Technical Documentation

Fluids and Lubricants
Specification

A001061/32E
(all commercial MTU-Series and DDC S60 Marine)

Printed in Germany

This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.
Subject to alterations and amendments.

1 Preface

The service life, operational reliability and function of the drive systems are largely dependent on the fluids and lubricants employed. The correct selection and treatment of these fluids and lubricants are therefore extremely important. This publication specifies which fluids and lubricants are to be used.

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Before using them, make sure you have the latest version. The latest version is also available at: http://www.mtu-online.com/Dienstleistungen/Dokumentation

If you have further queries, please contact your MTU representative.

Test standards for fluids and lubricants:

DIN	Federal German Standards Institute
EN	European Standards
ISO	International Standards Organisation
ASTM	American Society for Testing and Materials
IP	Institute of Petroleum

Note:

Use of the approved fluids and lubricants, either under the brand name or in accordance with the specifications given in this publication, constitutes part of the warranty conditions.

The supplier of the fluids and lubricants is responsible for the world-wide standard quality of the named products.

Fluids and lubricants for drive plants may be hazardous materials. Certain regulations must be obeyed when handling, storing and disposing of these substances.

These regulations are contained in the manufacturers' instructions, legal requirements and technical guidelines valid in the individual countries. Great differences can apply from country to country and a generally valid guide to applicable regulations for fluids and lubricants is therefore not possible within this publication.

Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. MTU accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants which it has approved.

2 Lubricants

Engine oils

Requirements for MTU Approval of Engine Oils (diesel engines)

The MTU requirements for approval of engine oils for diesel engines are contained in the MTU Factory Standards MTL 5044 and MTL 5051 for first-use oils and corrosion-inhibiting oils. For gas engines, oil approval requirements are contained in MTU Factory Standard MTL 5074. These standards can be ordered under these reference numbers.

Manufacturers of engine oils are notified in writing if their product is approved.

Approved engine oils are divided into the following MTU Quality Categories:

- Oil category 1: Standard quality / Single and multigrade oils
- Oil category 2: Higher quality / Single and multigrade oils
- Oil category 3: Highest quality / Multigrade oils
- Oil category 3.1: Multigrade oils with a low ash-forming additive content (low SAPS oils)

Low SAPS oils currently provide the highest oil quality category with low sulfur and phosphor contents and an ash-forming additive content of <1%.

They are only approved if the sulfur content in the fuel does not exceed 350 mg/kg.

Selection of a suitable engine oil is based on fuel quality, projected oil drain interval and on-site climatic conditions. At present there is no international industrial standard which alone takes into account all these criteria.

Special Features

MTU Engine Oils

One single-grade and one multigrade oil are available from MTU/DDC. These engine oils are marketed under the name Power Guard DEO SAE 40 and SAE 15W-40. The engine oils are tailored to the MTU Off-Highway application groups and correspond to Oil Category 2.

Engine Oils for Series 2000, 4000

For Series 2000 and 4000 engines engine oils other than those listed as approved in Section 6 may be used provided they satisfy all of the specifications and match all of the characteristics listed in Tables 1 and 2.

Performance specifications for engine oils for Series 2000 and 4000 (Table 1)

Oil category 1	Specification min. API CG-4/CH-4 and ACEA E2–96
Oil category 2	Specification ACEA E7–04
Oil category 3	Specification ACEA E4–04
Oil category 3.1	Specification ACEA E4–04, E6–04

Chemical-physical characteristics for engine oils (Table 2)

	Test Method	Limit Value
Total base number	ASTM D 2896 ISO 3771	> 8mgKOH/g
Shear stability	ASTM D 3945 or CEC-L-14-A-88	Limit values of respective viscosity class
Deposit test [1)]	DIN 51535	Max. 120 mg

[1)] Required for multi-grade oils used in closed crankcase ventilation.

Note:

Engine oils which comply with only one of the standards API CF, CF-2, CF-4, CG-4, CH-4 or CI-4 or with a combination of these specifications, do not fully meet performance specifications.

If these oils are intended for use, the oil drain interval is to be shortened by up to 50% after consultation with MTU.

Engine Oils for Series 6H 1800

Only engine oils as specified in Chapter 7 must be used for engine model 6H 1800 (→ Page 53).

Where diesel fuel in accordance with EN 590 is in use, the oil must be changed either after 1000 operating hours or after one year, whichever occurs first.

Where biodiesel/FAME in accordance with EN 14214 is in use, the oil change intervals are reduced (→ Page 21).

Restrictions on Series 595, 1163 and 8000 applications

For fast commercial ferries with Series 595 or 1163 engines, Category 2 or 3 oils are generally specified.

Oil Category 3.1 may be used if the sulfur content in the fuel does not exceed 350 mg/kg.

For Series 8000, only the following engine oils may be used:

- Exxon Mobil Delvac1630 SAE 30
- Shell Sirius X SAE 30

Engine Oil Requirements for Gas Engines

Viscosity grade SAE 40 is stipulated for gas engines!

The selection of a suitable engine oil for gas engines depends primarily on the type of gas used to power the engine. Another significant factor is the quality of the gas regarding its purity. This requires that the operator regularly carries out gas checks. The gas-engine oils to be used feature a low ash content (< 0.6%) and base numbers within a range of 4-6 mgKOH/g. This prevents increased ash deposits which can lead to reduced catalytic converter performance.

Selection of viscosity grades

Selection of the viscosity grade is based primarily on the ambient temperature at which the engine is to be started and operated. If the relevant performance criteria are observed the engines can be operated both with single grade and multigrade oils, depending on the application. Standard values for the temperature limits in each viscosity grade are shown in Chart 1.

Only where crankcase ventilation to atmosphere is in use as in the case of off-highway vehicles (e.g. tractor units, earth-moving machines, haul trucks) is it essential that multigrade oils are used.

If the prevailing temperature is too low, the engine oil must be preheated.

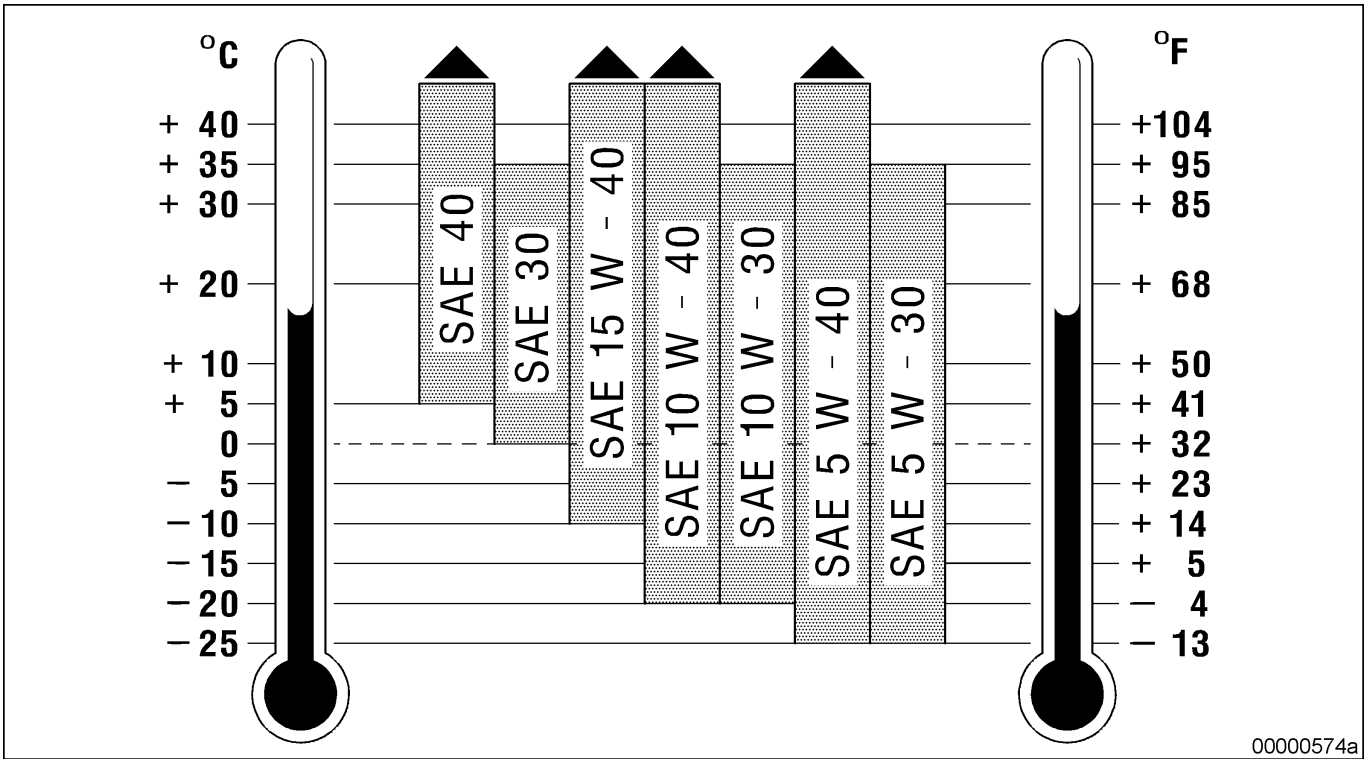


Diagram 1

Oil Drain Intervals for Diesel Engines

Engine oil drain intervals depend on the engine-oil quality, its conditioning, the operating conditions and the fuel used.

The intervals quoted (Table 3) are guidelines based on operational experience and are valid for applications with a standard load profile.

Oil Drain Intervals (Table 3)

Oil category	Without centrifugal oil filter	With centrifugal oil filter
1	250 operating hours	500 operating hours
2	500 operating hours	1000 operating hours
3	750 operating hours	1500 operating hours
3.1[1)]	750 operating hours	1500 operating hours

1) = To be used in conjunction with fuels with max. 350 mg/kg sulfur content.

The oil drain intervals in the table are recommended guidelines when using diesel fuels with < 0.5% sulfur content. The limit values specified in Table 4 for used oil must be complied with. The numbers of operating hours quoted for oils must be confirmed by means of oil analysis.

The oil drain intervals must be determined by oil analysis if one or more of the following difficult operating conditions are encountered:

- Extreme climatic conditions
- High engine start-up frequency
- Frequent and prolonged idling or low-load operation
- High sulfur content in the fuel of 0.5 to 1.5 % by weight (→ Page 10)

  New oils must be selected which have total base numbers appropriate to the sulfur content of the fuel in use. (→ Page 08)

For applications involving low runtimes, the engine oil must be changed every two years at the latest irrespective of its category.

Where engine oils with higher-grade corrosion-inhibiting characteristics are in use, (→ Page 33) a change must be carried out every 3 years at the latest.

In individual cases the service life of the engine oil can be optimized by regular laboratory analysis and appropriate engine inspections in consultation with the MTU service point responsible:

The first oil sample should be taken from the engine as a “basic sample” after the engine has run for approximately 1 hour after being filled with fresh oil.
Further oil samples should be analyzed after engine runtimes which are to be specified. (→ Page 08)
The appropriate engine inspections are to be carried out before and after the oil analyses.
After completion of all analyses, and depending on the findings, special agreements can be reached for individual cases.
Oil samples must always be taken under the same conditions and at the point provided for that purpose (see Operating Instructions).

Oil Drain Intervals for Gas Engines 12V 4000 L61

Engine oil drain intervals depend on the engine-oil quality, its conditioning, the operating conditions and the fuel used.

Regular oil analyses are necessary because of the varying gas qualities. At the beginning of the product’s life cycle, oil samples must be taken and analyzed after every 500 hours of operation.

Given consistent gas quality, an oil drain interval of max. 1,500 hours of operation is recommended.

In individual cases, the oil change intervals can be optimized:

For this purpose, oil samples are analyzed after every 200 -250 hours of operation. (→ Page 08).
The oil samples must always be taken from the extraction point provided and under the same conditions.

Special Additives

Engine oils approved have been specially developed for diesel engines and have all necessary properties. Further additives are therefore superfluous and may even be harmful.

Laboratory Analysis

General

Orders for engine oil analyses can be placed with MTU.

The oil sample must be taken in accordance with the Operating Instructions.

The following data are required:

- Oil manufacturer
- Brand name with viscosity class
- Oil service life to date
- Serial number of engine from which oil sample was taken

The following must be submitted (for each oil change):

- Min. 0.25 ltr used oil
- Min. 0.25 ltr reference sample (after approx. 1 hour’s operation)
- Min. 0.25 ltr new oil

Spectrometric Oil Analysis

Analysis of the engine oil’s additive-metal content is carried out by the MTU laboratory to determine the brand of oil.

MTU does not generally analyze the oil’s wear-metal contents in order to determine the degree of engine wear. These content levels are very much dependent on the following factors, among others:

- Individual engine equipment status
- Tolerance scatter
- Operating conditions
- Duty profile
- Fluids and lubricants
- Miscellaneous assembly materials

Unambiguous conclusions as to the wear status of the engine components involved are therefore not possible. This means that no limit values can be given for wear-metal contents.

Used-oil Analysis

In order to check the used oil, it is recommended that regular oil analyses be carried out. Oil samples should be taken and analyzed at least once per year and during each oil change and under certain conditions, depending on application and the engine’s operating conditions, sampling/analysis should take place more frequently.

The test methods and limit values given in Table 4 and Table 5 (Analytical Limit Values for Diesel / Gas Engine Oils) indicate when the results of an individual oil sample analysis are to be regarded as abnormal.

An abnormal result requires immediate investigation and remedy of the abnormality.

The limit values relate to individual oil samples. When these limit values are reached or exceeded, an immediate oil change is necessary. The results of the oil analysis do not necessarily give an indication of the wear status of particular components.

In addition to the analytical limit values, the engine condition, its operating condition and any operational faults are decisive factors with regard to oil changes.

Some of the signs of oil deterioration are:

- Abnormally heavy deposits or precipitates in the engine or engine-mounted parts such as oil filters, centrifugal oil filters or separators, especially in comparison with the previous analysis.
- Abnormal discoloration of components.

Analytical limit values for diesel engine oils (Table 4)

	Test Method	Limit Value	
Viscosity at 100 °C max. mm²/s	ASTM D445 DIN 51562	SAE 30 SAE 5W-30 SAE 10W-30	. 15.0
		SAE 40 SAE 10W-40 SAE 15W-40	19.0
min. mm²/s		SAE 30 SAE 5W-30 SAE 10W-30	9.0
		SAE 40 SAE 10W-40 SAE 15W-40	10.5
Flash point °C (COC)	ASTM D 92 ISO 2592	Min. 190	
Flash point °C (PM)	ASTM D 93 EN 22719	Min. 140	
Soot	DIN 51452 CEC-L-82-A-97	Max. 3.0 % by weight (Oil category 1) max. 3.5% by weight (Oil Categories 2, 3 and 3.1)	
Total base number (mg KOH/g)	ASTM D 2896 ISO 3771	Min. 50% of new-oil value	
Water	DIN 51777 ASTM 1744	Max. 0.2% by volume	
Ethylene glycol	ASTM D 2982 DIN 51375	Max. 50 mg/kg	

Analytical limit values for gas engine oils SAE 40 (Table 5)

	Test Method	Limit Value
Viscosity at 100 °C	ASTM D 445 DIN 51562	max. 17.5 max. mm²/s min.11.5 min. mm²/s

Total base number (mg KOH/g)	ASTM D 2896 ISO 3771	Min. 3
Acid number (mgKOH/g)	ASTM D664	New oil value + 2.5
pH value		Min. 4.5
Water	DIN 51777	Max. 0.2% by volume
Oxidation	DIN 51453	Max. 20 A/cm
Nitration		Max. 20 A/cm
Wear elements (mg/kg) Iron (Fe) Lead (Pb) Aluminum (Al) Copper (Cu) Tin (Sn) Silicon (Si)	RFA, ICP	 Max. 30 mg/kg Max. 20 mg/kg Max. 10 mg/kg Max. 20 mg/kg Max. 5 mg/kg Max. 15 mg/kg [1)]

[1)] = For landfill gas and special gases with increased Si-content, the metal content must be >15 ppm.

Use of High-Sulfur Diesel Fuel

The following measures must be taken in the case of diesel fuels with a sulfur content above 0.5%:

- Use of an engine oil with a total base number (TBN) (ASTM D 2896) of more than 8 mgKOH/g
- Shortening of oil drain intervals (→ Page 07)

The total base numbers for the approved engine oils are listed in Chapter 6 (→ Page 33).

Chart 2 (Total Base Numbers) lists the recommended minimum total base numbers for new and used oils depending on the sulfur content of the diesel fuel.

