

# Quality requirements for lube oil

## 3.3.6

### Lube oil for heavy fuel oil operation (HFO)

The specific power output offered by today's Diesel engines and the use of fuels which more and more often approach the acceptable limit in quality increase the requirements placed on the lube oil and make it imperative that the lube oil is chosen carefully. Medium-alkaline lube oils have proven to be suitable for lubricating the running gear, the cylinders, the turbo-charger and for cooling of the pistons. Medium-alkaline oils contain additives which, amongst other things, provide them with a higher neutralisation capacity than doped (HD) engine oils have.

No international specifications exist for medium-alkaline lube oils. An adequately long trial operation in compliance with the manufacturer's instructions is therefore necessary before a general release is possible.

Only lube oils, which have been released by MAN B&W, are to be used. These are listed in Table 4.

### Requirements

#### Base oil

The base oil (medium-alkaline lube oil = base oil + additives) must be a narrow distillation cut and must be refined in accordance with modern procedures. Brightstocks, if contained, must neither adversely affect the thermal nor the oxidation stability.

The base oil must meet the limit values of the following Table, particularly as concerns its aging stability.

<i>Properties/characteristics</i>	<i>Unit</i>	<i>Test method</i>	<i>Characteristic values</i>
Structure	-	-	preferably paraffin-basic
Behaviour in cold, still flowing	°C	ASTM-D2500	-15
Flash point (as per Cleveland)	°C	ASTM-D92	> 200
Ash content (oxide ash)	Weight %	ASTM-D482	< 0.02
Coke residue (as per Conradson)	Weight %	ASTM-D189	< 0.50
Aging tendency after being heated up to 135° C for 100 hrs	-	MAN-aging cabinet	-
n-heptane insolubles	Weight %	ASTM-D4055 or DIN 51592	< 0.2
evaporation loss	Weight %	-	< 2
drop test (filter paper)	-	MAN-test	must not allow to recognize precipitation of resinous or asphalt-like aging products

Table 1. Lube oil (HFO operation) - characteristic values to be observed

#### Medium-alkaline lube oil

The base oil (medium-alkaline lube oil) with which additives have been mixed must demonstrate the following properties:

#### Additives

The additives must be dissolved in the oil and must be of such a composition that an absolute minimum of ash remains as residue after combustion,

even if the engine is run on distillate fuel temporarily. The ash must be soft. If this prerequisite is not complied with, increased deposits are to be expected in the combustion chamber, especially on the exhaust valves and in the inlet housing of the turbochargers. Hard additive ash promotes pitting on the valve seats, as well as valve blow-by and increased mechanical wear in the cylinder crankcase.

Additives must not promote clogging of the filter elements, neither in their active nor in their exhausted state.

Detergency	The detergency must be so high that the build-up of coke and tar-like residues forming during the combustion of heavy fuel oil is precluded.
Dispersancy	The dispersancy must be selected such that commercially available lube-oil cleaning equipment can remove the detrimental contaminations from the used oil, i.e., the used oil must have good separating and filtering properties
Diesel-Performance	The Diesel performance (without taking the neutralisation capacity into consideration) must, at least, comply with MIL-L-2104 D resp. API-CD.
Neutralisation capacity	The neutralisation capacity (ASTM-D2896) must be so high that the acidic products resulting from combustion are neutralised at the lube oil consumption rate that is specific for the engine. The reaction time of the additives must be matched to the processes in the cylinder crankcase. Hints concerning the selection of the BN are given in Table 3.
Evaporation tendency	The tendency to evaporate must be as low as possible, otherwise the oil consumption is adversely affected.
Further conditions	The lube oil must not form a stable emulsion with water. Less than 40 ml emulsion are acceptable in the ASTM-D 1410 test after one hour. The foaming behaviour (ASTM-D 892) must meet the following conditions: after 10 minutes < 20 ml. The lube oil must not contain agents to improve the viscosity index. Fresh oil must not contain any water or other contaminations.

## Lube oil selection

<b>Engine</b>	<b>SAE class</b>	<b>Viscosity mm<sup>2</sup>/s at 40° C or 100° C</b>
20/27*, 23/30, 28/32	30**	preferably in the upper range of the SAE class
25/30	40	
32/36 through 58/64	40	applicable to the engine

\* Applies to engines with year of manufacture from 1985. For engines delivered before 01 Jan. 1985, lube oil viscosity as per SAE 40 continues to be valid.

\*\* If the lube oil is heated to approx. 40° C before the engine is started, SAE class 40 can also be used if necessary (e.g. on account of simplified lube-oil storage).

