

3.2 Regulations and Maintenance - Engine Lubricating Oil


The quality of the engine oil has a big influence on the service life and performance and thus the overall economic efficiency of the engine.

High demands in terms of suitability must, therefore, be made on the lubricants to be used.

The lubricating oil is to be selected depending on the specification of the fuel used to run the engine.


When the engine is operating on heavy fuel, the effect of the increased amounts of coke-type and acid deposits which form during combustion due to higher ash and sulfur content, must be rendered harmless. For this reason only lubricating oils are approved which have been specifically developed for medium-speed trunk piston diesel engines.

On engines which are equipped with special cylinder liner fresh oil lubrication the same oil brand is to be used in the circulation system and for liner lubrication.

	NOTE
	<p>When using fuel with a very low sulfur content liner lacquering may occur. If this phenomenon occurs in combination with high lubricating oil consumption special oils should be used after consultation with Caterpillar Motoren GmbH & Co. KG.</p>

3.2.1 Base Oil

The base oil must be a high-quality solvent refined product from a source suitable for engine lubricating oil and have a good ageing stability as well as a good pressure absorption capability and thermo-stability.

	NOTE
	<p>Regenerated oils are not permitted!</p>

3.2.2 Additives

The additives contained in the lubricating oil must remain effective and uniformly distributed at all temperatures occurring under normal operation between pour point and 220 °C as well as in storage and also meet the following requirements in engines:

- Have good detergent and dispersant properties (which for heavy fuel operation must at least meet the API-CF level) to prevent the depositing of combustion products (coke and asphalt-like compounds) or dissolve and keep them in suspension.
- Have sufficient alkalinity in order to be able to neutralize the sulfur acid compounds generated during the combustion process. This is usually referred to as the Base Number (BN), or as Alkalinity Value (AV) and indicated in mg KOH/g. For engines operating on heavy fuel this value should range between 30 and 40 mg KOH/g for fresh oils.

3.3 Maintenance of Lubricating Oil

The service life of lubricating oil can be extended by means of separators, oil centrifuges, and by-pass filters.

Mechanical filters suitable for filtering blended oils may be used only. Chemically active filters are not permitted.

3.3.1 Lubricating Oil Cleaning (by-pass)

By-pass oil cleaning in separators is specified for heavy-fuel operation because the finely distributed combustion deposits cannot be removed effectively from the oil in any other way. The separator capacity should be designed in accordance with the Instructions for Heavy Fuel Operation.

Prerequisite for good cleaning of the lubricating oil is a low viscosity which requires a correspondingly high temperature. When separating the temperature should be between 90 and 95 °C.

For gas oil or MDO operating by-pass filters can be used instead of separators.

3.3.2 Lubricating Oil Filtration (main stream)

In order to remove the higher amount of contaminants in the lubricating oil when operating on heavy fuel, the installation of an "automatic back flushing filter" in combination with a downstream indicator filter as double filter is necessary. (For further details please refer to the Instructions for Heavy Fuel Operation).

For gas oil or MDO operation, a double filter with manual change-over is sufficient.


Exception: automatic filters

- Filter mesh sizes: Automatic filter: 34 μ
 Double filter: 48 μ
 Safety filter (if equipped): 200 μ

3.4 Lubricating Oil Brand Recommendations – Limitation of Warranty

In most cases, the company name is part of the brand designation of the lubricating oil and should, when ordering, be placed in front of the designation to avoid confusion. Caterpillar Motoren GmbH & Co. KG does not have sufficient experience with the lubricating oil brands listed in column II. The intended use of any of these oils must therefore be discussed with the engine manufacturer beforehand as otherwise the warranty will expire.

Caterpillar Motoren GmbH & Co. KG does not have any experience with oils not mentioned in this document. Caterpillar Motoren GmbH & Co. KG cannot assume any warranty for the oil used because, for example, recipe and production cannot be influenced by Caterpillar Motoren GmbH & Co. KG. Furthermore no warranty can be assumed in case of improper engine and lubricating oil maintenance nor if non-approved fuels are used. Proof that a damage is not attributable to the lubricating oil must be provided by the user.

	NOTE
	Viscosity class SAE 40 is required for all engines.