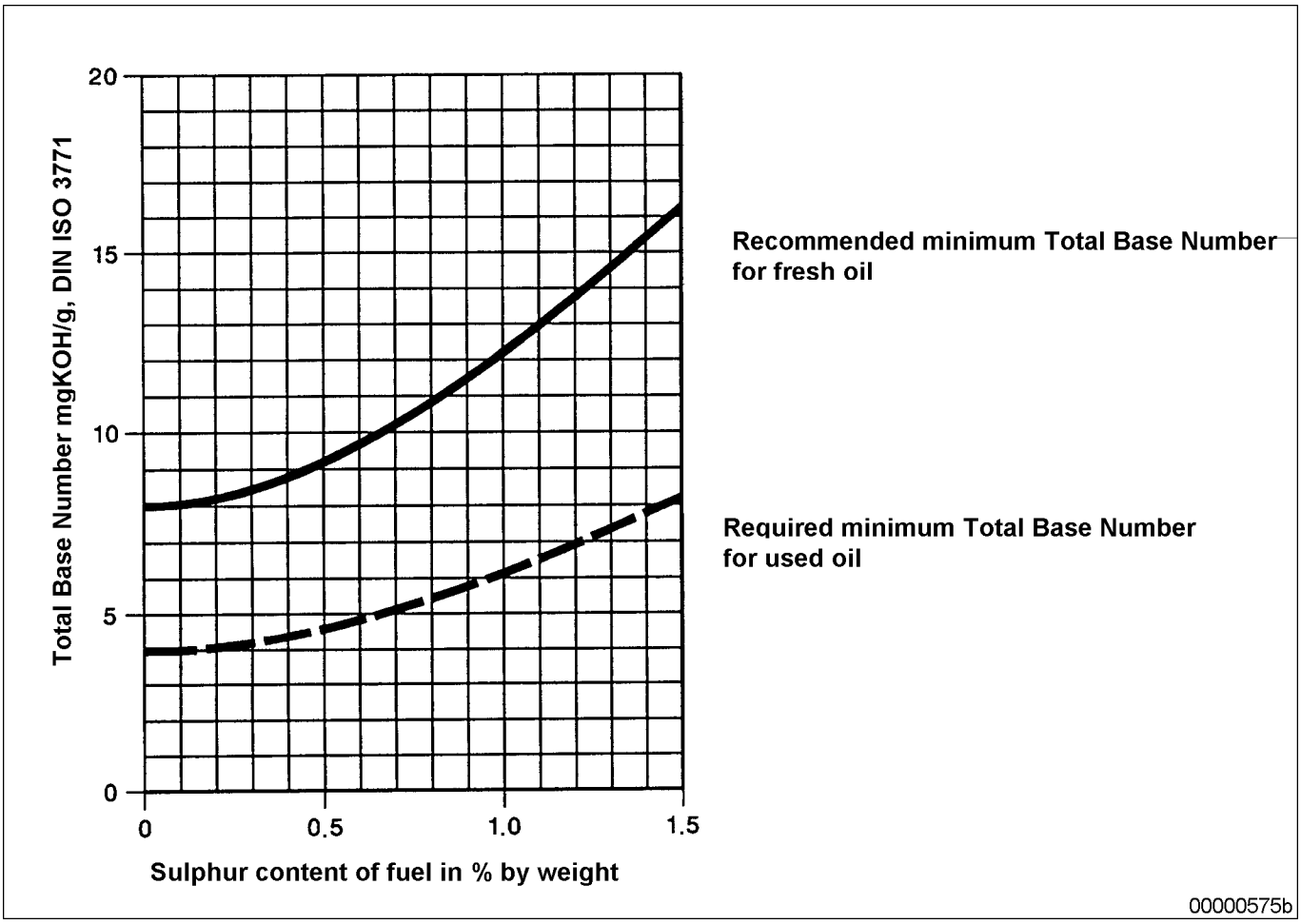


Diagram 2

Use of Low-Sulfur Diesel Fuel

The use of diesel fuels with low sulfur content (< 0.5%) does not influence the oil drain intervals.

Minimum Requirements for Operational Checks

Oil analyses can be carried out using the MTU Test Kit. The Test Kit contains all the equipment required as well as instructions for use.

The following checks can be performed:

- Determination of oil dispersing capacity (spot test)
- Determination of diesel fuel content in the oil.
- Determination of water content in oil

Lubricating Greases

Requirements

The MTU conditions for lubricating-grease approval are specified in the MTU Factory Standard MTL 5050, which can be ordered under this reference number.

Grease manufacturers are notified in writing if their product is approved by MTU.

Lubricating Greases for General Applications

Lithium-saponified greases are to be used for all lubrication points with the exception of:

- Emergency air shut-off flaps fitted between turbocharger and intercooler. (→ Page 11)
- Coupling internal centering

High Melting-point Greases

High-temperature grease (up to 250°C) must be used for emergency shut-off flaps located between turbocharger and intercooler:

- Aero Shell Grease 15
- Optimol Inertox Medium

General purpose greases suffice for emergency air shut-off flaps located before the turbocharger or after the intercooler.

Coupling Internal Centerings

Greases for internal centerings:

- Esso Unirex N3 (stable up to approx. 160 °C)

Special-Purpose Lubricants

Turbochargers

Exhaust turbochargers with integrated oil supply are generally connected to the engine oil system.

For ABB turbochargers which are not connected to the engine lube oil system, mineral-based turbine oils with viscosity grade ISO-VG 68 must be used.

Gear Couplings

Depending on the application, the following lubricants have been approved for curvic gear couplings:

- - Klüber: Structovis BHD MF (highly viscous lubricating oil)
- - Klüber: Klüberplex GE11–680 (adhesive transmission lubricant)

Guidelines on use and service life are contained in the relevant Operating Instructions and Maintenance Schedules.

3 Coolants

Requirements

Coolants must be prepared from suitable fresh water and an MTU-approved coolant additive.

Mixing of different coolant additives and supplementary additives is prohibited!

The MTU conditions for coolant-additive approval are specified in MTU Factory Standards (MTL). The following standards are available:

- Emulsifiable corrosion-inhibiting oils, MTL 5047
- Corrosion-inhibiting antifreeze: MTL 5048
- Water-soluble corrosion inhibitors, MTL 5049

Coolant manufacturers are informed in writing if their product is approved by MTU.

Coolants for Series 6H 1800

Only coolant additives as specified in Chapter 7 must be used for engine model 6H 1800! (→ Page 53).

To prevent cooling system damage:

- When topping up (following loss of coolant) it must be ensured that the concentration of corrosion-inhibiting additive in the cooling system is 50% by volume (frost-protection to -37°C).
- Do not use concentrations of corrosion-inhibiting additives exceeding 55% by volume (max. antifreeze protection). Concentrations in excess of this reduce antifreeze protection and heat dissipation.

Coolant mixtures:

Antifreeze protection to °C	-37	approx. -45
Water % by vol.	50	45
Corrosion-inhibiting additive % by vol.	50	Max. 55

Fresh water

Only clean, clear water with values in accordance with those in the following table must be used for preparing the coolant. If the limit values for the water are not achieved, its hardness or mineral content can be decreased by adding de-mineralized water.

	Min.	Max.
Total earth alkalines[1)] (Water hardness)	0 mmol/l 0°d	2.7 mmol/l 15°d
pH-value at 20°C	6,5	8,0
Chloride ions		100 mg/l
Anion total		200 mg/l

[1)] Common designations for water hardness in various countries:

1mmol/l = 5.6°d = 100 mg/kg $CaCO_3$
- 1°d = 17.9 mg/kg $CaCO_3$, USA hardness
- 1°d = 1.79° French hardness
- 1°d = 1.25° English hardness

Coolant Additives

Emulsifiable Corrosion Inhibiting Oils

A 2% by volume concentration must be used for initial filling.

Emulsions of MTU-approved corrosion-inhibiting oils (1.0 - 2.0% by volume) and suitable fresh water provide adequate corrosion protection.

Some corrosion-inhibiting oils tend to foam if used with completely demineralized water. This can be avoided by adding an appropriate quantity of harder water.

The required quantity of corrosion-inhibiting oil is best mixed in advance in a container with 4 to 5 times the amount of fresh water and then added to the coolant when the engine is running at operating temperature.

In maintenance stations or multi-engine installations the complete amount of coolant required should be prepared in a separate container, it can then be used for initial filling or replenishment as required.

Under unfavorable conditions, individual cases of bacterial attack may occur in the emulsifiable corrosion-inhibiting oils. In such cases, and after consultation with the MTU chemical laboratory, the emulsion is to be treated with biocides.

Emulsifiable corrosion-inhibiting oil must never be used for coolant temperatures >90°C except during test stand runs and test runs.

In addition, emulsifiable corrosion-inhibiting oil is to be used for Series 595, 956 and 1163 engines in marine applications.

Emulsifiable corrosion-inhibiting oils must not be used with the following Series:
- Series 183
- Series 396 TB (external charge air cooling with plate core heat exchanger)
- Series 396 TE (split-circuit cooling system)
- Series 4000
- Series 8000

Corrosion-inhibiting antifreezes

General

These antifreezes are necessary for engines without heating facilities and operating in areas where below-freezing temperatures may occur.

Provided that the specified concentrations are maintained, the MTU-approved corrosion inhibiting antifreezes ensure adequate corrosion protection.

The corrosion inhibiting antifreeze concentration must therefore be determined not only in accordance with the minimum anticipated temperatures but with the corrosion protection requirements also.

If a higher level of corrosion-inhibiting antifreeze is used, a higher engine temperature will result.

Limitations on the Use of Corrosion-Inhibiting Antifreezes

Marine engines are subject to the following limitations when using corrosion-inhibiting antifreezes:
- Series 538, 595 and 956/1163:

  These engines are fitted with heating units. Because of their cooler capacity, corrosion-inhibiting antifreezes must not be used.
- Series 099, 183, 396:

The use of corrosion-inhibiting antifreeze in these engines is permitted only at seawater temperatures of up to 20°C maximum.

- Series 2000 and 4000:

  Corrosion-inhibiting antifreeze may be used with these engines at seawater temperatures up to 25°C
- Series 8000:

  The use of corrosion-inhibiting antifreezes is not allowed for these engines.

Corrosion-inhibiting antifreezes can be used without reservation in vehicle, locomotive and stationary applications.

Corrosion-Inhibiting Antifreezes for Special Applications

Propylene glycol-based corrosion-inhibiting antifreezes are stipulated for use in some types of applications. These products have a lower thermal conductivity than the usual ethylene glycol products. This brings about a higher temperature level in the engine. Specifications for concentrations are in accordance with (→ Table Calc. table for corrosion-inhibiting antifreezes for special applications (Table 8) on page 17).

The product BASF G206 (see Chapter 6) is available for use at extremely low temperatures (< -40°C) (→ Page 33). Specifications for concentrations are in accordance with (→ Table Calc. table for corrosion-inhibiting antifreezes for special applications (Table 8) on page 17).

Water-soluble Corrosion Inhibitors

General

Water-soluble corrosion inhibitors are required for higher coolant temperatures and large temperature drops in heat exchangers, e.g. in TB- (with plate core heat exchanger) and TE-systems in Series 396, 4000 and 183 engines.

For Series 8000 engines, only water-soluble corrosion-inhibitors in accordance with Chapter 6 may be used. (→ Page 33)

The watersoluble corrosion inhibitors recommended by MTU ensure adequate protection provided the correct concentrations are used. The relevant concentration range for use is listed in the section on Operational Monitoring (→ Table Permissible concentrations (Table 6) on page 16) under “Water-soluble corrosion inhibitors”.

Special arrangements are possible after consultation with MTU. Special arrangements presently in effect remain valid.

Note:

Before the first use of water-soluble corrosion inhibitors and after every product change, the system must first be flushed out with water. This also applies to new engines. The work involved and cleaning agents required are described in the MTU Flushing and Cleaning Specifications (see appendix to these Fluids and Lubricants Specifications).

Coolant additives for aluminum-free engine series (Series 2000 C&I, Series 4000 C&I/Genset)

For Series 2000 C&I, Series 4000 C&I and Series 4000 genset engines, all of the coolant additives listed in Chapter 6 as being suitable for light-alloy-free engines may be used. (→ Page 33) The restrictions listed under "Remarks” must be complied with.

The coolant additives listed in Chapter 6 must not be used for any other engine series! (→ Page 33)

Operational Monitoring

Inspection of the freshwater and continuous monitoring of the coolant are essential for trouble-free engine operation. Freshwater and coolant should be inspected at least once per year and with each fill-up. Inspections can be carried out using the MTU test kit which contains the necessary equipment, chemicals and instructions for use.

The following tests can be conducted with the MTU Test Kit:

- Determination of total hardness (°d)
- pH value
- Chloride content of fresh water
- Corrosion-inhibiting oil content
- Antifreeze (corrosion-inhibiting) concentration
- Water-soluble corrosion inhibitor content

Orders for freshwater and coolant analysis may be placed with MTU. Samples of min. 0.25l must be supplied.

Permissible concentrations (Table 6)

	Min. % by vol.	Max. % by vol.
Emulsifiable corrosion-inhibiting oils	1,0	2,0
Corrosion-inhibiting antifreezes	35 Antifreeze protection to approx. -25°C	50 Antifreeze protection to approx. -40°C
Propylene glycol corrosion-inhibiting antifreeze	35 Antifreeze protection to approx. -25°C	50 Antifreeze protection to approx. -40°C
BASF G206	35 Antifreeze protection to approx. -18°C	65 Antifreeze protection to approx. -65°C
Water-soluble corrosion inhibitors		
– BASF Glysacorr G93–94 – Ginouves York 719 – Valvoline ZEREX G-93 CCI Manufacturing IL Corp.	9	11
– Nalco Alfloc 2000 – Nalco Nalcool 2000 – Nalco Nalco 2000 – Detroit Diesel Power Cool 2000 – Peentray Pencool 2000	3	4
– Nalco Alfloc 3477 – Arteco Havoline Extended Life Corrosion Inhibitor – Chevron Texaco Extended Life Corrosion Inhibitor Nitrite Free – Caltex XL Corrosion Inhibitor Concentrate	7	11
– Fleetguard DCA-4L	5	6

Table 7 can be used to determine the concentration of water-soluble corrosion inhibitors using the hand refractometer. Calibrate the hand refractometer with clean water at coolant temperature. Coolant temperature should be 20–30 °C.

Test kits are available from the manufacturer for determining the concentration of the other water-soluble corrosion inhibitors.

Calculation table for water-soluble corrosion inhibitors (Table 7)

Product	Product	Product	Product	
BASF Glysacorr G93–94	Arteco Havoline Extended Life Corrosion Inhibitor	CCI Manufacturing IL Corp.	– Nalco Alfloc 3477	
Ginouves York 719	Chevron Texaco Extended Life Corrosion Inhibitor Nitrite Free			
Valvoline ZEREX G-93	Caltex XL Corrosion Inhibitor Concentrate			
Reading on hand refractometer at 20°C (= degrees Brix)				Corresponds to a concentration of
3.5	2.6	4,9	1,75	7% by volume
4,0	3,0	5,6	2,0	8% by volume
4,5	3,4	6.3	2,25	9% by volume
5,0	3,7	7,0	2,5	10% by volume
5,5	4,1	7,7	2,75	11% by volume
6,0	4,4	8,4	3,0	12% by volume

Calc. table for corrosion-inhibiting antifreezes for special applications (Table 8)

Product	Product	
Propylene glycol corrosion-inhibiting antifreeze	BASF G206	
Reading on hand refractometer at 20°C (= degrees Brix)		Corresponds to a concentration of
26,3	24,8	35% by volume
26,9	25,5	36% by volume
27,5	26,1	37% by volume
28,2	26,7	38% by volume
28,8	27,4	39% by volume
29,5	28,0	40% by volume
30,1	28,6	41% by volume
30,8	29,2	42% by volume
31,3	29,8	43% by volume
31,9	30,4	44% by volume
32,5	30,9	45% by volume

33,1	31,5	46% by volume
33,7	32,1	47% by volume
34,2	32,6	48% by volume
34,8	33,2	49% by volume
35,3	33,8	50% by volume
	34,4	51% by volume
	34,9	52% by volume
	35,5	53% by volume
	36,1	54% by volume
	36,7	55% by volume
	37,2	56% by volume
	37,8	57% by volume
	38,3	58% by volume
	38,9	59% by volume
	39,4	60% by volume
	39,9	61% by volume
	40,5	62% by volume
	41,0	63% by volume
	41,5	64% by volume
	42,0	65% by volume

Note:
Slight precipitation may occur where coolant emulsions are used. This is shown by a layer on the surface of the coolant in the expansion tank. This is of no significance provided that the emulsion concentration remains within the specified limit values. Change the coolant in the event of a sudden drop in coolant additive concentration or if the additive is no longer absorbed. If necessary, the engine coolant spaces are to be cleaned (see the Flushing and Cleaning Specification for Engine Coolant Systems at the end of this specification).

Limit values for prepared coolant (Table 9)

pH value when using:		
– Emulsifiable corrosion inhibiting oil	Min. 7.5	Max. 9.5
– Corrosion inhibitor /antifreeze	Min. 7.0	Max. 9.0
– Water-soluble corrosion inhibitor for engines with aluminum/light-metal parts	Min. 7.0	Max. 9.0
– Water-soluble corrosion inhibitor for engines without aluminum/light-metal parts	Min. 7.0	Max. 11.0
Silicon (valid for coolants containing Si)	Min. 25 mg/l	

Storage capability of coolant concentrates up to max. 35°C (Table 10)

Emulsifiable corrosion-inhibiting oil	6 months	
Corrosion-inhibiting antifreezes	5 years	
Products containing propylene glycol	3 years	BASF G206
Water-soluble corrosion inhibitors	2 years	– Nalco Alfloc 2000 Nalco Nalcool 2000 Nalco Nalco 2000 Detroit Diesel Power Cool 2000 Pentray Pencool 2000
	3 years	Alfloc 3477 BASF Glysacorr G93–94 Ginouves York 719 Valvoline ZEREX G-93
	5 years	Arteco Havoline Extended Life Corrosion Inhibitor Caltex XL Corrosion Inhibitor Concentrate Chevron Texaco Extended Life Corrosion Inhibitor Nitrite Free Fleetguard DCA-4L CCI Manufacturing IL A216

4 Fuels

Diesel Fuels

Selection of a Suitable Diesel Fuel

The quality of the fuel is very important for satisfactory engine performance, long engine service life and acceptable exhaust emission levels. The engines can be operated with most diesel fuels sold worldwide. The properties and limit values specified in Table 11 (fuels of comparable quality) ensure optimum engine performance.

In order to achieve optimum engine performance and satisfactory service life for the entire fuel and injection system, the limit values for water and total contamination at the inlet of the main fuel filter fitted on the engine must be complied with for all approved fuel qualities.

An order for fuel analysis can be placed with MTU. Depending on the scope of the analysis, 500 - 1000 ml fuel samples should be supplied.