Table 2. Viscosity (SAE class) of lube oils

Neutralisation capacity (BN)	Medium-alkaline lube oils having differently high levels of neutralisation capacity (BN) are available on the market. According to the present-day state of knowledge, operating conditions to be expected and BN can be correlated as follows (refer to Table 3). The operating results will in the essence be the decisive criterion as to which BN will ensure the most economic engine operation.
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<b>BN (mg KOH/g oil)</b>	<b>Operating conditions</b>
~ 20 - 25	Marine Diesel Oil (MDO) of poor quality (ISO-F-DMC) or heavy fuel oils with a low fuel sulphur content ( $\leq 0.5$ % by weight).
~ 30	For 32/40, 40/54, 48/60 and 58/64 engines only if the sulphur content of the fuel is $< 1.5$ % For older engines with higher lube oil consumption also if the fuel has a higher sulphur content.
~ 40	For 32/40, 40/54, 48/60 and 58/64 engines generally if the sulphur content of the fuel is $> 1.5$ % For older engine types if BN 30 is demonstrably inadequate in terms of wear, residue formation and time between renewal of the oil charge, or if the sulphur concentration is $> 4.0$ % by weight.
~ 50	For 32/40, 40/54, 48/60 and 58/64 engines if BN 40 is inadequate in terms of time between renewal of oil charge (high sulphur content of the fuel, very low oil consumption).

Table 3. Determining the BN appropriate for operating conditions

Cylinder lube oil	<p>In the case of engines with separate cylinder lubrication, the pistons and the cylinder liner are supplied with lube oil by means of a separate oil pump. The lube oil supply rate is factory-set to conform to both the quality of the fuel to be used in service and to the anticipated operating conditions.</p> <p>A lube oil as specified above is to be used for the cylinder lubrication and the lubricating circuit.</p>
Speed governor	<p>In case of mechanic-hydraulic governors with separate oil sump, multi-grade oil 5W-40 is preferably used. If this oil is not available as refill, an oil 15W-40 can be used for once. In this context it is not important, if multi-grade oils based on synthetic or mineral oil are used. According to the mineral oil companies they can be mixed in all cases.</p> <p>The oil quality specified by the manufacturer is to be used for the remaining equipment fitted to the engine.</p>
Lube-oil additives	<p>We strongly advise against subsequently adding additives to the lube oil, or mixing the different makes (brands) of the lube oil, as the performance of the carefully matched package of additives, which is suiting itself and adapted to the base oil, may be upset. Also, the lube oil company (oil supplier) is no longer responsible for the oil.</p>
Selection of lube oils/ warranty	<p>Most of the mineral oil companies are in close and permanent consultation with the engine manufacturers and are, therefore, in a the position to quote the oil from their own product line that has been approved by the engine manufacturer for the given application. Independent of this release, the lube oil manufacturers are in any case responsible for quality and performance of their products. In case of doubt, we are more than willing to provide you with further information.</p>

## Examinations

We carry out the lube oil examinations in our laboratories for our customers who need only pay the self-costs (net-costs). A representative sample of about 1 dm<sup>3</sup> is required for the examination.

<b>Manufacturer</b>	<b>Base Number (mgKOH/g)</b>		
	<b>20 - 25</b>	<b>30</b>	<b>40</b>
ADNOC	Marine Engine Oil X424	Marine Engine Oil X430	Marine Engine Oil X440
AGIP	-	Cladium 300	Cladium 400
BP	Energol IC-HFX 204	Energol IC-HFX 304	Energol IC-HFX 404
CASTROL	TLX 204 TLX Plus 204	TLX 304 TLX Plus 304	TLX 404 TLX Plus 404
CEPSA	Koral 25	Koral 35	-
CHEVRON Texaco (FAMM, Caltex)	Taro 20DP40 Delo 2000 Marine Oil SAE 40	Taro 30DP40 Delo 3000 Marine Oil SAE 40	Taro 40XL40 Delo 3400 Marine Oil SAE 40
DELEK	Delmar 40-24	Delmar 40-30	Delmar 40-40
ENGEN	-	Genmarine EO 4030	Genmarine EO 4040
ERTOIL	Koral 25	Koral 35	-
ESSO / EXXON	Exxmar 24 TP 40 -	Exxmar 30 TP 40 Exxmar 30 TP 40 Plus	Exxmar 40 TP 40 Exxmar 40 TP 40 Plus
IRVING	Marine MTX 2040	Marine MXD 3040	Marine MXD 4040
MAO MING	-	MMDL 4030	-
MOBIL	- -	Mobilgard 430 Mobilgard M430	Mobilgard 440 Mobilgard M440
PETROBRAS	Marbrax CCD-420	Marbrax CCD-430	Marbrax CCD-440
REPSOL	Neptuno NT 2040	Neptuno NT 3040	Neptuno NT 4040
SHELL	Argina S 40	Argina T 40	Argina X 40
STATOIL	MarWay-2040	MarWay-3040	MarWay-4040
TEBOIL	-	Ward S 30 T	Ward S 40 T
TOTAL LUBMARINE	Aurelia XL 4025	Aurelia XL 4030	Aurelia XL 4040

Table 4. Lubricating oils, which have been released for the use in MAN B&W Diesel four-stroke engines running on heavy fuel oil