



GreenOil Standard ApS
Erhvervsparken 10
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Denmark

LEF4/MIKA

11 May 2016

No Objection Letter (NOL) regarding GreenOil filtration unit for Lubricating oil cleaning.

Dear Mr. Tomas Skjærris

MAN Diesel & Turbo, branch of MAN Diesel & Turbo SE, Germany ("MDT") has participated in the testing of the GreenOil filtration unit in the period between September 2015 and February 2016 according to the field test agreement between MDT and GreenOil Standard ApS ("GreenOil"). The Field test was performed on a 9L27/38 MAN B&W GenSet Engine. The field test included 2000 service running hours and inspections, recording and analysing of the lubricating oil samples during the field test-by MDT.

MDT has evaluated the field test and found the test results of the GreenOil filtration unit acceptable and within MDT's specifications.

MDT has No Objection to the installation of the GreenOil filtrations units on the following MAN B&W Holeby GenSet engine designs,

L16/24, L21/31, L27/38, L23/30, L23/30H, L28/32H V28/32S, L28/32DF, V28/32S-DF, L23/30DF
L16/24S, L21/31S, L27/38S L23/30S, L28/32S

always provided that the recommendations in our prevailing engine type specific guidelines are followed. Attached specification: *Criteria for cleaning/exchange of lubricating oil*


As the GreenOil filtration units is neither produced nor sold by MDT, MDT cannot be held responsible for any damage to the engine or engines components that may be caused by installation of the GreenOil filtration unit.

Only the full and complete version of this NOL may be reproduced and/or displayed by the receiver.

Yours sincerely,
MAN Diesel & Turbo



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**L27/38, L23/30H, L21/31, L16/24, V28/32S, L28/32DF, L16/24S, L21/31S,
L23/30S, L27/38S, L23/30DF, L28/32S, V28/32S-DF**

Replacement of lubricating oil

The expected lubricating oil lifetime in operation is difficult to determine. The lubricating oil lifetime is depending on the fuel oil quality, the lubricating oil quality, the lubricating oil consumption, the lubricating oil cleaning equipment efficiency and the engine operational conditions.

In order to evaluate the lubricating oil condition a sample should be drawn on regular basis at least once every three month or depending on the latest analysis result. The lubricating oil sample must be drawn before the filter at engine in operation. The sample bottle must be clean and dry, supplied with sufficient identification and should be closed immediately after filling. The lubricating oil sample must be examined in an approved laboratory or in the lubricating oil suppliers own laboratory.

A lubricating oil replacement or an extensive lubricating oil cleaning is required when the MAN Diesel & Turbo exchange criteria's have been reached.

Evaluation of the lubricating oil condition

Based on the analysis results, the following guidance are normally sufficient for evaluating the lubricating oil condition. The parameters themselves can not be judged alonestanding, but must be evaluated together in order to conclude the lubricating oil condition.

1. Viscosity

Limit value:

| | Normal value | min. value | max. value |
|---------------------|---------------------|-------------------|-------------------|
| SAE 30 [cSt@40° C] | 95 - 125 | 75 | 160 |
| SAE 30 [cSt@100° C] | 11 - 13 | 9 | 15 |
| SAE 40 [cSt@40° C] | 135 - 165 | 100 | 220 |
| SAE 40 [cSt@100° C] | 13.5 - 15.0 | 11 | 19 |

Unit : cSt (mm²/s)
Possible test : ASTM D-445, DIN51562/53018, ISO method 3104

Increasing viscosity indicates problems with insolubles, HFO contamination, water contamination, oxidation, nitration and low load operation. Decreasing viscosity is generally due to dilution with lighter viscosity oil.

2. Flash point

Min. value : 185° C
Possible test : ASTM D-92, ISO 2719 method

Normally used to indicate fuel dilution.

3. Water content

Max. value : 0.2 %
Unit : Weight %
Possible test : ASTM D4928, ISO 3733 method

Water can originate from contaminated fuel oil, an engine cooling water leak or formed as part of the combustion process. If water is detected also Sodium, Glycol or Boron content should be checked in order to confirm engine coolant leaks.

4. Base number

Min. value : The BN value should not be lower than 50% of fresh lubricating oil value, but minimum BN level never to be lower than 10-12 at operating on HFO!
Unit : mg KOH/g
Possible test : ASTM D-2896, ISO 3771 method

The neutralization capacity must secure that the acidic combustion products, mainly sulphur originate from the fuel oil, are neutralized at the lube oil consumption level for the specific engine type. Gradually the BN will be reduced, but should reach an equilibrium.

5. Total acid number (TAN)

Max. value : 3.0 acc. to fresh oil value
Unit : mg KOH/g
Possible test : ASTM D-664 method

TAN is used to monitor oil degradation and is a measure of the total acids present in the lubricating oil derived from oil oxidation (weak acids) and acidic products of fuel combustion (strong acids).

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L27/38, L23/30H, L21/31, L16/24, V28/32S, L28/32DF, L16/24S, L21/31S, L23/30S, L27/38S, L23/30DF, L28/32S, V28/32S-DF

6. Insolubles content

Max. value : 1.5 % generally, depending upon actual dispersant value and the increase in viscosity

Unit : Weight %

Possible test : ASTM D-893 procedure B in Heptane, DIN 51592

Additionally : If the level in n-Heptane insolubles is considered high for the type of oil and application, the test could be followed by a supplementary determination in Toluene.

Total insolubles is mainly derived from products of combustion blown by the piston rings into the crankcase. It also includes burnt lubricating oil, additive ash, rust, salt, wear debris and abrasive matter.

7. Metal content

| Metal content | Remarks | Attention limits |
|---|--|---|
| Iron Chromium Copper Lead Tin Aluminium Silicon | Depend upon engine type and operating conditions | max. 50 ppm max. 10 ppm max. 15 ppm max. 20 ppm max. 10 ppm max. 20 ppm max. 20 ppm |