Fuels of comparable quality with following test results: (Table 11)

		Test Method		Limit Value
		ASTM	ISO	
Composition				The diesel fuel must be free of inorganic acids, visible water, solid foreign matter and chlorous compounds.
Total contamination	Max.		EN 12662	24 mg/kg
Spec. grav. at 15°C	Min. Max.	D 1298 D 4052	EN 3675 EN 12185	0.820 g/ml 0.860 g/ml
API grade at 60 °F	Min. Max.	D 287		41 33
Viscosity at 40 °C	Min. Max.	D 445	EN 3104	1.5 mm²/s 4.5 mm²/s
Flash point	Min.	D 93	EN 22719	60 °C
Boiling curve: - Initial boiling point - Recovery at 250 °C - Recovery at 350 °C - Residue and loss	 Max. Min. Max.	D 86	3405	 160 - 220 °C 65% by volume 85% by volume 3% by volume
Water	Max.		EN 12937	200 mg/kg
Carbon residue from 10% distillation residue	Max.	D 189	EN 10370	0.30 % by weight
Oxide ash	Max.	D 482	EN 6245	0.01 by weight %
Sulfur[1)]	Max.	D 5453 D 2622	EN 20846 EN 20884	0.5 by weight %
Cetane number	Min.	D 613	EN 5165	45
Cetane index	Min.	D 976	EN 4264	42
Corrosion effect on copper. 3 hrs. at 50 °C	Max. degree of corrosion	D 130	EN 2160	1a
Oxidation resistance	Max.	D 2274	EN 12205	25 g/m³
Lubricity at 60°C	Max.	D6079	12156-1	460 µm
Filter plugging point		D 4359	EN 116	See Note [2)]
Neutralization number	Max.	D 974		0.2 mgKOH/g

[1] Sulfur content of more than 0.5% requires an engine oil with a higher TBN and shorter oil drain intervals.

[2] It is the fuel supplier's responsibility to provide a fuel that will assure correct engine operation at the expected minimum temperatures and under the given geographical and other local conditions.

Requirements

Commercially available diesel fuels meeting the following specifications are approved for use:

Distillate Fuels

– Diesel fuel	in accordance with	EN 590
– Grade No. 1–D (S15, S500, S5000)	in accordance with	ASTM D 975–06
– Grade No. 2–D (S15, S500, S5000)	in accordance with	ASTM D 975–06

Distillate fuels with a sulfur content <50mg/kg must not be used if lubricity (HFRR) is <460µm.

Marine Distillate Fuels

– DMX acc. to ISO 8217

The following can be used if the oil quality and service-life limitations are taken into consideration:

– DMA acc. to ISO 8217
  - Series 8000 M71: generally usable
  - Series 8000 M90: Approved for specific projects only.
  - Not for Series 2000, S60
  - Series 4000: Approved for specific projects only.

– Other qualities on request

Biodiesel

The standardized general term "FAME" (Fatty Acid Methyl Ether) is used here to designate biodiesel fuels.

The following engines are approved/not approved (as indicated) for operation with FAME in compliance with EN 14214.

Series	Approved / Not approved	Conversion necessary
SUN	Not approved	
700	Not approved	
750	Not approved	
OM 457 LA	From series introduction	No
460	From series introduction	No
900	From series introduction	No
500	From series introduction	No
S 40	Not approved	
S 50	Not approved	
S 60	Not approved	
1800	From series introduction	No
2000	Not approved	
396	Not approved	
4000	Not approved	
595	Not approved	
956	Not approved	
1163	Not approved	
8000	Not approved	

Diesel fuel with a FAME content of max. 5% in compliance with DIN EN 590 may be used. Such fuel may also be used in engines which have not been approved for operation with FAME, without affecting oil drain intervals.

It is intended that future engine series will be approved for operation with FAME. Further details will be published at the appropriate time.

Fuel

- The fuel must comply with DIN EN 14214 . Operation with fuels of lower quality can lead to damage and malfunctions.
- Either FAME or diesel fuel may be used. The various mixtures of FAME and normal diesel fuel which may occur in the fuel tank as a result, present no problems.

Engine Oil and Servicing

- For operation using FAME, engine oils are to be preferred which comply with MB Fluids and Lubricants Specifications, Sheet 228.5 or Oil Category 3 in accordance with MTU Fluids and Lubricants Specifications. Engine oils in accordance with Sheet 228.3 or Oil Category 2 as per MTU Fluids and Lubricants Specifications may also be used provided that oil drain intervals are reduced.
- A certain amount of fuel always finds its way into the engine oil via the pistons and cylinders. Its high boiling point means that FAME does not evaporate but remains in the engine oil in its entirety. Under certain conditions chemical reactions may take place between FAME and the engine oil. This can lead to engine damage.
- For this reason, engine oil and filter change intervals must be shortened for operation both with pure FAME and with FAME-diesel mixtures.

- For Series 457, 460/1800, 900 and 500 engines, special equipment is available which facilitates an increase in the engine oil change intervals for operation with FAME. This involves fitting the engines with special equipment Code MK21 (special unit pump) and Code MK04 (fuel prefilter with heated water separator).

Engine version	Engine oil change interval
Engines not fitted with special equipment for operation with FAME	Reduction of engine oil change interval to 30% of the interval required for operation with fossil diesel fuels.
Engines fitted with special equipment Code MK21 and Code MK04	Reduction of engine oil change interval to 50% of the interval required for operation with fossil diesel fuels.

The relevant engine oil change intervals must be complied with without fail!
Exceeding the engine oil change intervals can cause engine damage!

- Operation with FAME requires shortened fuel filter change intervals. A new fuel filter must be fitted each time the engine oil is changed.
- Fuel and engine oil must be changed approximately 25 operating hours after conversion to FAME due to the danger of blockage caused by loosened deposits (FAME has a pronounced cleaning effect).
- Over longer periods, fuel filter service life may be reduced as a result of old residues being carried into the filter from the fuel system. A special, approved fuel prefilter can be installed as an improvement. This fuel prefilter with heated water separator is already installed on engines fitted with special equipment Code MK04.

Engine Power and Engine Standstill

- Due to its calorific value, operation with FAME involves a reduction of approx. 8% - 10% in engine power. This leads to a corresponding increase in fuel consumption as compared to operation with diesel fuel. Engine power corrections are not permissible.
- Prior to any extended period out of operation, the fuel system must be flushed out in order to prevent congestion. For flushing, the engine must be operated for at least 30 minutes on diesel fuel.

General Information

- We can make no comment with regard to the ability of the fuel system which is not part of our scope of supply, to resist FAME.
- FAME is an extremely effective solvent. Any contact with paint, for example, must therefore be avoided.
- The characteristic smell of FAME exhaust, especially during long periods of idling, may be perceived as unpleasant. The nuisance caused by smell can be reduced by an oxidation catalyzer which may be installed by the vehicle/equipment manufacturers at their own risk.

Our company accepts no responsibility for and provides no warranty in respect of any fault or damage connected in any way with the use of FAME of a lower quality or resulting from non-compliance with our specifications on operation using FAME. All resultant irregularities and consequential damage lie outside our responsibility.

Vegetable Oils as an Alternative to Diesel Fuel

The use of pure vegetable oils as an alternative to diesel fuel or FAME is strictly prohibited due to the absence of standardization and to negative experience (engine damage caused by coking, deposits in the combustion chambers and oil sludge)!

Low-Sulfur Diesel Fuels

Sulfur is contained in chemically bound form in crude oil and therefore occurs in fuel at varying levels.

A sulfur content of max. 50mg/kg or 10mg/kg (depending on category) has been a European Union requirement since 01.01.2005. The term "sulfur-free" is used here to designate diesel fuels with a sulfur content of max. 10 mg/kg. Low-sulfur diesel fuels (max. 50 mg/kg) are to be recommended for environmental reasons. In order to avoid problems with wear, lubricity additives, among other things, are added by the manufacturer.

On older series engines (Series 538, 595, 956, 1163) with cylinder heads not fitted with valve seat inserts, the use of low-sulfur fuel (< 50 mg/kg) can lead to increased valve seat wear. This wear can be reduced by the addition of anti-wear additives. Approved additives are listed in Table 12 and must be added to the fuel. It is recommended that the additive be added before filling the tank with fuel.

Approved anti-wear additives (Table 12)

Manufacturer	Brand name	Concentration for use
Liqui Moly Jerg-Wielandstr.4 89081 Ulm Tel. 0731/1420–13 Fax. 0731/1420–82	Blei-Ersatz	250 mg per 1kg
Tunap Industrie GmbH Bürgermeister-Seidl-Str. 2 82515 Wolfratshausen Tel. 08171/16000 Fax. 08171/1600–91	Tunadd PS	250 mg per 1kg

Diesel Fuels in Winter Operation

At low outdoor temperatures, the diesel fuel's fluidity can be inadequate on account of paraffin precipitation.

In order to prevent operational problems (e.g. clogged filters) during the winter months, diesel fuel with suitable cold-flow characteristics is available on the market. Deviations are possible during transitional periods and in individual countries. If no frost-resistant diesel fuels are available, paraffin oil or aviation turbine fuel must be added before frosts occur. As a basic guide, adding 5% by volume achieves an improvement of frost resistance of approx. 1° C.

Add the additive to the diesel fuel in good time before the fluidity of the diesel fuel is impaired by paraffin precipitation. Malfunctions resulting from paraffin precipitation can only be eliminated by heating the entire fuel system.

Petrol (gasoline) must not be added.

Flow improvers

Flow improvers cannot prevent paraffin precipitation but they do influence the size of the crystals and allow the diesel fuel to pass through the filter.

The effectiveness of the flow improvers is not guaranteed for every fuel.

Certainty is only assured after laboratory testing of the filtering capability.

Required quantities and mixing procedures must be carried out according to the manufacturer's instructions.

Heating Oil EL

Domestic heating oil differs from diesel fuel mainly because of the following characteristics:

– Cetane number
– Sulfur content
– Oxidation stability
– Corrosion effect on copper
– Lubricity
– Low temperature behavior

Technically, if the characteristics of domestic heating oil satisfy the specifications for the required diesel fuel, then it can be used in a diesel engine.

Cetane number

DIN 51 603 -1 does not specify the cetane number. If heating oil is used, the cetane number must therefore be quoted by the supplier or measured and be at least 45 as required in the MTU Fluids and Lubricants Specification. The purely calculated cetane index must not be less than 42.

Sulfur content

In accordance with DIN 51 603 -1, the maximum sulfur content for EL-1 standard heating oil is 0.2%. The maximum sulfur content for EL-1 heating oil is 50 mg/kg. Lubricity additives must never be added as its primary purpose is for heating. Lubrication problems can therefore be expected when using these qualities of heating oil because of the missing additives.

Consultation with the individual fuel supplier is necessary.

Supplementary Fuel Additives

The engines are so designed that satisfactory operation with normal, commercially available fuels is ensured. Many of these fuels already contain performance-enhancing additives.

The additives are added by the supplier as the agent responsible for product quality.

The anti-wear additives in (→ Table Approved anti-wear additives (Table 12) on page 26) represent an exception.

Attention is drawn to the fact that the use of diesel fuels or additives other than those stipulated in the MTU Fluids and Lubricants Specifications is always the responsibility of the operator.

Microorganisms in Fuel

Bacterial attack and sludge formation may occur in the fuel under unfavorable conditions. In such cases, the fuel must be treated with biocides in accordance with the manufacturer's specifications. Overconcentration must always be avoided.

For prophylactic use, the appropriate concentration must be identified in consultation with the relevant manufacturer.

Approved Biocides (Table 13)

Manufacturer	Brand name	Concentration for use
Bode Chemie Melanchthonstr. 27 22525 Hamburg Tel. 040/54006-0 Tel. 040/54006-200	Bakzid	100ml per 100l
Schülke und Mayr 22840 Norderstedt Tel. 040/52100-00 Tel. 040/52100-244	MAR 71 StabiCor 71	0.5 l / ton 0.5 l / ton
Rohm und Haas In der Kron 4 60489 Frankfurt Tel. 069/78996–0 Fax. 069/7895356	Kathon FP 1,5	100-200 mg/kg

Fuel for Gas Engines

Gas engines must be operated exclusively with gases which have been specifically approved for the type of gas engine in use. The suitability for use of approved gas types must be checked every six months by means of a gas analysis in order to detect changes in harmful components in the gas and to take appropriate action. This will prevent corrosion damage to the engine.

Suitability of gas types for use in MTU gas engines (Table 14)

Name	Components	Unit	Limit Value	Series G 4000	Remarks
Natural gas type H				X	
	CH_4	% by vol.	88,5		
	C_2H_6	% by vol.	4,7		
	C_3H_8	% by vol.	1,6		
	C_4H_{10}	% by vol.	0,2		
	N_2	% by vol.	5,0		

If specific limit values are exceeded, engine operation must be stopped in order to prevent damage to engine components.

Attention is drawn to the fact that the manufacturer's warranty is canceled if the specified limit values are exceeded. Further operation is possible after consulting MTU and obtaining written confirmation relating to any necessary measures.

Requirements for Fuel Gas

Engine series-based requirements for fuel gas (Table 15)

Designation	Unit	Limit Value	Series G 4000	Remarks
Methane number		≥ 70	X	Combustion knock, gas analysis and consultation with MTU-TEG
Calorific value	kWh/m^3_N kWh/m^3_N kWh/m^3_N	≥ 5.0 ≥ 6 9,5 - 10,5	 X	Consultation with manufacturer required in case of lower values.
Calorific value tolerance	kWh/m^3_N	± 0.2	X	
Calorific value fluctuation frequency	1/hr.	5	X	Based on whole hour
Tecjet intake	mbar	80 - 200	X	Project-based specifications for the gas train must be observed. Lower gas pressures on enquiry.
Gas pressure tolerance	%	± 5	X	
Gas pressure fluctuation frequency	1/hr.	10	X	Based on whole hour

Designation	Unit	Limit Value	Series G 4000	Remarks
Gas temperature	°C	10 - 50	X	Condensation of water vapor at <10°C, thermal ageing of NBR materials (seals, diaphragms) and influence on elasticity characteristics at t >50°C
Temperature tolerance	%	±5	X	
Temperature fluctuation frequency	1/hr.	5	X	Based on whole hour
Gas moisture	%	< 90	X	No water vapor condensation in pressure and temperature range
Oil vapors (HC with carbon number >5)	$mg/m^3_NCH_4$	< 0.4	X	No condensation or condensed oil mist formation in lines carrying fuel gas and fuel gas mixtures
HC solvent vapors	$g/m^3_NCH_4$	0	X	Consultation with manufacturer and analysis necessary
Organically fixed silicium (e.g. hydrosilicons, siloxanes, silicons)	$mg/m^3_NCH_4$	< 1.0	X	Consultation with manufacturer and analysis necessary
Dust 3- 10 µm	$mg/m^3_NCH_4$	5	X	Consultation with manufacturer and analysis necessary
Dust<3µm	$mg/m^3_NCH_4$		X	If available. Consultation with MTU
Inorganically fixed silicium	$mg/m^3_NCH_4$	< 5	X	For Si >5 $mg/m^3_NCH_4$; special attention re. abrasion particles in oil required during oil analysis
Total sulfur	$mg/m^3_NCH_4$	150	X	Consultation with MTU

* = Figures in brackets are guideline values, given without warranty, where oxidation-type catalytic converters are in use. Analysis and consultation with MTU necessary.

Limit values are based on 100% methane by volume or, where other combustible gases are present, on a net calorific value of $10kWh/m^3_N$ under normal conditions.

No warranty is given in respect of impairment and/or damage (corrosion, contamination etc.) resulting from gases or materials the presence of which was not known about and agreed upon on conclusion of contract.

5 Preservatives

Requirements

The MTU conditions for preservative approval are specified in MTU Factory Standards (MTL). The following standards are available:

- Initial-operation oil and corrosion-inhibitor oil, MTL 5051
- Corrosion inhibitors for external preservation, MTL 5052

The preservation product manufacturer is informed in writing if his product is approved by MTU.

Types of Preservation

See Preservation Specification, Chapter 8 (→ Page 65)

Initial Operation Oils and Corrosion Inhibiting Oils for Internal Preservation

SAE 30 viscosity grade corrosion inhibiting oils are to be used for internal preservation (oil-moistened components) of MTU engines and gearboxes.

These oils may also be used for running-in and acceptance testing procedures. Some are also suitable for continuous operation, see Chapter 6 (→ Page 33).

Corrosion Inhibitors for External Preservation

For external preservation, all non-painted parts are to be treated with a corrosion inhibitor providing a wax-like protective coating after the inhibitor solvent has evaporated.

Corrosion Inhibiting Oils for Internal Preservation of the Fuel System

Fuel injection-pump test oil conforming to DIN ISO 4113 is to be used for internal preservation of the fuel system. The engine should be run with these oils for the last 10 minutes before shutdown.

Preservation can also be effected using diesel fuel to which approximately 10-12% corrosion-inhibitor oil for internal preservation has been added.

6 Approved Fluids and Lubricants (except Series 1800 PowerPack)

Engine oils

For details and special information, see chapter on “Lubricants” (→ Page 05)

Single-grade Oils - Category 1, SAE-grades 30 and 40 for Diesel Engines

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Marine MS4011 Addinol Turbo Diesel MD305 Addinol Turbo Diesel MD405	40 30 40	X	 X X		
Aral AG	Aral Basic Turboral	30 ,40	X			
Avia	Avia Special HDC	30, 40	X			
BP p.l.c.	Energol DS3-153/154	30, 40			X	
Castrol Ltd.	Castrol MLC	30, 40		X		
Cepsa Lubricantes	Cepsa Rodaje Y Proteccion	30	X			Increased corrosion protection
Chevron	Texaco Ursa Super LA	30, 40	X			
ENI S.p.A	Agip Cladium 120	30, 40				Not for Series 2000, 4000
Exxon Mobil	Essolube X 4	30, 40	X			
Fuchs	Titan Universal HD	30, 40	X			
	FuchsTitan EM 30 MTU	30	X			Increased corrosion protection
Hindustan Petr. Comp. Indien	Hylube MTU	40	X			
Idemitsu, Singapore	Daphne Marine Oil MT	40		X		
Igol, France	Trans Turbo Mono	40		X		
Kuwait Petroleum	Q8 T 520	30, 40	X			
Mexicana De Lubri-cantes, Mexico	Mexlub CF/CF-2 Akron Extra Fleet	40 40	X X			
Motor Oil (Hellas)	EMO Turbo Champion Plus	30, 40	X			
OMV AG	OMV truck	30, 40	X			

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Pertamina Indonesien	Meditran SMX	40	X			
Petrobras	Marbrax CCD-310 Marbrax CCD-410	30 40		X X		
Petrol Ofisi	Süpersarj MF 30	30	X			
PTT Public Comp.	PTT Navita MTU Type 1	40	X			
Ravensberger Schmierstoffvertrieb GmbH	RAVENOL Standard Truck	30, 40	X			
SRS Schmierstoff Vertrieb GmbH	Wintershall Antikorrol M Wintershall Rekord	30	X			Increased corrosion protection
		30, 40		X		
Shell	Shell Gadinia Shell Rimula X Monograde Shell Sirius Monograde	30, 40 30, 40 30, 40	 X X	X		
Sakson	Parnas Hercules 1	40	X			
Total	Total Rubia S Elf Performance Super D RTO Prexima	30, 40 30, 40 30, 40		X X X		
United Oil	XD 7000 Extra Duty-3U XD 7000 Extra Duty-4U	30 40	X X			

Single-grade Oils - Category 1, SAE-grade 40 for Gas Engines

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			5–6mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Exxon Mobil	Mobil Pegasus 705	40	X			
Fuchs	Fuchs Titan Ganymet LA	40	X			
Shell	Shell Mysella LA 40	40	X			
SRS Schmierstoff Vertrieb GmbH	Wintershall Mihagrun LA 40	40	X			
Total	Nateria MH 40	40	X			

Multi-grade Oils - Category 1, SAE-grades 10W-40 and 15W-40 for Diesel Engines

[1] These multi-grade oils can only be used if crankcase ventilation is led to atmosphere.