3.4.1 Dual fuel

For the engine types M46 DF and M34 DF the following lubricant brands should be chosen depending on the kind of liquid fuels.

When using distillate fuels, the lubricating oils for distillate operation are to be used.

If heavy fuel is used as liquid fuel component, the lubricating oils for heavy fuel that have a TBN of 30 are to be used.

In case of longer operation with heavy fuel instead of gas attention should be paid to maintain a sufficiently high TBN (at least TBN 18). If the oil is otherwise in a good condition, the base number can be increased by changing part of the oil.

3.4.2 List of Lubricating Oil Brands for Operation with Distillate Fuel

i	NOTE
	Viscosity class SAE 40 is required for all engines.

Manufacturer	Brand	I	II
AGIP	DIESEL SIGMA S CLADIUM 120		X X
BP	ENERGOL HPDX 40 VANELLUS C3	X	X
CAT	DEO	X	
CHEVRON, CALTEX, TEXACO	DELO 1000 MARINE DELO SHP TARO 12 XD TARO 16 XD TARO 20 DP TARO 20 DPX	X X X X X X	
CASTROL	MARINE MLC MHP 154 TLX PLUS 204 HLX 40	X X X X	
CEPSA	KORAL 1540		X
ESSO	EXXMAR 12 TP EXXMAR CM+ ESSOLUBE X 301	X	X X
MOBIL	MOBILGARD 412 MOBILGARD ADL MOBILGARD M430 ¹⁾ MOBILGARD 1-SHC ²⁾ DELVAC 1640	X X X X	X

Manufacturer	Brand	I	II
SHELL	GADINIA	X	
	GADINIA AL	X	
	ARGINA S	X	
	ARGINA T ¹⁾	X	
TOTAL LUBMARINE	RUBIA FP		X
	DISOLA M 4015	X	
	AURELIA TI 4030 ¹⁾	X	
	CAPRANO M40	X	
LUKOIL	NAVIGO 12/40	X	
	NAVIGO 15/40	X	
KPC	Q8 Mozart KV	X	

I Proven in use

II Permitted for controlled use. If these lubricating oils are used, Caterpillar Motoren GmbH & Co. KG must be informed because at the moment there is insufficient experience available regarding their use in engines. Otherwise the warranty will expire.

1) See also List of Lubricating Oil Brands for Heavy Fuel Operation.

2) Synthetic oil with a high viscosity index (SAE 15 W/40). For engines under SAE 40 regulation only allowed if the oil inlet temperature can be decreased by 5 - 10 °C.

3.4.3 List of Lubricating Oil Brands for Heavy Fuel Operation

i	NOTE
	Only viscosity class SAE 40 is permitted.

Manufacturer	Brand	I	II
AGIP	CLADIUM 300 S	X	
	CLADIUM 400 S	X	
CHEVRON, CALTEX, TEXACO	TARO 30 DP	X	
	TARO 40 XL	X	
	TARO 40 XLX	X	
CASTROL	TLX PLUS 304	X	
	TLX PLUS 404	X	
ESSO	EXXMAR 30 TP	X	
	EXXMAR 30 TP PLUS	X	
	EXXMAR 40 TP		X
	EXXMAR 40 TP PLUS	X	
MOBIL	MOBILGARD M430	X	
	MOBILGARD M440	X	
	MOBILGARD M50	X	
SHELL	ARGINA T	X	
	ARGINA X	X	
TOTAL LUBMARINE	AURELIA TI 4030	X	
	AURELIA TI 4040	X	
GULF	SEA POWER 4030	X	
	SEA POWER 4040	X	
LUKOIL	NAVIGO TPEO 40/40	X	
	NAVIGO TPEO 30/40	X	
KPC	Q8 Mozart TM 30	X	
	Q8 Mozart TM 40	X	

I Proven in use

II Permitted for controlled use. If these lubricating oils are used, Caterpillar Motoren GmbH & Co. KG must be informed because at the moment there is insufficient experience available regarding their use in engines. Otherwise the warranty will expire.

3.4.4 Special Lubricating Oil Approvals


If local engine oils are to be used instead of the engine oils recommended in chapter "Lubricating Oil Brand Recommendations", the following brands can be used for the engines indicated.

