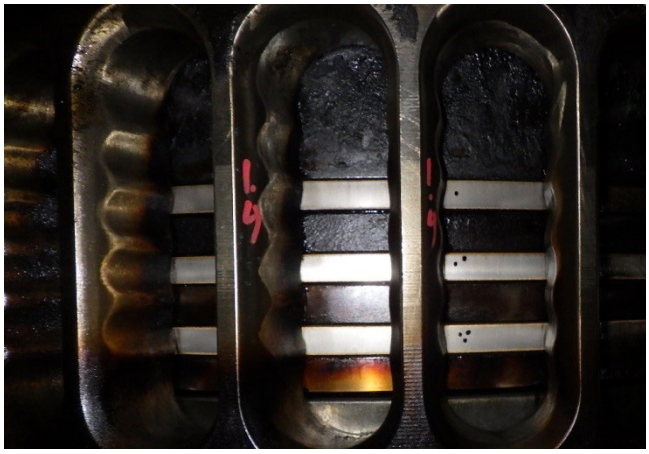
– No action is required

D.2

Medium amount of deposits on first ring land

Description:

Medium amount of deposits on first ring land



Action: Monitor the condition

– Increase the feed rate by 0.2 g/kWh
– If the feed rate (g/kWh) is 1.0 g/kWh or above, consider changing to a Cat. II CLO

D.3

High amount of deposits on first ring land

Description:

High amount of deposits on first ring land, and medium amount of deposits on second ring land

Action: At first opportunity

– Increase feed rate by 0.2 g/kWh
– If the feed rate (g/kWh) is 1.0 g/kWh or above, consider changing to a Cat. II CLO

Appendix V

Cermet condition overview (C.*)

C.1

Cermet-coated piston ring, good condition

Description:

Cermet-coated piston ring in good condition with a smooth running surface and rounded edges

Action: No action

No action is required

C.2

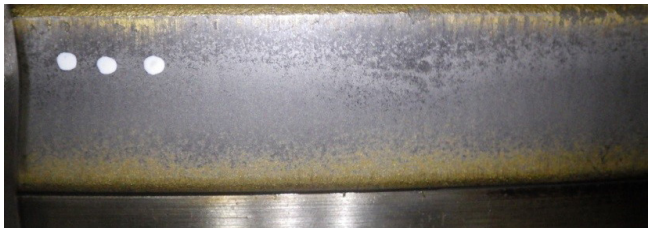
Hard piston ring contact marks

Description:

Cermet-coated piston ring with hard contact marks

Action: Monitor the condition

- Increase the feed rate to 1.2 g/kWh
- Monitor the condition
- When acceptable, initiate a stepwise feed rate reduction



C.3

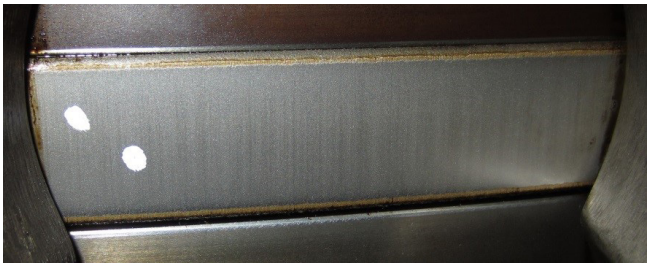
Hard piston ring contact marks

Description:

Cermet-coated piston ring with hard contact marks after the alucoating has been worn off

Action: Monitor the condition

- Increase the feed rate to 1.2 g/kWh
- Monitor the condition
- When acceptable, initiate a stepwise feed rate reduction



C.4

Hard piston ring contact

Description:

Partly damaged piston ring after hard contact

Action: At first opportunity

- Increase the feed rate to 1.2 g/kWh
- Monitor the performance of the unit
- Plan ring renewal
- Check liner surface condition, dressing/honing may be necessary.