[2] Engine oils with the index [2] are also approved for "Series 60"

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Super Star MX 1547	15W-40		X		
Avia	Avia HDC Extra UTM	15W-40		X		
BP p.l.c.	BP Vanellus C5 Global	15W-40	X			
Castrol Ltd.	Castrol Assuron T Max	15W-40	X			
Chevron	Texaco Ursa Super LA	15W-40	X			
ENI S.p.A	Agip Superdiesel Multigrade	15W-40	X			[2]

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Exxon Mobil	Mobil Delvac MX	15W-40	X			1), 2) and oil change interval 500 operating hours
	Mobil Delvac MX Extra	10W-40		X		1)) and oil change interval 500 operating hours
	Essolube XT 5	15W-40	X			1), 2) and oil change interval 500 operating hours
	Essolube XT 3	15W-40	X			1), 2)
	Mobil Delvac Super 1300	15W-40	X			1), 2)
Feoso Oil	Super VG Motor Oils	15W-40	X			
Fuchs	Titan Hydromat SL SAE 10W40	10W-40		X		
	Titan Universal HD	15W-40	X			
Igol, France	Trans Turbo 4X	15W-40	X			
Gulf Oil International	Gulf Superfleet	15W-40	X			
Kuwait Petroleum	Q8 T 520	15W-40	X			
OPET Petrolcülük	Omega Turbo Power	15W-40		X		1)
OMV AG	OMV Truck M plus	15W-40	X			
Petróleos de Portugal	Galp Galaxia Super 15W-40	15W-40	X			
	Galp MDM 1 15W-40	15W-40	X			
Shell Tongyi (Beijing) Petroleum Chemical Co., Ltd.	You Ya Wong	15W-40	X			
SRS Schmierstoff	Wintershall Multi Rekord	15W-40		X		
Vertrieb GmbH	Wintershall Primalub	15W-40	X			
Singapore Petroleum Comp.	SPC SDM 801	15W-40	X			
Total	Elf Performance Super D	15W-40	X			
	Total Caprano TD	15W-40	X			
	Total Rubia 4400	15W-40	X			
	Total Rubia XT	15W-40	X			
Unicorn Oil Comp.	Dexus 9000	15W-40	X			
United Oil	XD 9000 Ultra Diesel-U	15W-40	X			

Single-grade Oils – Category 2, SAE-grades 30 and 40 for Diesel Engines

MTU/DDC Single-grade Engine Oil

	Brand name	SAE Viscosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
	Power Guard DEO SAE 40	40		X		20l Container (Order No. X00037908) 208l Container (Order No. X00037903)

Other Single-grade Engine Oils

Manufacturer	Brand name	SAE Viscosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Addinol	Addinol Turbo Diesel MD 407	40	X			
Belgin Madeni Yaglar	Lubex Marine M-30 Lubex Marine M-40	30 40		X X		
BP Marine	Energol HPDX	30, 40		X		Approved for fast commercial vessels up to 1500h
Castrol Ltd.	Castrol HLX	30, 40		X		Approved for fast commercial vessels up to 1500h
Cepsa Lubricants	Ertoil Koral HDL	30, 40			X	
Chevron	Texaco Ursa Super TD Texaco Ursa Premium TDX Caltex Delo Gold [ISOSYN]	30, 40 40 30, 40	 X	X X 		
Chevron – Lyteca –	Texaco Ursa Premium TDX	40		X		
Cyclon Hellas	Cyclon D Super	40		X		
Delek	Delkol Super Diesel Delkol Super Diesel MT Mono	40 40	 X	X 		
ENI S.p.A.	Agip Sigma GDF	40		X		

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Exxon Mobil	Mobil Delvac 1630	30		X		Approved for Series 8000
	Mobil Delvac 1640 Exxmar CM Super	40 30, 40		X	 X	
Hyrax Oil	Hyrax top deo	40	X			
Klora Gres Ve Yağ Sanay A. Ş	Klora Motor Yagi SAE 40 K	40	X			
Kuwait Petroleum	Q8 T 750	30, 40	X			
Motor Oil, Hellas	EMO SHPD Plus	30, 40	X			
Panolin AG	Panolin Extra Diesel	40	X			
Paz Lubricants & Chemicals	Pazl Marine S 40	40	X			
Petrobras	Marbrax CCD-310-AP Marbrax CCD-410-AP	30 40			X X	
Petrol Ofisi	Turbosarj Ekstra SAE 40-E PO Turbosarj Extra	40 30, 40	 X	X		
Petróleos de Potugal	Galp Galaxia 40	40		X		
PTT Public Comp.	PTT Navita MTU Type 2	40		X		
Shell	Shell Sirius X	30			X	Approved for Series 8000
	Shell Sirius X	40			X	
Singapore Petroleum Comp.	SPC 900 SDM 900	40 30, 40	X X			
Sonol, Israel	Sonol 2340	40		X		
SRS Schmierstoff Vertriebs GmbH	Wintershall Rekord plus	30, 40		X		
Statoil	Statoil Diesel Way	30, 40				
Total	Total Disola MT Total Rubia TIR XLD	30, 40 40		X	 X	

Multi-grade Oils - Category 2, SAE-grades 10W-40, 15W40 and 20W-40 for Diesel Engines

2) Engine oils with the index 2) are also approved for “Series 60“

MTU/DDC Multi-grade Engine Oil

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
	Power Guard DEO SAE 15W-40	15W-40		X		20l Container (Order No. X00037902) 208l Container Order No. X00037897)

Other Multi-grade Oils

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Diesel Longlife MD1047 Addinol Diesel Longlife MD1548 Addinol Diesel Power MD1547 Addinol Diesel Longlife MD1546 Addinol Diesel Longlife MD1547	10W-40 15W-40 15W-40 15W-40 15W-40		X X X X X		2) 2) 2), not for Series 4000 2)
API	D Multi Diesel Turbo	15W-40		X		2)
AP Oil International Ltd.	AP X-Super Dieselube Turbo CF-4	15W-40	X			
Arabi Enertech KSC	Burgan Diesel CH-4	15W-40		X		2)
Aral AG	Aral Multigrade SHPD Aral Mega Turboral Aral Plus Turboral	15W-40 10W-40 15W-40		X X	 X 	 2)
Belgin Madeni Yaglar	Lubex Marine M	15W-40		X		
Bharat Petroleum	MAK MB SHPD 15W-40	15W-40		X		
Bölünmez Petrocülük A-S	MOIL Dizel 15W-40	15W-40		X		

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
BP p.l.c.	BP Vanellus C6 Global	15W-40	X			2)
	BP Vanellus C6 Global Plus	10W-40		X		
	BP Vanellus E6	15W-40		X		2)
	BP Vanellus C7 Global	15W-40		X		2)
Castrol Ltd.	Castrol Tection	15W-40	X			2)
	Castrol Tection T	15W-40		X		2)
	Castrol Tection S	15W-40	X			2)
	Castrol Tection Plus	15W-40		X		2)
Cepsa	Cepsa Euromax	15W-40		X		2)
Chevron	Caltex Delo SHP Multigrade	15W-40		X		
	Caltex Delo Gold [ISOSYN] Multigrade	15W-40		X		2)
	Caltex Delo 400 Multigrade	15W-40		X		
	Chevron RPM Heavy Duty Motor Oil	15W-40		X		2)
	Chevron Delo 400 Multigrade	15W-40		X		2)
	Texaco Ursa Super Plus	15W-40		X		2)
	Texaco Ursa Super TD	15W-40		X		
	Texaco Ursa Premium TDX					
Chinese Petroleum Company	CPC Superfleet CG-4 Motor Oil	15W-40	X			
Conoco Phillips Com.	Conoco Hydroclear Power D	15W-40			X	
Delek	Delkol Super Diesel	15W-40	X			
Denizati Petrokimya Urunleri San	Seahorse Motor Oil 15W-40	15W-40		X		
ENI S.p.A.	Agip Sigma Truck	15W-40	X			
	Agip Sigma Turbo	15W-40	X			
	Agip Blitum T	15W-40	X			
Exxon Mobil	Mobilgard 1 SHC	20W-40			X	Approved for fast commercial vessels up to 1500h
	Essolube XT 4	15W-40	X			2)
	Exxmar Super CM	15W-40	X			2)
	Mobil Delvac Super 1400	15W-40	X			
	Mobil Delvac XHP	10W-40		X		
	Mobil Delvac XHP	15W-40	X			
Feoso Oil	Ultra VG Motor Oils	15W-40	X			

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Fuchs	Fuchs Titan Truck Plus	15W-40		X		2)
	Fuchs Titan HPE	15W-40	X			2)
	Titan Unic Plus MC	10W-40		X		
	Titan Unic Ultra MC	10W-40		X		
	Titan Formel Plus	15W-40		X		
	Titan Truck	15W-40		X		
	Titan Unimax	15W-40	X			
Gulf Oil International	Gulf Superfleet LE	10W-40		X		
	Gulf Superfleet LE	15W-40		X		2)
	Gulf Superfleet Supreme	10W-40		X		
	Gulf Superfleet Plus	15W-40	X			
Igol, France	Trans Turbo 5X	15W-40	X			
	Trans Turbo 7X	15W-40	X			2)
	Trans Turbo 9X	15W-40	X			2)
	Protruck 100 X	10W-40		X		
	Protruck 100 X	15W-40		X		2)
Imperial Oil	Esso XD-3 Extra	15W-40		X		2)
Indian Oil Corp.	Servo Premium (N)	15W-40		X		2)
Italiana Petroli	IP Tarus Turbo	15W-40	X			
	IP Turbo Plus	15W-40	X			2)
Kuwait Petroleum	Q8 T 720	10W-40	X			2)
	Q8 T 750	15W-40	X			2)
Kocak Petrol Ürünleri San	Speedol SHPD Tirot 15W-40	15W-40		X		
MOL-LUB	MOL Mk-9	15W-40	X			
Motor Oil, Hellas	EMO SHPD Plus	15W-40		X		
OMV AG	OMV eco truck extra	10W-40		X		
	OMV truck LD	15W-40	X			2)
Panolin AG	Panolin Universal SFE	10W-40		X		
	Panolin Diesel Synth	10W-40		X		
Pennzoil Products	Supreme Duty Fleet Motor Oil	15W-40	X			
	Longlife EF Heavy Duty Multigrade Engine Oil	15W-40	X			
Pertamina	Meditran SMX	15W-40		X		2)
Petro-Canada Lubricants	Duron	15W-40		X		2)
	Duron XL Synthetic Blend	15W-40		X		2)

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Petrol Ofisi	PO Turbo Dizel Extra	15W-40	X			2)
Petrolimex Petrochmical Joint-Stock Company	PLC Diesel SHPD 15W-40	15W-40		X		2)
Prista Oil AD	Prista SHPD	15W-40	X			2)
	Prista Turbo Diesel	15W-40	X			
Ravensberger Schmierst-offvertrieb GmbH	RAVENOL Expert SHPD	10W-40		X		
	RAVENOL Formel Diesel Super	15W-40		X		
	RAVENOL Mineralöl Turbo Plus SHPD	15W-40	X			2)
Shanghai HIRI Lubricants	HIRI 245	15W-40	X			2)
Shell	Shell DEO Super	15W-40		X		2)
	Shell Rimula MV	15W-40	X			2)
	Shell Rimula X	15W-40		X		
	Shell Rotella T Multigrade	15W-40		X		2)
	Rimula X CH-4	15W-40		X		2)
Sinclair Oil Corp.	Sinclair Dura Tec Premium 1000	15W-40		X		
Singapore Petroleum Company	SDM 900, SAE 15W40	15W-40		X		2)
Sinopec	Great Wall Century supremacy	15W-40		X		2)
SRS Schmierstoff Vertrieb GmbH	Wintershall Multi-Rekord top	15W-40		X		2)
	Wintershall Turbo Rekord	15W-40		X		
	Wintershall Turbo Diesel Plus	15W-40		X		2)
	Wintershall TFX	10W-40		X		2)
Svenska Statoil	Statoil Maxway	10W-40		X		2)
Total	Antar Milantar PH	15W-40	X			2)
	Antar Milantar PX	15W-40	X			2)
	Elf Performance Trophy DX	15W-40	X			2)
	Elf Performance Victory	15W-40		X		2)
	Fina Kappa Optima	15W-40	X			2)
	RTO Maxima RD	15W-40	X			2)
	RTO Maxima RLD	15W-40	X			2)
	Total Caprano TDH	15W-40	X			2)
	Total Caprano TDI	15W-40	X			2)
	Total Disola W	15W-40		X		
	Total Rubia TIR 6400	15W-40	X			
	Total Rubia TIR 7400	15W-40		X		2)

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Statoil	Turbosynt	15W-40			X	2)
Valvoline	Valvoline Premium Blue	15W-40		X		
Yacco	Inboard 100 4 T Diesel Transpro 40 S	15W-40 10W-40	X	 X		2)

Multi-grade Oils – Category 3, SAE-grades 5W-30, 5W-40, and 10W-40 for Diesel Engines,

2) Engine oils with the index 2) are also approved for " Series 60 "

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Ultra MD 0538 Addinol Super Truck MD 1048	5W-30 10W-40			X X	
Aral AG	Aral Super Turboral	5W-30			X	
BP p.l.c	BP Energol IC-MT BP Vanellus E7 Ultra BP Vanellus E8 Ultra	10W-40 5W-30 5W-30			X X X	
Bucher	Motorex MC Power 3	10W-40			X	
Castrol Ltd.	Castrol Enduron MT Castrol Enduron Plus Castrol Elixion 5W-30	10W-40 5W-30 5W-30		 X	X X 	
Cepsa	Cepsa Eruotech LS Cepsa Eurotrans SHPD Cepsa Eurotrans SHPD	10W-40 5W-30 10W-40		X X	 X 	
Chevron	Caltex Delo XLD Multigrade Texaco Ursa Super Texaco Ursa Premium FE Texaco Ursa Super TDX	10W-40 10W-40 5W-30 10W-40		 X 	X X X	
Elinoil	Elin Diesel Tec Synthetic	10W-40		X		

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
ENI S.p.A.	Agip Sigma Trucksint TFE	5W-40			X	
	Agip Sigma Super TFE	10W-40		X		
	Agip Sigma Ultra TFE	10W-40			X	
Enoc	Enoc Vulcan 770 SLD	10W-40		X		
Exxon Mobil	Essolube XTS 5	10W-40			X	
	Mobil Delvac XHP Extra	10W-40			X	
	Mobil Delvac 1 SHC	5W-40			X	
FL Selenia	Urania 100 K	10W-40		X		
	Urania FE	5W-30			X	
Fuchs	Titan Cargo SL	5W-30			X	
	Titan Cargo MC	10W-40			X	
	Titan Cargo LDF	10W-40			X	
Ginouves	York 847 10W40	10W-40			X	
Gulf Oil International	Gulf Fleet Force synth.	5W-30			X	
	Gulf Superfleet XLE	10W-40	X		X	
	Superfleet ELD	10W-40		X	X	
IB German Oil	High Tech Truck	10W-40			X	
Igol, France	Trans Turbo 8X	5W-30			X	
INA	INA Super 2000	10W-40			X	
Iranol Oil Co.	Iranol D - 40000	10W-40		X		
Kuwait Petroleum	Q8 T 860	10W-40		X		
	Q8 T 905	10W-40	X			
Lotos Oil	Turdus Semisynthetic XHPDO	10W-40		X		
	Turdus Powertec Synthetic	5W-30			X	
Meguin	Megol Motorenöl Super LL Dimo Premium	10W-40		X		
MOL-LUB	MOL Synt Diesel	10W-40		X		
Ölwerke Julius Schindler	Econo Veritas Truck FE	5W-30			X	
OMV	OMV truck FE plus	10W-40			X	
	OMV super truck	5W-30			X	
Panolin	Panolin Diesel HTE	10W-40			X	
Petróleos de Portugal	Galp Galaxia Ultra EC	10W-40		X		
	Galp Galaxia Extreme	5W-30		X		

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Petrol Ofisi	PO Maxima Diesel	10W-40		X		
Prista Oil AD	Prista UHPD	10W-40	X			
Ravensberger Schmierst-offvertrieb GmbH	RAVENOL Super Performance Truck RAVENOL Performance Truck	5W-30 10W-40			X X	
Redoil Italia	Challoils Syntextruck	10W-40		X		
Repsol YPF	Repsol Diesel Turbo VHPD	5W-40			X	
SRS Schmierstoff Vertrieb GmbH	Wintershall TFF Wintershall TFL Wintershall TFG Wintershall TLA	10W-40 5W-30 10W-40 10W-40	 X	 	X X X 	
Shell	Shell Rimula Ultra Shell Rimula Ultra Shell Rimula Ultra E7	5W-30 10W-40 10W-40			X X X	
Total	Antar Maxolia Elf Performance Experty FE Elf Performance Experty Fina Kappa First RTO Extensia ECO RTO Extensia RXD Total Rubia TIR 8600 Total Rubia TIR 9200 FE	10W-40 5W-30 10W-40 5W-30 5W-30 10W-40 10W-40 5W-30		X X X 	 X X X X X	
Unil Opal	LCM 800	10W-40			X	
Valvoline International	Valvoline Pro Fleet Extra Valvoline Pro Fleet	5W-30 10W-40			X X	
Wolf Oil Corporation	Champion Turbofleet UHPD	10W-40				
Yacco	Yacco Transpro 45	10W-40			X	