Manufacturer	Oil brand	Approval acc. to column	Region	Letter of Guarantee	Fuel type	Engine type
Bharat Oil	MaK Marine X 404 (TBN 40)	(2)	India		HFO	M35 – M601 M20 – M43
Pertamina (Lubrizol)	Medripal 411	(2)	Indonesia	LG	MDO/ MGO	M35 – M601 M20 – M43
	Medripal 412	(2)		LG	MDO/MGO	
	Medripal 430	(2)		LG	HFO	
	Medripal 440	(2)		LG	HFO	
(Infineum)	Salyx 412	(1)				MDO/ MGO
	Salyx 415	(1)				MDO/MGO
	Salyx 420	(1)			MDO/MGO	
Petromin (Lubrizol)	Petroshield 1-40	(2)	Saudi Arabia		MDO/MGO	M35 – M601 M20 – M43
Petromin (In fineum)	Petropower 1-40	?	Saudi Arabia		MGO/MDO	M35 – M601 M20 – M43
Valvoline	Valmarin TP 1240	(1)	NL (D) (02/95)		MGO/MDO	M35 – M601 M20 – M43
DEA	Cronos Super	(1)	D			M35 – M601 M20 – M43
FUCHS	TITAN UNIC 1040 MC	(1)	(D) (10W-40) (09.04.97)		Locomotive applications only	12M282 Locomotive engine
BP	Vanellus Multigrad 15W40	(1)	(D) (15W-40)		Locomotive applications only	12M282 Locomotive engine
Castrol	TPL 204	(1)	(Russia) (08.00)		MGO/MDO	M35 – M601 M20 – M43
Statoil	Dieselway 40	(2)	N		MGO	M35 – M601
	Marway 1040	(2)		MGO	M20 – M43	
Petron Corp.	Petromar XC 4040	(2)	Philippines		HFO	M35 – M601 M20 – M43
SINOPEC	TPEO4020	(1)	China	LG	MGO/MDO	M35 – M601
	TPEO4030	(1)		LG	HFO	M20 – M43
	TPEO4040	(1)		LG	HFO	
	TPEO4012	(1)		LG	MGO/MDO	
Aegean	Alfamar 430	(2)	Griechenland	LG	HFO	M35 – M601
	Alfamar 440	(2)		LG	HFO	M20 – M43

LG = Letter of Guarantee available.


3.5 Lubricating Oil Changes

The oil change interval is dependent to a large extent on the quality of the oil used and is influenced also by the fuel used, the amount circulating in the engine lubricating system, the operating conditions, the engine oil consumption, the lubricating oil and engine maintenance.

	NOTE
	The optimal oil circulation quantity is 1.36 l/kW.

If in special exceptions low circulation amounts down to a minimum of 0.3 l/kW cannot be avoided, shorter oil change intervals are necessary. In such cases the oil change times indicated below must be multiplied by the quotient of the actual quantity to the normally required quantity. However, an oil change must take place latest every 6 months.

The oil level must be checked daily (the level must not drop below the minimum mark). It must be topped up at the latest when 20% of the amount in circulation have been used.

	NOTE
	<p>Modern engines are characterized by low lubricating oil consumption rates of < 1 g/kWh, which in individual cases may even fall significantly below this value. Under such conditions and due to the low refilling requirement the usability limit may already be reached after shorter periods depending on the oil grade used (BN) and the influence of the other operating parameters. Independent of the kind of treatment it is necessary to replenish by adding new oil when the BN limit (see "Alkalinity") is reached.</p> <p>Due to the above-mentioned factors the indicated oil change intervals are guide values only.</p> <p>The essential criterion for determining the time for an oil change is compliance with the limit values specified under "Limits".</p>

It is, therefore, necessary to check the lubricating oil continuously by means of regular oil analyses. These analyses will be carried out by the lubricating oil service of the oil supplier or by Caterpillar Motoren GmbH & Co. KG at cost price. The oil for such an analysis must be taken from the oil circuit upstream of the engine during operation. The amount required is approx. 0.5 to 1.0 l.