Multi-grade Oils - Category 3.1 (Low SAPS Oils)

Manufacturer	Brand name	SAE Vis-cosity class	TBN			Remarks
			8–10mgKOH/g	10–12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Extra Truck MD 1049 LE	10W-40	X			
Castrol Ltd.	Castrol Enduron Euro 4 Low SAPS	10W-40	X			
Chevron	Texaco Ursa Ultra	10W-40	X			
FL Selenia	Urania Ecosynth	10W-40	X			
Kuwait Petroleum R&T	Q T 900	10W-40	X			
Panolin	Panolin Diesel Synth EU-4	10W-40	X			
Petróleos de Portugal	Galp Galaxia Ultra LS	10W-40	X			
Repsol YPF	Repsol Diesel Turbo UHPD MID SAPS	10W-40	X			
Shell	Shell Rimula Signia	10W-40	X			
Svenska Statoil	Statoil TruckWay E6	10W-40	X			

Lubricating Greases for General Applications

For details and special information, see chapter on “Lubricants” (→ Page 05)

Manufacturer	Brand name	Remarks
Aral AG	Mehrzweckfett Arallub HL2	
BP p.l.c.	Energrease LS2	
Castrol Ltd.	Spheerol AP2	
Chevron	Multifak EP2	
Exxon Mobil	Beacon 2X	
SRS Schmierstoff Vertrieb GmbH	Wintershall Wiolub LFK2	
Shell	Shell Retinax EP2	
Veedol International	Multipurpose	

Coolant Additives

For details and special information, see chapter on “Coolants” (→ Page 13)

Emulsifiable Corrosion Inhibiting Oils

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Shell	Shell Oil 9156	6000 / 1	Usability (→ Page 13)

Corrosion-inhibiting Antifreeze Concentrates (valid for all Series)

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Addinol	Antifreeze Super	9000 / 5	
Arteco	Freecor SPC [EU Code 502247]	9000 / 3	
Ashland	Drewgard ZX	9000 / 3	
Avia	Antifreeze APN	9000 / 5	
BASF	Glysantin G05 Glysantin Antikorrosion Glysantin G48 Glysantin Protect Plus Glysantin G30 Glysantin Alu Protect	9000 / 5 9000 / 5 9000 / 5 9000 / 5 9000 / 3 9000 / 3	
Bucher	Motorex Antifreeze G05 Motorex Antifreeze Protect G48 Motorex Antifreeze Protect Plus G30	9000 / 5 9000 / 5 9000 / 3	
Clariant	Genatin Super	9000 / 3	
Detroit Diesel	Power Cool Antifreeze Power Cool Off.Highway	9000 / 3 9000 / 5	
Deutsche BP	Aral Antifreeze Extra ARAL Antifreeze SF Castrol Antifreeze SF Veedol Antifreeze NF	9000 / 5 9000 / 3 9000 / 5 9000 / 5	
Fuchs	Fricofin	9000 / 5	
Ginouves	York 716	9000 / 5	
Ineos	C2272	9000 / 3	
Krafft	Refrigerante ACU 2300	9000 / 3	
Maziva	INA Antifriz Al Super	9000 / 5	
MOL-LUB	EVOX Plus G05 Antifreeze concentrate EVOX Plus concentrate EVOX Extra G48 Antifreeze concentrate	9000 / 5 9000 / 5 9000 / 5	
Nalco	Nalcool 5990	9000 / 3	

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Old World	Fleetcharge SCA Precharged Heavy Duty Coolant/ Antifreeze	9000 / 3	
OMV	OMV Coolant Plus OMV Coolant SF	9000 / 5 9000 / 3	
Panolin	Panolin Anti-Frost MT-325	9000 / 5	
Ravensberger Schmierstoffvertrieb GmbH	RAVENOL Kühlerfrostschutz silikatfrei	9000 / 3	
Recochem	R542	9000 / 3	
Shell	Glyco Shell Glyco Shell SF longlife	9000 / 5 9000 / 3	
Total	Glacelf MDX	9000 / 5	
Valvoline	Zerex G-05 Zerex G-48 Zerex G-30	9000 / 5 9000 / 5 9000 / 3	

Corrosion-inhibiting Antifreezes: Ready Mix (valid for all Series)

Manufacturer	Brand name	Runtime Hour / Year	Remarks
BASF	Kühlstoff G05-23/50 (50%)	9000 / 5	
Detroit Diesel	Power Cool Plus Marine (30/70) Power Cool Off-Highway (50%)	9000 / 3 9000 / 5	
Sotragal - Mont Blanc	L.R.-30 Power Cooling (44%) L.R.-38 Power Cooling (52%)	9000 / 5 9000 / 5	
Total	Coolelf MDX (40%)	9000 / 5	

Corrosion-inhibiting Antifreeze Concentrates for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset Engines

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Arteco	Havoline Extended Life Coolant [EU Code 30379] (XLC)	9000 / 3	
Caltex	Caltex Extended Life Coolant [Code 510614] (XLC)	9000 / 3	
Chevron	Havoline Dexcool Extended Life Antifreeze [US Code 227994]	9000 / 3	
CCI	L 415	9000 / 3	
CCI Manufacturing IL Corp.	C 521	9000 / 3	
Fuchs Australien	Titan HDD Coolant Concentrate	9000 / 3	
Krafft	Energy Plus K-140	9000 / 3	
Nalco	Nalcool 4070	9000 / 3	
OAO Technoform	Cool Stream Premium C	9000 / 3	
Old World	Final Charge Global Extended Life Coolant/Antifreeze	9000 / 3	
Recochem	Turbo Power R 824M	9000 / 3	
Total	Elf Glacelf Auto Supra Glacelf Supra	9000 / 3 9000 / 3	

Corrosion-inhibiting Antifreezes, Ready Mix, for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset Engines

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Arteco	Havoline Extended Life Coolant + B2 50/50 OF01 [EU Code 33073] (50%) Havoline Extended Life Coolant + B2 40/60 OF01 [EU Code 33069] (40%) Havoline Extended Life Coolant + B2 35/65 OF01 [EU Code 33074] (35%)	9000 / 3 9000 / 3 9000 / 3	
Caltex	Caltex Extended Life Coolant Pre-Mixed 50/50 [Code 510609] (50%)	9000 / 3	
CCI	L 415 (50%)	9000 / 3	
CCI Manufacturing IL Corp.	C 521 (50%)	9000 / 3	
Chevron	Havoline Dexcool Extended Life Prediluted 50/50 Antifreeze Coolant [US Code 227995] (50%)	9000 / 3	
Fuchs Australien	Titan HDD Premix Coolant (50%)	9000 / 3	
Nalco	Nalcool 4100 (50%)	9000 / 3	
Old World	Final Charge Global 50/50 Prediluted Extended Life Coolant/Antifreeze	9000 / 3	
Total	Coolelf Supra (40%)	9000 / 3	

Corrosion-inhibiting Antifreeze Concentrates for Special Applications

Manufacturer	Brand name	Runtime Hour / Year	Remarks
BASF	G206	9000 / 3	For use in arctic regions (< -40°C)

Water-soluble Corrosion Inhibitor Concentrates (valid for all Series)

Manufacturer	Brand name	Runtime Hour / Year	Remarks
BASF	Glysacorr G93-94	6000 / 2	
Detroit Diesel	Power Cool Plus 6000	6000 / 2	
Ginouves	York 719	6000 / 2	
Valvoline	ZEREX G-93	6000 / 2	

Water-soluble Corrosion Inhibitor Concentrates for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset Engines

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Arteco	Havoline Extended Life Corrosion Inhibitor [EU Code 32765] (XLI)	6000 / 2	
Caltex	XL Corrosion Inhibitor Concentrate [Code 510533]	6000 / 2	
CCI Manufacturing IL Corp.	A 216	6000 / 2	
Detroit Diesel	Power Cool 2000	6000 / 2	
Fleetguard	DCA-4L	2000 / 1	
Nalco	Alfloc (Maxitreat) 3477 Alfloc 2000 Nalco 2000 Nalcool 2000	6000 / 2 6000 / 2 6000 / 2 6000 / 2	
Penray	Pencool 2000	6000 / 2	
Total	Total WT Supra	6000 / 2	

Water-soluble Corrosion Inhibitor Ready Mixes for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset Engines

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Caltex	Caltex XL Corrosion Inhibitor [Code 510534] (10%)	6000 / 2	
Nalco	Alfloc (Maxitreat) 3443 (7%)	6000 / 2	

Preservatives

For details and special information, see chapter on “Preservation” (→ Page 31)

Initial Operation Corrosion-inhibiting Oils for Internal Preservation

Manufacturer	Brand name	Remarks
BP p.l.c.	Motorenschutzöl MEK SAE 30	
Cespa Lubricants	Cepsa Rodaje Y Proteccion SAE 30	Full-load engine oil in compliance with Oil Category 1
Exxon Mobil	Mobilarma 524	Only suitable for preservation run! (→ Page 65)
Fuchs	Titan EM 30 MTU	Full-load engine oil in compliance with Oil Category 1
SRS Schmierstoff Vertrieb GmbH	Wintershall Antikorrol M SAE 30	Full-load engine oil in compliance with Oil Category 1
Shell	Shell Running-In Oil 7294 SAE 30 Shell Ensis Engine Oil SAE 30	

Corrosion Inhibitors for External Preservation

Manufacturer	Brand name	Remarks
Castrol Ltd.	Rustilo 181	
Esso Lubricants	Rust BAN 397	
Valvoline Oel	Tectyl 846	

Corrosion Inhibiting Oils for Internal Preservation of the Fuel System

Manufacturer	Brand name	Remarks
Esso	Prüföl 4113	
Ravensberger Schmierstoffvertrieb GmbH	RAVENOL Calibration Fluid	
SRS Schmierstoff Vertrieb GmbH	Wintershall Calibration Fluid	
Shell	V - Oil 1404	
	Shell Oil S 9356	

Corrosion Inhibitors for Internal Preservation of Cooling System

Manufacturer	Brand name	Remarks
BASF	Glysacorr P113	10%
Exxon Mobil	Kutwell 40	2%
Shell	Shell Oil 9156	2%

7 Approved Fluids and Lubricants, Series 1800 PowerPack

General

Fluids and Lubricants for Hydrostatic Drive Systems (fans, generator drive)

Only approved engine oils as listed below may be used as operating fluids in the hydraulic system.

Fluids and Lubricants for Transmissions

Mechanical manual shift transmissions from ZF Co. Friedrichshafen:

The current, permissible fluids and lubricants for ZF transmissions can be downloaded free-of-charge from the following Internet address: “www.ZF.com” Menüpunkt Service / Technische Information / ZF Schmierstoffliste / Sprache auswählen / TE-ML16.

Voith hydrodynamic transmision:

The current, permissible fluids and lubricants for Voith transmissions can be downloaded free-of-charge from the following Internet address: “www.Voithturbo.com” Menüpunkt Produkte & Anwendungen / Schiene / Hydrodynamische Antriebe / Druckschriften / (Titel) Datenblatt - (Marktbereich) Hydrodynamische Antriebe / Kraftübertragungsöle für Turbogetriebe

Engine oils

For details and special information, see chapter on “Lubricants” (→ Page 05)

Multi-grade Oils, SAE-grades 0W-30, 5W-30, 5W-40, and 10W-40 for Diesel Engines

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
AD Parts, S. L.	AD SDX 10W40	10W-40	
Addinol Lube Oil	Addinol Super Truck MD 1048 Addinol Ultra Truck MD 0538	10W-40 5W-30	
Adolf Würth GmbH & Co. KG	Triathlon Super Cargo	10W-40	
Agip Schmiertechnik GmbH	Autol Valve Ultra FE	10W-40	
Aral AG	Aral Giga Turboral Aral Mega Turboral Aral Mega Turboral LA 10W-40	10W-40 10W-40 10W-40	
Armorine S.A.	Armorine Diamant	10W-40	
Ashland Nederland B.V.	Ashland A.P.B. Prefleet DDQ	10W-40	
Astris S.A.	Astris TNX	10W-40	
Avia Mineralöl-AG	Avia Turbosynth HT-E	10W-40	
BayWa AG	BayWa Motorenöl Super Truck 1040 MC BayWa Super Truck 1040 MC BayWa Super Truck 530 SL	10W-40 10W-40 5W-30	
Behran Oil Company	Behran Turbo EIN	10W-40	
Beigin Madeni Yaglar Tic. Ve San. A.S.	Lubex Premium XT 10W40	10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Blaser Swisslube AG	Blasol DER 5W30 Blasol DHP 10W40 Blasol DHSP 10W40	5W-30 10W-40 10W-40	
BP p.l.c.	BP Vanellus C8 Ultima BP Vanellus E7 LE BP Vanellus E7 Plus BP Vanellus E7 Supreme BP Vanellus E7 Ultra BP Vanellus E7 Ultra M BP Vanellus E8 Ultra BP Vanellus Eco BP Vanellus Max Drain BP Vanellus Max Drain Eco BP Vanellus E4 Plus	5W-30 10W-40 10W-40 5W-40 5W-30 5W-30 5W-30 10W-40 10W-40 10W-40 10W-40	
Bucher AG	Motorex Focus 4 Motorex MC Power 3 Motorex MC Power Plus	10W-40 10W-40 10W-40	
C.F.C.L.	ECLA	10W-40	
Calpam Mineralöl-Gesellschaft mbH	Calpam Turbosynth	10W-40	
Carat GmbH & Co. KG	ad-Super Cargo Leichtlauf-Oil	10W-40	
Castrol Ltd.	Castrol Elixion Castrol Elixion Castrol Enduron Castrol Enduron Euro 4 Castrol Enduron Euro 4 Low SAPS Castrol Enduron New Technology Castrol Enduron Plus Castrol Enduron Plus	0W-30 5W-30 10W-40 10W-40 10W-40 10W-40 5W-30 5W-40	
Cepsa Lubricantes	Cepsa Eurotech LS Cepsa Eurotrans SHPD Cepsa Eurotrans SHPD 5W30	10W-40 10W-40 5W-30	
Chevron	Caltex Delo XLD Texaco Ursa TDX Texaco Ursa Ultra Texaco Ursa Premium FE Texaco Ursa Super TDX	10W-40 10W-40 5W-30 10W-40	
Christian Lühmann GmbH & Co. KG	Classic Motorenöl Super Classic Motorenöl Ultra 5W-30	10W-40 5W-30	
CLAAS Vertriebsgesellschaft mbH	CLAAS AGRIMOT ULTRATEC 10W-40	10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Condat S.A.	Condat Vicam Eurosynth Condat Vicam Runner 10W40	10W-40 10W-40	
Conqord Oil S.r.L.	Roadstar	10W-40	
Coparts Autoteile GmbH	Carl Motorenöl Cargo	10W-40	
DaimlerChrysler AG	MB 228.5 Motorenöl 000 989 60 01 12 MB 228.5 Motorenöl 000 989 60 01 13	10W-40	
De Oliebron B.V.	Tor Turbosynt Tor Turbosynt Tor Turbosynth 10W-40 NF Tor Turbosynth LSP, 10W-40	5W-30 10W-40 10W-40 10W-40	
Delek	Delkol Turbosynth M 10W40	10W-40	
Eldon's S.A.	Eldon's Elona Syn	5W-30	
Eller-Montan-Comp. GmbH	Ellmotol Econo Plus HDC	10W-40	
EMKA Schmiertechnik GmbH	EMKA Cargo MC 10W40	10W-40	
Engen Petroleum Ltd.	Engen Dieselube 3000 Super	10W-40 10W-40	
ENI S.p.A.	Agip Sigma Super TFE Agip Sigma Trucksint TFE Agip Sigma Ultra TFE	10W-40 5W-30 10W-40	
ENOC International Sales L.L.C.	ENOC Vulcan 770 SLD 10W-40	10W-40	
ERG Petroli S.p.A.	ERG TD 501, SAE 10W-40	10W-40	
ESA	ESA Multilub Freeway	10W-40	
Ets A. Mauran & Fils S.A.	Inter Turbo LD 5	10W-40	
Eurol Produktionsges.m.b.H	Eurol Concept LD	10W-40	
Evva-Schmiermittel-Fabrik	Evva Truck Extra	10W-40	
Exxon Mobil Corp.	Essolube XTS 5 10W-40 Essolube XTS 5 01 10W-40 Mobil Delvac 1 5W-40 Mobil Delvac 1 SHC Mobil Delvac XHP Extra 101 10W-40 Mobil Delvac XHP Extra 10W-40 Mobil Delvac XHP LE 10W-40 Mobil Delvac XHP Ultra	10W-40 10W-40 5W-40 5W-40 10W-40 10W-40 10W-40 5W-30	
Finke Mineralölwerk GmbH	Aviaticon Finko-Super Truck LA 10W/40 Aviaticon Finko Truck LD 10W/40 Aviaticon FinkoTruck LD 5W/30	10W-40 10W-40 5W-30	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
FL Italia S.p.A.	Urania FE	5W-30	
FL Selenia S.p.A.	Aktual Synthec Hercules FE Hercules SHTF Urania 100K	10W-40 10W-40 10W-40 10W-40	
Fuchs Petrolub AG	Cofran Marathon 10W-40 Fuchs Titan Cargo LDF Fuchs Titan Cargo MC SAE 10W-40 Fuchs Titan Cargo SL SAE 5W-30	10W-40 10W-40 10W-40 5W-30	
GB Lubricants Ltd.	UNIMOT 5 10W/40 Unimot Synth 5	10W-40 5W-30	
Gedol International S.R.L.	TCK EURO 5W-30	5W-30	
Georg Oest Mineralölwerke GmbH & Co KG	Oest Dimo HT Super	10W-40	
Ginouves Georges S.A.	York 845 York 847 York 847 10W-40	10W-40 5W-30 10W-40	
Greenway Lubricants Limited	Stamina LOS 100	10W-40	
Grupa Lotos SA.	Turdus Powertec Synthetic SAE 5W/30 Turdus Semisyntetic CF/SL 10W-40 Turdus Semisyntetic XHPDO	5W-30 10W-40 10W-40	
Gulf Oil International	Gulf Fleet Force Synth Gulf Superfleet ELD 10W-40	5W-30 10W-40	
Hafa	Hafa Eurodex	10W-40	
Handel-Mij Noviol B.V.	Kennoco Eurosynth HP	10W-40	
Handelsges. für Kfz-Bedarf GmbH & CO. KG	SVG Esvaugol Premium SAE 10W-40 SVG Esvaugol SHPD-0	10W-40 10W-40	
Hankook Shell Oil Company Limited	Hankook Shell Rimula Ultra	10W-40	
Hermann Bantleon GmbH	Avilub Motorenöl WDB 10W-40	10W-40	
Huiles Berliet S.A.	RTO Extensia RXD 10W-40 RTO Extensia RXD ECO 5W-30	10W-40 5W-30	
Hunold Schmierstoffe GmbH	Eurolub Muiticargo 10W/40 Hunold Multicargo	10W-40 10W-40	
Igol, France	Igol Trans Turbo 6X Igol Trans Turbo 8X	10W-40 5W-30	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
INA Maziva Rijeka	INA Super 2000 INA Super EKO	10W-40 10W-40	
Italiana Petroli (IP) S.p.A.	IP Tarus Turbo Plus IP Tarus Turbo Synthetic	10W-40 5W-30	
Japan Energy Corp.	Jomo Delcion	5W-40	
Kompressol-Oel Verkaufs GmbH	Kompressol-FX	10W-40	
Krafft S.A.	Molykote Synt 10W-40 SHPD Ultra SHPDO Synthetic	10W-40 10W-40	
Kuttenkeuler GmbH	Master Truck	10W-40	
Kuwait Petroleum	Q8 Super Truck FE Q8 T 860 SAE 10W-40	5W-30 10W-40	
Liqui Moly GmbH	Liqui Moly LKW Langzeit Motoröl Liqui Moly LKW-Langzeit-Motoröl FE	10W-40 5W-30	
Mapetrol d.o.o.	Mapetrol Motoröl SHPD Ultra	10W-40	
Meguin GmbH & Co. KG Mineraloelwerke	Diesel Truck Performance Megol Motorenoel Low SAPS Megol Motorenoel Super Leichtlauf DIMO Megol Motorenoel Super LL DIMO Premium	5W-30 10W-40 10W-40 10W-40	
MHT Industrietechnische Produkte GmbH	MHT STL Extra	10W-40	
Millers Oils Ltd.	Truckmaster XPFE Trucksynth	10W-40 5W-30	
Mineralöl-Raffinerie Dollbergen GmbH	Pennasol Performance Truck	10W-40	
MOL-LUB Ltd.	MOL Synt Diesel	10W-40	
Morris & Co. Ltd.	Morris Ringfree Ultra Ring Free Ultra plus FE 5W30	10W-40 5W-30	
Motor Oil (Hellas)	Emo Turbo Max	10W-40	
Motul	Motul Tekma Optima 5W-30 Motul Tekma Ultima	5W-30 10W-40	
Müller Mineralöle Handels- und Beratungsgesellschaft mgH	OTP Plus Super-Leichtlauf-Motorenöl	10W-40	
Nervol S.A.	Freeway DBE4	10W-40	
New-Process AG	Dallas Power 5 New Process Motoroil Dallas Plus 3	5W-30 10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Nils Italia GmbH	Bora Nils Stratos	10W-40 10W-40	
Noaloil	Noaloil Diam LD 100 10W-40	10W-40	
NOCC, a. s.	Valar Adut XL 053	5W-30	
Oel-Brack AG	Midland Nova Midland Synqron Diesel Midland Synqron Diesel Quaker State Synquest Diesel Quaker State Synquest Diesel	10W-40 5W-30 10W-40 5W-30 10W-40	
Oelwerke Julius Schindler GmbH	Econo-Veritas Truck FE Veritas Spezial HD Extra	5W-30 10W-40	
Oil Company Champion in the World s.r.l.	One Hundred SAE 10W-40 MB 228.5	10W-40	
Oil Refinery Modrica	Maxima HC Magnum XHPD Maxima XHPD	5W-30 10W-40	
Olipes, S. L.	Averoil TIR-UHP	10W-40	
OMV	OMV super truck OMV truck blue SAE 10W-40 OMV truck FE plus	5W-30 10W-40 10W-40	
OOO Lukoil-Permnefte-orgsintez	Lukoil Prima	10W-40	
Orlen Oil Sp. z o. o.	ORLEN OIL Diesel (4) XHPDO CF 10W-40 Platinum Ultor Extreme 10W-40 Platinum Ultor Progress, 10W-40	10W-40 10W-40 10W-40	
Orly International	Orly Taurus 3002	10W-40	
OY TEBOIL AB, Suomen Petrooli	Teboil Super XLD Teboil Super XLD L-SAPS, SAE 10W-40	10W-40 10W-40	
Pakelo Motor Oil S.r.l.	Pakelo Goldenstar Pakelo Goldenstar LA 51 Pakelo Kentron Over MB 5	5W-30 10W-40 10W-40	
Panolin AG	Panolin Diesel HTE Panolin Diesel HTE	5W-30 10W-40	
Paramo, a. s.	Mogul Diesel DTT Plus Mogul Diesel Ultra Paramo Trysk Global	10W-40 5W-30 10W-40	
Peeters Brems S.A.	Ardea Semi Synthetic Special Diesel Oil	10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Petrobras Distribuidora S.A.	BR-352-EX Lubrax Tee Turbo	5W-30 10W-40	
Petrogal S.A.	Galp Galaxia Extreme Galp Galaxia LD S Ultra Galp Galaxia Ultra EC Galp Galaxia Ultra LS	5W-30 10W-40 10W-40 10W-40	
Petrol d.d.	Proton Turbo Diesel Super	10W-40	
Petrol Ofisi Anonim Sirketi	PO Maximus Diesel 10W-40	10W-40	
Petroliam Nasional Berhad	Motolub 3000 Motolub 800	5W-30 10W-40	
Prista Oil Ltd.	Prista Ultra TD, SAE 10W-40	10W-40	
PROFI-TECH GmbH	PROFI-CAR DIESEL POWER TRUCK ACTRON	10W-40	
Rafinerija Nafte DOO Beograd	Galax Extra HPD	5W-30	
Raiffeisen Central-Genossenschaft Nordwest eG	Mega Truck Power Truck 10W-40	5W-30 10W-40	
Raloy Lubricantes	Max Raloy Diesel	5W-30	
Ravensberger Schmierstoffvertrieb GmbH	Ravenol Super Performance Truck 5W-30 Ravenol Performance Truck 10W-40	5W-30 10W-40	
Repsol YPF	Repsol Diesel Turbo UHPD MID SAPS Repsol Diesel Turbo VHPD Repsol Turbo UHPD	10W-40 5W-30 10W-40	
Rilub S.p.A.	Megasynt	10W-40	
Rondine Azienda Petrochimica S.p.A.	Blu Oil 5	10W-40	
S.A.Espanola de Lubrificantes	Gulfleet Highway 10W-40 Gulfleet Supreme (EP)	10W-40 5W-30	
Sakson S.A.	Parnas Hercules 5 SAE 10W-40	10W-40	
Sasol Oil (Pty) Ltd	Sasol Ruby	10W-40	
Shell International Petroleum Company	Shell Normina Extra Shell Rimula Signia Shell Rimula Ultra Shell Rimula Ultra Shell Rimula Ultra (E7) Shell SL 0807	10W-40 10W-40 5W-30 10W-40 5W-30 10W-40	
Sips-Dieter Docker GmbH	SIPS-TSL -4 Motorenoel Sips-TSL 4	10W-40 10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
SK Corporation	ZIC XQ 5000 10W-40	10W-40	
Slider SA, Rentis	Taurus Ultra	10W-40	
Slovnaft a. s.	Madit Mistral	10W-40	
Solda Vladimiro S.p.A.	Wladoil UHP Diesel Oil	10W-40	
SRS Schmierstoff Vertrieb GmbH	Wintershall TFG Wintershall TFL	10W-40 5W-30	
Strub + Co AG	Strub Partsynt HC Ultra UHPD	10W-40	
Sun Oil Co.	Sunoco Ultra HPD	10W-40	
Svenska Statoil AB	Statoil TruckWay Statoil TruckWay Statoil TruckWay E6	5W-30 10W-40 10W-40	
Swd Lubricants GmbH & Co. KG	Expert XH, SAE 10W40 swd Expert PAO	10W-40 5W-30	
Syneco S.p.A.	Syneco K-E5 Syneco Multirange	10W-40 10W-40	
Tamoil Petroli S.p.A.	Tamoil Diesel Top Performance FE Tamoil Diesel Premium FE	5W-30 10W-40	
Tehnosintd.o.o.	Extrol Gold Star (XHPD)	5W-30	
The Valvoline Company	Valvoline ProFleet Valvoline ProFleet Extra	10W-40 5W-30	
Total Lubrifiants	AntarMaxolia 10W-40 Antar Maxolia FE 5W-30 Elf Performance Experty 10W-40 Elf Performance Experty FE 5W-30 Elf Performance Experty LSX 10W-40 Fina Kappa First 5W30 FinaKappa Ultra 10W-40 Total Rubia TIR 8600 10W-40 Total Rubia TIR 8900 10W-40 Total Rubia TIR 9200 FE 5W-30	10W-40 5W-30 10W-40 5W-30 10W-40 5W-30 10W-40 10W-40 10W-40 5W-30	
Unil Deutschland GmbH	Unil Unimot Truck LD	10W-40	
Unil S.A.	Unil LCM XS Unil Opal LCM 800 Unil Opal LCM 850	10W-40 10W-40 5W-30	
Usoco N.V.	Usoco UHPD	10W-40	
Verkol, S.A.	Verkol TD-Max	10W-40	
Wilhelm Schölten GmbH	Aviatic Super FEG	10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Wisura Mineralölwerk	Wisura Cargo MC 10W-40	10W-40	
Witham Oil & Paint Ltd.	Qualube Extendol, SAE 10W-40	10W-40	
Wolf Oil Corporation N.V.	Champion Turbofleet UHPD Wolf Masterlube Longdrain Ultra	10W-40 10W-40	
Wunsch Öle GmbH	Wunsch TSL-Diesel	10W-40	
Wynn's Italia S.P.A..	Multitruck FE	10W-40	
Yacco	Yacco Transpro 45 10W-40 Yacco Transpro 65 SAE 10W-40	10W-40 10W-40	
Zeller + Gmelin GmbH & Co.	Divinol Multimax Plus 10W-40 Divinol Multimax Synth Divinol Multimax USHPD	10W-40 10W-40 5W-30	

Multi-grade Oils (Low SAPS Oils)

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Addinol Lube Oil	Addinol Extra Truck MD 1049 LE	10W-40	
Amstutz Produkte AG	Orol Gold Longmot 04	10W-40	
Aral AG	Aral Mega Turboral LA 10W-40	10W-40	
Astris S.A.	Astris Diesel ADC-04	10W-40	
Blaser Swisslube AG	Blasol DHSP 10W-40	10W-40	
BP p.l.c.	BP Vanellus Eco BP Vanellus Max Drain Eco	10W-40 10W-40	
Bucher AG	Motorex Focus 4	10W-40	
Castrol Ltd.	Castrol Enduron Euro 4 Low SAPS	10W-40	
Cepsa Lubricantes, S.A.	Cepsa Eurotech LS	10W-40	
Chevron	Texaco Ursa Ultra	10W-40	
DaimlerChrysler AG	MB 228.51 Motorenöl 000 989 91 01 Granat	10W-40	
De Olibron B.V.	Tor Turbosynth LSP, 10W-40	10W-40	
Deutsche Pentosin-Werke GmbH	Pentosin Diesel 10W-40 LA	10W-40	
ENI S.p.A.	Agip SIGMA UltraPlus TFE	10W-40	
Exxon Mobil Corp.	Mobil Delvac XHP LE 10W-40	10W-40	
Finke Mineralölwerk GmbH	Aviaticon Finko-Super Truck LA 10W/40	10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
Fuchs Petrolub AG,	Fuchs Titan Cargo Maxx SAE 10W-40	10W-40	
Georg Oest Mineralölwerk GmbH & Co KG	OEST Dimo LS SAE 10VV-40	10W-40	
Ginouves Georges S.A.	York 947 10W-40	10W-40	
Gulf Oil International	Gulf Superfleet XLE	10W-40	
Handelsges. für Kfz-Bedarf GmbH & CO. KG	SVG Esvaugol Low SAPS SAE 10W-40	10W-40	
Hunold Schmierstoffe GmbH	Euroclub Supermax 10W/40	10W-40	
Igol France	Igol Protruck 200X, SAE 10W-40	10W-40	
Kuwait Petroleum	Q8 T 900	10W-40	
Liqui Moly GmbH	Liqui Moly Top Tec Truck 4050 Liqui Moly Truck-Nachfüll-Öl	10W-40 10W-40	
Meguin GmbH & Co. KG	mogol Motorenoel Low SAPS	10W-40	
Mineralöl-Raffinerie Dollbergen GmbH	Motor Gold LightTec	10W-40	
MOL-LUB Ltd.	MOL Synt Diesel Euro 4	10W-40	
Morris & Co. Ltd.	Morris Ring Free Ultra 10W-40	10W-40	
Motor Oil (Hellas)	Emo Turbo Max	10W-40	
New-Process AG	Super Dallas Synkat	10W-40	
Oel-Brack AG	Midland Nova	10W-40	
OMV	OMV truck blue SAE 10W-40	10W-40	
Orlen Oil Sp. z o. o.	Platinum Ultor Progress, 10W-40	10W-40	
OY TEBOIL AB, Suomen Petrooli	Teboil Super XLD L-SAPS, SAE 10W-40	10W-40	
Pakelo Motor Oil S.r.L	Pakelo Goldenstar LA 51	10W-40	
Panolin AG	Panolin Diesel Synth EU-4	10W-40	
Petrogal S.A.	Galp Galáxia Ultra LS	10W-40	
Ravensberger Schmierstoffvertrieb\ GmbH	Ravenol EURO IV Truck SAE 10W-40	10W-40	
Repsol YPF Lubricantes y Especialidades	Repsol Diesel Turbo UHPD MID SAPS	10W-40	
ROWE Mineralölwerk GmbH	Rowe Truckstar 1040 HC-LA	10W-40	
Shell International	Shell Rimula Signia Shell SL 0807	10W-40 10W-40	
Sips-Dieter Docker GmbH	SIPS TLA-5-Diesel	10W-40	

Manufacturer	Brand name	SAE Viscos-ity class	Remarks
SRS Schmierstoff Vertrieb GmbH	Wintershall TLA	10W-40	
Strub + Co AG	Strub Partsynt HC UItra SAE 10W/40	10W-40	
Svenska Statoil AB	Statoil TruckWay E6	10W-40	
Swd Lubricants GmbH & Co. KG	swd FAVORIT LSAP SAE 10W-40	10W-40	
The Valvoline Company	Valvoline ProFleet LS SAE 10W-40	10W-40	
Total	Total Rubia TIR 8900 10W-40 Elf Performance Experty LSX 10W40	10W-40 10W-40	
Unil S.A.	Unil Opal Pallas 900, SAE 10W-40	10W-40	
Wunsch Öle GmbH	Wunsch TLA - Diesel	10W-40	
Yacco SAS	Yacco Transpro 65 SAE 10W-40	10W-40	
Zeller + Gmelin GmbH & Co.	Divinol Multimax Plus 10W-40	10W-40	

Coolant Additives

For details and special information, see chapter on “Coolants” (→ Page 13)

Mixing of different coolant additives and supplementary additives is prohibited!

Corrosion-inhibiting Antifreeze Concentrates

Manufacturer	Brand name	Runtime Hour / Year	Remarks
Addinol	Antifreeze Super		
Aral AG	Aral Antifreeze Extra Aral Antifreeze Silikatfrei		
BASF AG	Glysantin Anti Korrosion Glysantin G 30 Glysantin G 48 Glysantin mit Protect Plus Glysantin Alu Protect		
Bucher AG	Motorex Antifreeze G05 Motorex Antifreeze Protect G48		
Castrol Ltd.	Castrol Antifreeze NF		
Clariant GmbH	Genantin Super		
Fuchs Petrolub AG	Fuchs Fricofin Kühlerfrostschutz		
Ginouves Georges S.A.	York 716		
Krafft S.A.	Krafft Refrigerante ACU 2300		
Maziva - Zagreb d.o.o.	INA Antifriz AI Super		
MOL-LUB Ltd.	EVOX Extra G48 Antifreeze concentrate		
Panolin AG	Panolin Anti-Frost MT-325		
Shell International	Glyco Shell		
The Valvoline Company	Zerex G 05 Zerex G 30 Zerex G 48		
Total	Glacelf MDX		

Corrosion-inhibiting Antifreezes: Ready-Mix

Manufacturer	Brand name	Runtime Hour / Year	Remarks
BASF	Kühlstoff G 05-23/50		
Total	Total Coolelf MDX -37		

8 Preservation Specifications

Warnings

Please note the following warnings in bold type:

Caution!

Work which has to be carried out exactly in order to avoid danger to persons.

Attention!

Work which has to be carried out exactly in order to avoid damage or destruction of material.

Note:

If a particular aspect requires special attention whilst work is being carried out.

Preface

Machined and unprotected surfaces, such as those in the cylinder liners, are subject to corrosion and have to be preserved during long out-of-service periods. The applicable engine documentation must also be considered together with this Preservation Specification. The gearbox manufacturer's preservation specification must be complied with when complete powerpacks / drive systems are taken out of service.