Oil change after operating hours (h) based on 1.36 l/kWh when equipped with:


- Pre- and main filter every 1.500 h*
- Additional by-pass filter or oil centrifuge every 3.500 h*
- Separator every 7.500 h*

* applicable to engines with an oil consumption of ≥ 1 g/kWh and a sulfur content in case of distillate fuel of $\leq 1.5\%$ and $\leq 3\%$ respectively for HFO

3.6 Limits

3.6.1 Lubricating Oil Dilution by Fuel

Flash point decrease not below 180 °C (measured according to Penski-Martens DIN 51758) or viscosity decrease for SAE 40 (40 °C) not below 120 mm²/s (cSt), viscosity increase at 40 °C not above 200 mm²/s (cSt), vanadium content not higher than 150 ppm, Asphaltene content not higher than 1 %.

	NOTE
When reaching the limits change at least 25% of the oil!	


3.6.2 Alkalinity (TBN)

For heavy fuel operation, the total base number of the circulation oil must not fall below 18 mg KOH/g. For engines with cylinder lubrication, the limit value is 15 mg KOH/g.

If the engine is running on gas oil or MDO, the total base number must not fall below 50% of the value of the new oil.


If only the base number has reached the lower limit and the other analysis values show a satisfactory oil condition, the alkalinity should be increased by adding new oil.

3.6.3 Water Content

	NOTE
	If the water content rises above 0.2% the cause of the increase is to be identified and eliminated immediately. Change or separate the oil!

3.6.4 Contamination

When engines are running on heavy fuel, separators are required to keep the oil clean. This way the content of solid foreign particles can normally be kept well below 1% by weight. If the content increases beyond 1% by weight, the oil must be separated more intensively.

	NOTE
	The limit is 2% by weight.

Also for gas oil operation the pentane or heptane insolubles must not exceed 2% by weight.

3.7 Lubricants for Exhaust Turbochargers, Hydraulic Governors, Reversing Controls and Barring Gears

A turbine or hydraulic oil with very good anti-oxidation properties and a viscosity between 68 and 90 mm²/s (cSt) at 40 °C should be selected. For highly loaded ABB turbochargers fully synthetic special oils (see footnote) are recommended.

When selecting the lubricating oil brand the regulations of the equipment manufacturers such as ABB, Woodward, etc. are to be taken into account.

For RE governors commercial 15W40 multi-purpose oil should be used.

Manufacturer	Brand
AGIP	OSO 68 OTE 68 DICREA SX 68 ¹⁾
CHEVRON, CALTEX, TEXACO	RANDO HD 68 REGAL R & O 68 CETUS PAO 68 ¹⁾
CASTROL	PERFECTO T 68 HYSPIN AWH-M 68 AIRCOL SR 68 ¹⁾
CEPSA	HD TURBINAS 68
ESSO	TERESSO 68 TROMAR T COMPRESSOR OIL 68 ¹⁾
MOBIL	D.T.E OIL HEAVY RARUS SHC 1026 ¹⁾

Manufacturer	Brand
SHELL	TELLUS OIL S2 V 68 TURBO OIL T 68 CORENA OIL S4 R 68 ¹⁾
TOTAL LUBMARINE	PRESLIA 68 AZOLLA ZS 68 TURBINE T 68 BARELF SM 68 ¹⁾ DACNIS SH 68 VISGA 68

¹⁾ Fully synthetic special oil for extended oil change intervals in highly loaded ABB turbochargers with independent lubrication.

3.7.1 Multi-purpose grease – lithium saponified – consistency grade 2 (also suitable for pneumatic control instruments)

Manufacturer	Brand
AGIP	GR MU 2
CHEVRON, CALTEX, TEXACO	MULTIFAK EP 2
CASTROL	SPHEEROL SX 2
ESSO	BEACON EP 2
MOBIL	MOBILUX EP 2
SHELL	ALVANIA R RL 2
TOTAL LUBMARINE	CERAN AD PLUS

3.7.2 Barring Gears

Select a transmission oil with a viscosity of 460 cSt at 40 °C, e.g.:

Manufacturer	Brand
BP	Energol GR-XP 460
Exxon Mobile	Mobilgear 634
ESSO	Spartan EP 460
SHELL	Omola 460