This specification describes the following types of preservation (→ Page 67)(according to the length of the period out of service):

- Out-of-service
  (1 to 3 months without operation)
- Preservation
  (from 3 to max. 36 months without operation)
- Special packing
  (more than 36 months without operation)

and the following storage conditions:

- Normal ambient conditions (no frost, clean surroundings, relative humidity below 50%).
- Difficult ambient conditions (high humidity, salty air, strongly varying temperatures, dust, etc.).
- Unsuitable ambient conditions (outside storage, in moist rooms, etc.). In such conditions it is not possible to store engines without special packing.

Note:

Warranty claims are invalid if the storage is not according to specifications.

Do not use natural rubber sealing material, as it is not proof against ageing.

Only MTU-approved fluids and lubricants as specified in Chapter 6 (Approved Fluids and Lubricants) are to be used for preservation and re-preservation (→ Page 33).

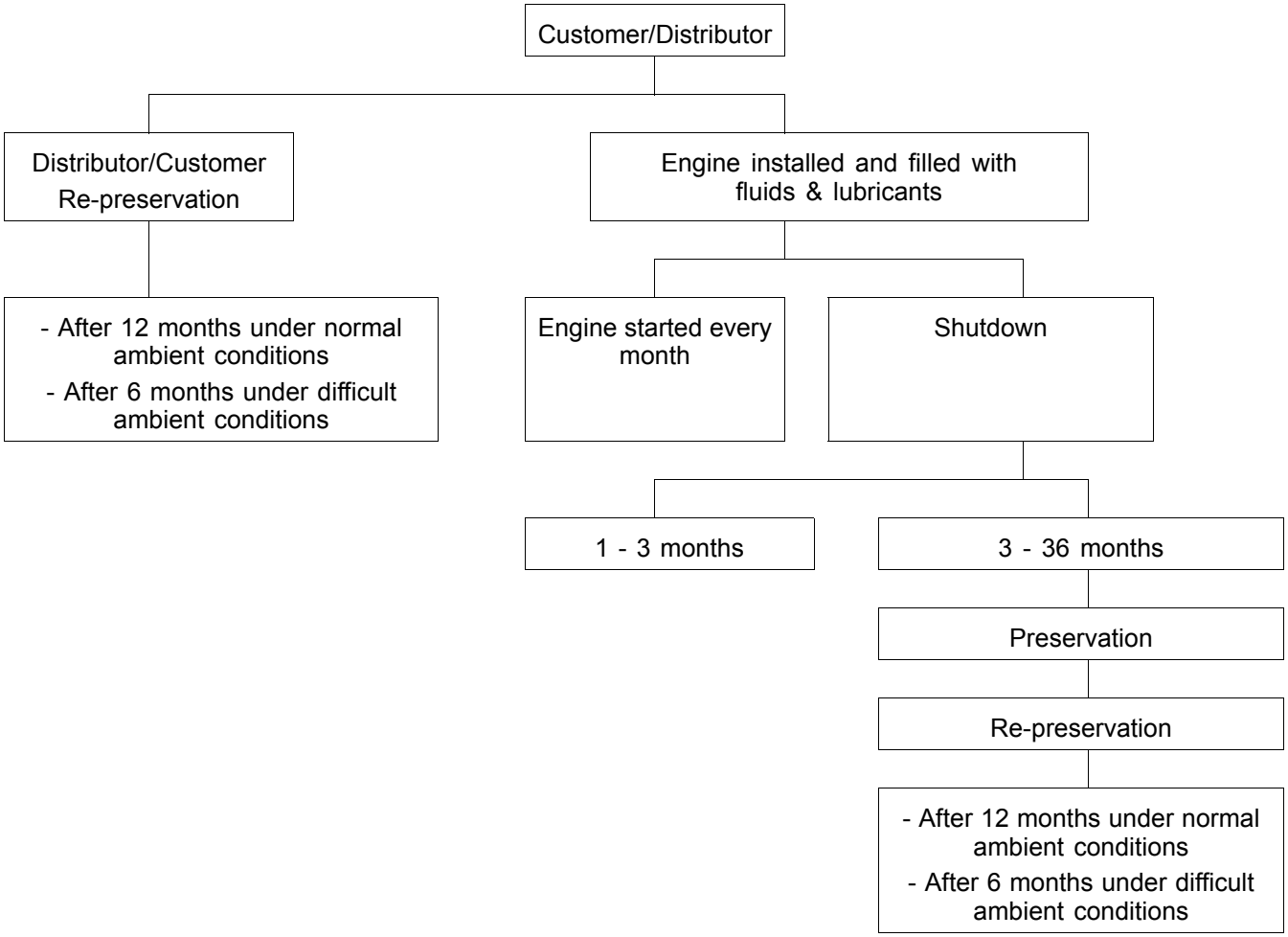
Engines that are to be shutdown for more than one month are to be preserved immediately after operation.

Refer to the engine documentation for tasks and checks to be carried out when shutting down an engine and before re-operating an engine.

Engines also have to be preserved if they are shutdown for a planned major overhaul and the period between shutdown and overhaul is over one month.

New engines or engines which have undergone a major overhaul must be preserved immediately after the test-stand run. Preservation is not necessary only if the engine is to be put into service (but only under normal ambient operating conditions) within one month of the test-stand run.

Engine Preservation - Overview



Overview of Types of Preservation

Shutdown period	Tasks
Out-of-service From 1 to 3 months	See Section (→ Page 67)
Out-of-service From 3 to 36 months	Preservation see Sections (→ Page 67) and (→ Page 69) Re-preservation • Under normal ambient conditions, re-preserve every 12 months • Under difficult ambient conditions, re-preserve every 6 months see Sections (→ Page 69) and (→ Page 70)
Out-of-service More than 36 months or earlier if required	Special packing See Section (→ Page 70) Checking the humidity indicators Check every 3 to 4 months See Section (→ Page 72)

Short-time Shutdown

Short-time shutdown of the engine means a period of maximum one month in installed condition. Close the emergency air shut-off flaps if they are provided. No further special preservation measures are otherwise necessary.

Out-of-service

Out-of-service means a shutdown of the engine for a period of 1 to 3 months.

Task description

Run engine up to operating temperature, then run up to rated speed for about 30 seconds and then shutdown at rated speed. The engine is not to be started again. This engine run must also be carried out before the engine is removed for a period out-of-service.

Engine in Installed Condition

The following openings are to be securely sealed on engines in installed condition.

- Cooling-air inlet
- Combustion-air inlet (Close the emergency air shut-off flaps if they are provided).
- Exhaust outlet
- Crankcase breather, if possible (when venting to atmosphere).

Engine Removed

The following system inlets and outlets/connections are always to be securely sealed off on removed engines.

- Coolants
- Fuel
- Engine oil
- Hydraulic oil
- Electrical plug connectors

Putting Out-of-Service Engines into Operation

Task description

Remove all sealing covers (→ Page 67). The engine can then be put into operation according to the engine documentation.

Preservation of Diesel Engines

General

Preservation must be carried out on engines which are to be shut down for a period of more than 3 months and up to a maximum of 36 months.

New engines or those which have undergone a major overhaul by MTU are always preserved as standard procedure.

In the interests of security, for shutdown periods of over one month, the preservation work which has been carried out should be noted on the Preservation Check Sheet (→ Page 82).

For engines stored whilst still under manufacturer's warranty, the Monitoring Sheet must be completed and returned to MTU in good time before the engine is returned to service (→ Page 83).

Note:

If the engine cannot be properly accessed to carry out preservation work (e.g. charge-air pipe inaccessible) then the engine must be removed and mounted on a ground run base or a test stand whilst preservation is completed.

Preservation of Cooling, Lubrication and Fuel Systems

Task description

- Clean engine if necessary.
- Fill the cooling system with coolant consisting of 3% emulsifiable corrosion-inhibiting oil and water or 10% BASF Glysacorr P113 and water.
- Fill with corrosion-inhibiting oil up to (→ Page 33) "Min" mark at least.
- Prepare preservation fuel consisting of diesel fuel and 10-12% preservation oil (corrosion-inhibiting oil for internal preservation) or 100% corrosion-inhibiting oil for internal preservation of the fuel system (→ Page 33)
- Run engine for about 10 minutes at high idle with preservation fuel. The coolant temperature must reach at least operating temperature.
- Shutdown engine.

If there is danger of frost, fill up with antifreeze (40%)! (Only for installed engines)

Preservation of the Combustion Chamber

Task description

- Clear access to the charge-air pipe. This may require removal of the flame-start canisters, sensors, covers or pipes. Access to the charge-air pipe must be available after the intercooler, after the pressure fine filter/air filter and after the turbocharger.
- Turn the warm engine over with the starting system.

Attention!

It must be ensured when turning the engine over that the engine cannot start. With mechanical governors, the shutdown lever must be at the STOP position during turn-over. With electronic governors, switch off the power supply and turn the engine over either with the emergency start or another suitable method.

- While the engine is being turned, use a fine-atomizing spray gun to spray preservation oil into the charge-air pipe openings for about 15 seconds.
- Re-seal the openings to the charge-air pipes.

Note:

Refer to the engine documentation.

External Preservation

Seal off all openings against moisture and humidity.

- Cooling-air inlet
- Combustion-air inlet
- Exhaust outlet

The following supply and return systems and openings are always to be securely sealed off on removed engines.

- Coolants
- Fuel
- Engine oil
- Hydraulic oil
- Electrical connections
- Crankcase vent (with venting to atmosphere).

1. Coat or spray unpainted parts with corrosion inhibitor (→ Page 33). Corrosion Inhibitors for External Preservation

2. Complete the check sheet after completion of preservation work (→ Page 82). Place the check sheet in a plastic sleeve and attach it to the engine in a clearly visible position.

Re-preservation

Task description

- Remove sealed covers from combustion-air inlet and exhaust outlet.
- Preservation of the Combustion Chamber (→ Page 68)
- Seal off the combustion air intake and exhaust outlet openings against moisture/humidity once again.
- Make a visual check of the engine for corrosion. If necessary, clean the affected places and recoat with corrosion-inhibiting oil.

De-preservation

Task description

- Clean engine if necessary.
- Remove all dealing covers (→ Page 68)
- Drain off remaining corrosion-inhibiting oil.
- Fit new oil filters (inserts) (not applicable for new deliveries; after 1 year at latest)
- Fit new fuel filters (inserts) (not applicable for new deliveries; after 1 year at latest)
- Fill up with engine oil.
- Bar engine manually.
- Prepare engine for operation.
- Renew coolant

Note:

Put engine into operation according to the engine documentation.

Preservation of Gas Engines

General

Preservation must be carried out on engines which are to be shut down for a period of more than 3 months and up to a maximum of 36 months.

New engines or those which have undergone a major overhaul by MTU are always preserved as standard procedure.

In the interests of security, for shutdown periods of over one month, the preservation work which has been carried out should be noted on the Preservation Check Sheet (→ Page 82).

For engines stored whilst still under manufacturer's warranty, the Monitoring Sheet (→ Page 83) must be completed and returned to MTU in good time before the engine is returned to service.

Note:

If the engine cannot be properly accessed to carry out preservation work (e.g. charge-air pipe inaccessible) then the engine must be removed and mounted on a ground run base or a test stand whilst preservation is completed.

Preservation of Cooling and Lubrication Systems

Task description

- Clean engine if necessary.
- Fill the cooling system with coolant consisting of 3% emulsifiable corrosion-inhibiting oil and water or 10% BASF Glysacorr P113 and water.
- Fill with corrosion-inhibiting oil up to (→ Page 33) "Min" mark at least.
- Run the engine for 15 minutes at 1/2-load
- Switch off the engine and drain off the fluids and lubricants (lubrication oil pan and oil filter cartridges).

If there is danger of frost, fill up with antifreeze (40%)! (Only for installed engines)

Preservation of the Combustion Chamber

Task description

- Fill with corrosion-inhibiting oil up to (→ Page 33) "Min" mark at least.
- Clear access to the charge-air pipe. This may require removal of sensors, covers and pipes. Access to the charge-air pipe must be available after the intercooler, after the pressure fine filter/air filter and after the turbocharger.
- Use the starting system to turn the engine over.

- Drain fluids and lubricants.

Attention!

It must be ensured when turning the engine over that the engine cannot start. To ensure this, the gas supply must be reliably interrupted by closing the gas line.

- While the engine is being turned, use a fine-atomizing spray gun to spray preservation oil into the charge-air pipe openings for about 15 seconds.
- The starter unit must only be used to turn over the engine if the engine is filled at least up to the "Min" mark with lube oil (corrosion-inhibiting oil) and the oil filters are filled with lube oil (corrosion-inhibiting oil)
- Re-seal the openings to the charge-air pipes.

Note:

Refer to the engine documentation.

External Preservation

Seal off all openings against humidity:

- Cooling-air inlet
- Combustion-air inlet
- Fuel gas inlet
- Exhaust outlet

In addition, the following feed and return systems and openings must also be sealed off on engines which have been removed:

- Coolants
- Engine oil
- Electrical connections
- Crankcase vent (with venting to atmosphere).
  1. Coat or spray unpainted parts with corrosion inhibitor (→ Page 33). Corrosion Inhibitors for External Preservation.
  2. Complete the check sheet (→ Page 82) after completion of preservation work. Place the check sheet in a plastic sleeve and attach it to the engine in a clearly visible position.

Re-preservation

Task description

- Remove sealed covers from combustion-air inlet and exhaust outlet.
- Preservation of the Combustion Chamber (→ Page 69)
- Seal off the combustion air intake and exhaust outlet openings against moisture/humidity once again.

Make a visual check of the engine for corrosion. If necessary, clean the affected places and recoat with corrosion-inhibiting oil.

De-preservation

Task description

- Clean engine if necessary.
- Remove all dealing covers (→ Page 68)
- Drain off remaining corrosion-inhibiting oil.
- Fill up with engine oil.
- Bar engine manually.
- Prepare engine for operation.
- Renew coolant

Note:

Put engine into operation according to the engine documentation.

Special packing

Special packing must be carried out, immediately following preservation if possible, for engines which are to be taken out of service for more than 36 months or which are to be transported by sea or in polar or tropical regions, see Section (→ Page 67)and (→ Page 69). Likewise, special packing is also usually of advantage in protecting the engine against corrosion during shorter periods of storage.

General Information on Special Packing

Engines / drive plants must be specially packed for transportation by sea or in polar/tropical regions and before long-term storage. This means that the engine must be preserved according to Section (→ Page 67) or (→ Page 69) (completely drain off coolant and preservation oil) and enclosed in special packing in addition.

The following types of special packing are available:
- Envelopes of bonded-layer material (e.g. aluminum bonded-layers).
- Hygroscopic (water-absorbing) materials (e.g. silica gel).

The engine is sealed in a semi-(water-vapor) permeable foil and the air is then drawn off with a vacuum cleaner. Desiccant is used to achieve a specific relative humidity inside the foil envelope. The climatic packing of bonded-layer material hinders the formation of condensed water on the metal surface and resulting corrosion.

Maintenance Intervals

Every 3 to 4 months
- Check humidity indicators (→ Page 72)

Note:

When storing the engine in special packing (with laminated-aluminum layers), it should be remembered that the elastomers have a limited life. The calculation of the total service life of the elastomers begins with either the year of manufacture or last engine overhaul (see nameplate). Based on current knowledge, elastomer components made of fluorocarbon rubber (e.g. O-rings) have a total service life of about 20 years and those made of other rubber materials (hoses) have a total service life of about 10 years.

In cases of storage for more than 10 years (from date of manufacture on identification plate) but before puttting into service
- Replace all rubber parts on engine (hoses, sleeves, etc.)

Storage beyond 20 years (as of year of manufacture on nameplate) but before commissioning:
- Replace all elastomers during a major overhaul of the engine.

Note:

A long storage period shortens the time limit for an engine's major overhaul (TBO) because of the limited total service life of the elastomers. MTU recommends that engines should not be stored for more than 10 years.

Envelopes of Laminated Material

The envelopes consist of tightly-bonded layers of aluminium composite foil which has limited permeability to water vapor and gas.

The material used by MTU is composed of polyethylene - aluminum and polyester, with the following properties:
- Temperature range for applications from +70°C to -50°C.
- Water vapor permeability (WVP): 0.1 g/m² per day at 38°C and 80% relative humidity (compared with PVC soft foil: WVP 6 g/m² per day)

Desiccant

Desiccant, mostly silica gel, is the name usually given to water-absorbing materials as used in the special packing. The desiccant is in packs of highly-permeable (for water vapor) and strong material (e.g. natron crepe paper) which are placed in the transport package.

Desiccant pack

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The following drying-agent packs are used for transport packing:
- MTU-No. 49542 desiccant 125 g = 4 units
- MTU No. 49543 desiccant 259 g = 8 units
- MTU-No. 49544 desiccant 500 g = 16 units
- MTU No. 49545 desiccant 1000 g = 32 units

Calculation of required desiccant

The amount of units placed in the special packing depends on the climatic conditions and type of storage at the place of destination. The minimum amount of units to be used is calculated as follows:

Climatic zone	Per m² laminated aluminium foil surface (A)	Per kg auxiliary packing materials (APM)	Desiccant units (DU)
A Europe (excluding Russia)	6 x A	17 x APM	= DU per shipment package
B USA Canada Mediterranean Near East	8 x A	20 x APM	= DU per shipment package
C Russia South and Middle America Middle and Far East	17 x A	20 x APM	= DU per shipment package

Procedure
1. Measure surface A of the laminated aluminum foil for the packing.
2. Weigh the packing material (e.g. wood, corrugated cardboard, etc.) necessary to support and protect the engine within the special packing envelope.
3. Determine which climatic zone(s) the protected engine will be transported through and finally stored in.
4. Calculate the Required desiccant (DU).

Note:

If the laminated aluminium foil is replaced or repaired following damage, the calculation for the desiccant required (DU) must be carried out again as follows (example) (→ Page 72).

Calculation Example for Desiccant Units

Determination of DU for the seaworthy transport of an engine to Singapore:
- Laminated aluminium foil surface 10 m²
- Packing material: 3 kg
- Packing for climatic zone C:

	17 DU/m² laminated aluminium foil	x 10 m²	=	170
+	20 DU/kg	x 3 kg	=	60
		Total		230 DU

Result: Sufficient protection of the engine requires 230 desiccant units (DU).

Humidity Indicator

Humidity indicators can be inserted into the foil envelope to show the saturation level of the desiccant. The indicators signalize by changing color that the specified level of relative humidity has been exceeded. An increase in relative humidity e.g. due to leaks or damage, presents a risk of corrosion for the engine.

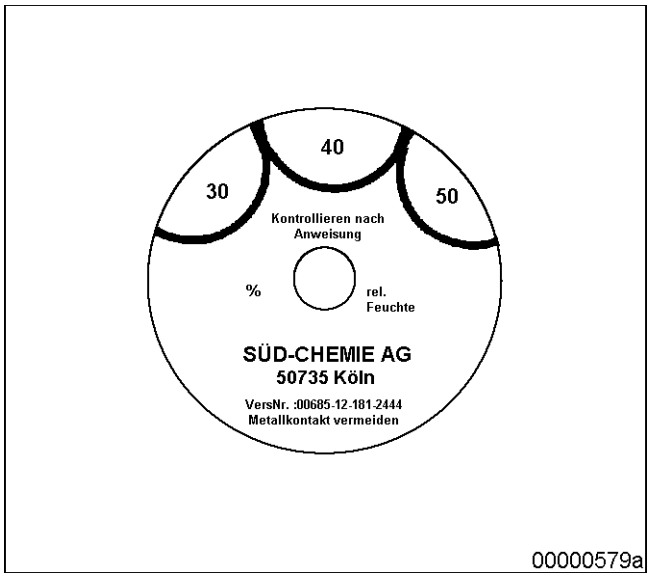
A viewing window with a humidity indicator is screwed into the laminated aluminium foil at a point as far away as possible from the desiccant. It is thus possible to check the relative humidity inside the foil envelope and /or to verify any changes.

The humidity must be checked regularly every 3 to 4 months.

30 Colored pink:
Relative humidity above 30 %.

40 Colored pink:
Relative humidity above 40 %

50 Colored pink:
Relative humidity above 50 %



Relative humidity above 30 %

Reduce time between checks, i.e. check every 4 weeks.

Relative humidity above 40 %

New desiccant required (→ Page 80), The new desiccant must be evenly distributed, primarily throughout the upper section of the packing envelope. Number of desiccant units required for special packing, (→ Page 72).

Relative humidity above 50 %

Check condition of packed engine, re-preserve engine, (→ Page 69)and (→ Page 70) and repack engine (→ Page 73).

Note:

The humidity indicator regenerates itself; replacement is not necessary.

Order Nos. for Packing Materials

Details required when ordering from MTU:

MTU No. 20447 Humidity indicator

MTU No. 20448 Viewing window

MTU-No. 49542 desiccant 125 g = 4 units

MTU-No. 49543 desiccant 250 g = 8 units

MTU-No. 49544 desiccant 500 g = 16 units

MTU No. 49545 desiccant 1000 g = 32 units

MTU No. 49576 Laminated aluminum foil 1.00 m wide

MTU No. 49577 Laminated aluminum foil 1.25 m wide

MTU No. 49579 Laminated aluminum foil 1.50 m wide

MTU No. 49578 PE (polyethylene) foam foil 1.25 m wide, 4 mm thick

Special Packing Procedure for Finished Products

Preparation for Special Packing

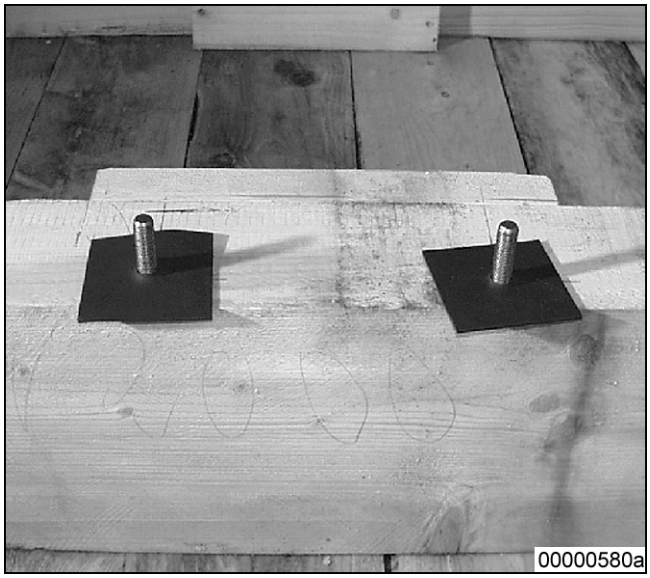
Provided that the engine is not new or has not undergone a major overhaul carried out by MTU (and has already been preserved), preservation (→ Page 67)and (→ Page 69) must be carried out before special packing takes place. Coolant and preservation oil must be completely drained.

Transport Locking Device

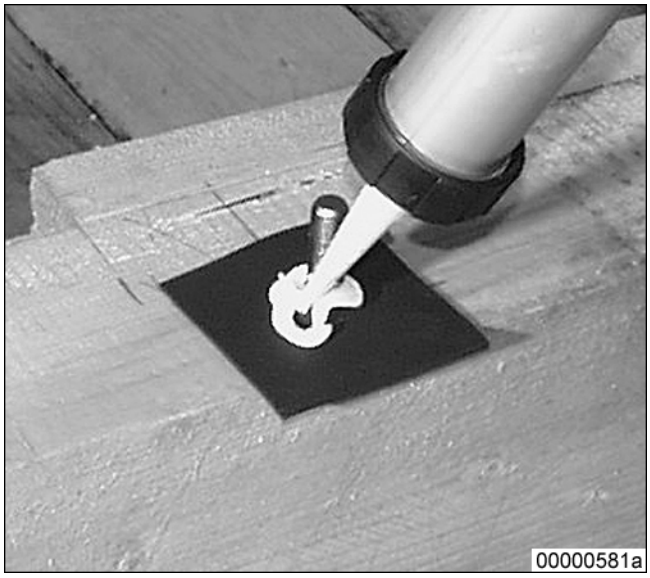
Check whether a transportation locking device is required (see engine documentation or consult MTU). Block crankshaft and engine mounts as specified in the engine documentation.

Special Packing of an Engine

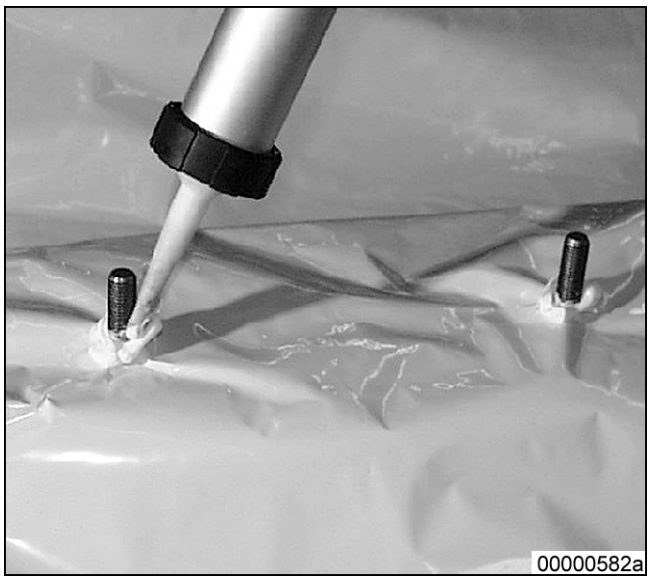
The laminated aluminium foil is to be clamped between two hard-rubber pads around the anchor studs. Use a hole punch to cut out holes for the studs.



Coat the intermediate pads liberally with non-hardening sealant (Loctite 5970, MTU Part No. 50773) around the studs.



After positioning the aluminium foil over the studs, coat liberally around the stud holes with non-hardening sealant (Loctite 5970, MTU Part No. 50773).

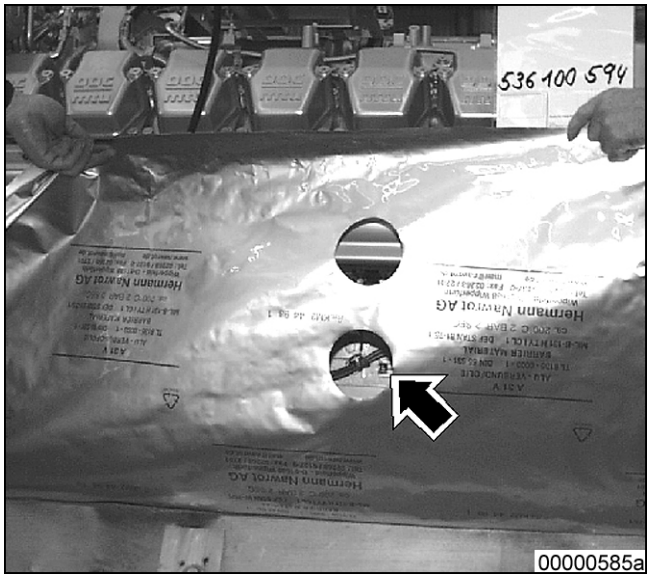


Position the second hard-rubber pads.

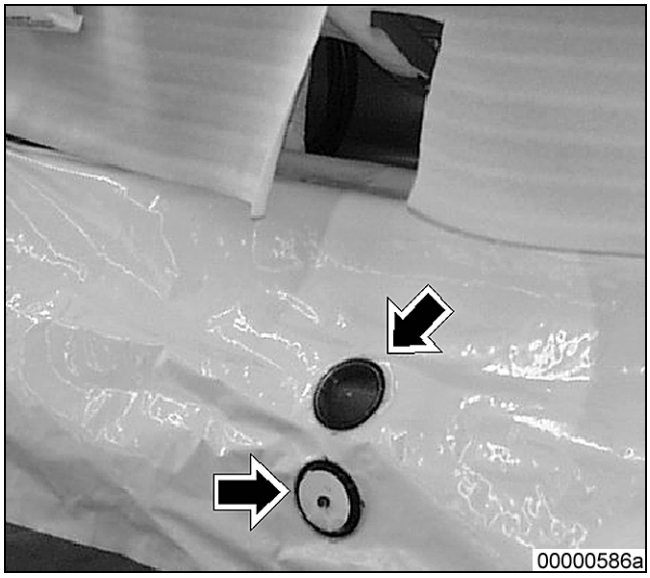
For additional protection of the laminated aluminum foil, position foam foil over the upper hard-rubber pad. The complete system is compressed and sealed after the engine mounts are installed and secured.

Installation of Humidity Indicator

The holes for the indicator and the viewing window are to be cut into the laminated aluminum foil in a clearly visible position and as far as possible from the desiccant units. The viewing window must be so positioned that the engine No. can be checked.



Screw in the humidity indicator and the viewing window.



Cushioning of Engine Edges and Corners

Engine edges and corners, which could damage the laminated aluminum foil, must be cushioned using foam foil or foam rubber.

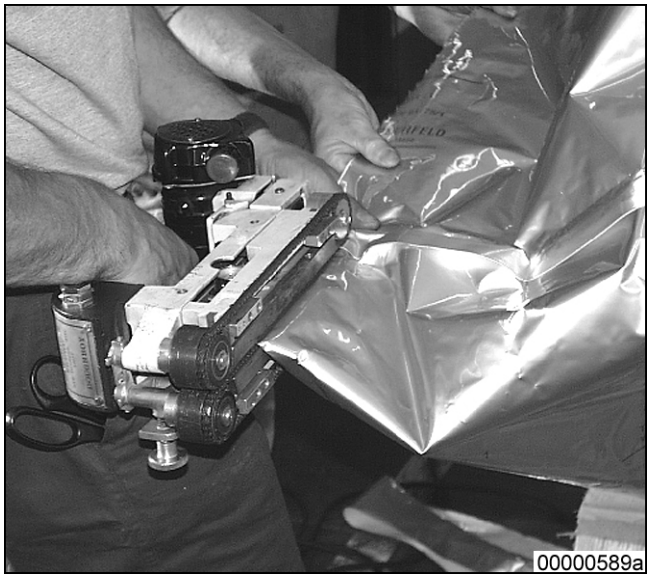
Location of Desiccant Units

Use the formula (→ Page 72) to calculate the required number of desiccant units and put them in place. The desiccant units must be arranged in the upper third of the envelope and attached to the engine, hanging free wherever possible. Ensure that the desiccant units are so attached (with string, adhesive tape or other suitable material) that no damage can be caused to the desiccant units, the engine or the laminated aluminum foil.

Note:
The desiccant units must not be in direct contact with corrosion-sensitive engine components.

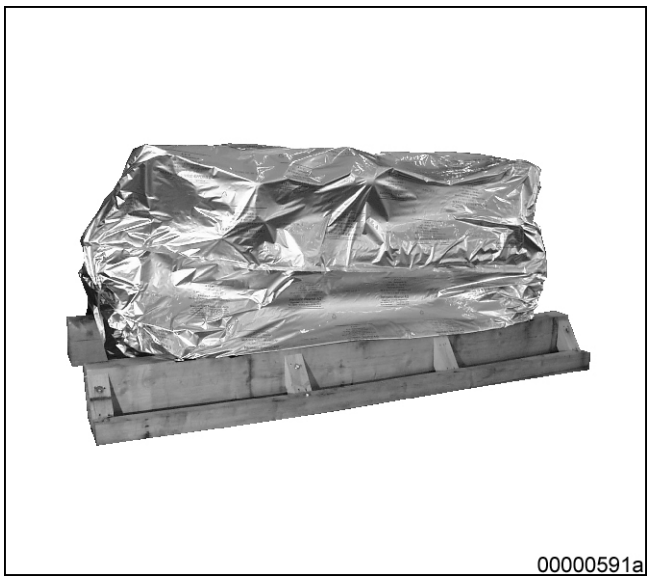
Laminated Aluminium Foil Sealing

Use a manual foil-welding unit suitable for aluminium laminate foils to seal the aluminium laminate envelope (→ Page 81).



Prior to final sealing of the aluminium laminate envelope, use a vacuum pump (e.g. vacuum cleaner) to extract the entrapped air.

As a result of the resulting pressure drop, the envelope must shrink into light contact with the engine. Excessively heavy contact must be avoided as friction damage could result during transportation.



Note:

Extraction of the entrapped air also reduces the humidity within the envelope thus creating a favorable initial humidity status. Extraction of the air also verifies that the envelope is free of leaks. If the envelope is not adequately sealed, it will re-expand within 30 minutes.

A leak can be found by pressurizing the envelope and repaired by welding.

Special Packing Checks

Humidity Check

Humidity within the envelope must be checked regularly every 3 - 4 months (→ Page 72). The results of the check must be entered on the monitoring sheet (→ Page 83). If the engine is still under warranty, return the monitoring sheet (→ Page 83) to MTU Friedrichshafen after putting the engine into service.

Attention!

When checking the special packing, ensure that the laminated aluminum foil is not damaged, exercise great care when opening the transportation box (if provided).

The condition of the laminated aluminum foil is to be checked minutely at every customs, stock or storage check. Corrosion protection is no longer guaranteed if the aluminium foil is damaged.

Desiccant Replacement

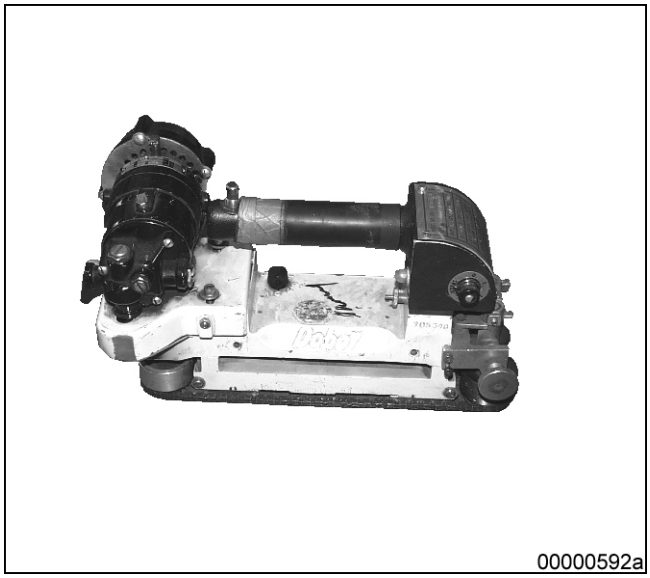
Open the upper section of the envelope and remove the old desiccant. Place the same amount of fresh desiccant in the upper section of the envelope (→ Page 78). Re-weld the envelope and extract the air (→ Page 79).

Repair of Special Packing

If the laminated aluminum foil is damaged, the damaged area can be cut out and a new section welded into position. If repairs have to be carried out, the envelope must be stocked with fresh desiccant (→ Page 78) and the air must be extracted again (→ Page 79). Incorrect repair, e.g. using adhesive tape, is not permissible, as the partial vacuum in the envelope cannot be maintained. In order to ensure correct repair, the specified packing materials (→ Page 73) and the manual welding unit (→ Page 81) must be used.

Manual Welding Unit

A supplier of foil-welding units is, for example:
W. Kopp Verpackungsmaschinen
Stettener Straße 111-117
D-73732 Esslingen- Waeldenbronn
Designation: HSD 95 Cello manual sealing unit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Form Sheets

Preservation Check Sheet

Engine model: ..... Engine No. ..... Acceptance date: ..... Correct execution of the tasks described in the Preservation Specification must be confirmed on this sheet by the person carrying out the tasks.		
Tasks Completed	Date	Name
Lubrication system		
Preserved with preservation oil. Brand of oil used:		
Fuel system		
Preserved with preservation fuel. Preservation fuel used: ..... Fuel main and pre-filters, fuel pipework not drained.		
Cooling System		
Is preserved with specified coolant. Coolant is not drained (except with special packing, engines which have been de-installed and engines for dispatch).		
Non-painted parts		
These are brush-coated with corrosion inhibitor. All engine openings are sealed as specified. All parts to be kept free of paint such as flywheel, starter ring gear and starter pinion as well as non-painted sections of the control linkage and the uncovered coupling flange (as appropriate) for the 3-phase generator are brush-coated with corrosion-inhibiting oil. Corrosion inhibitor used:		
Engine is preserved as specified.		
Re-preservation completed as specified		
On completion of preservation, place the completed Check Sheet in a plastic envelope. Seal the envelope and tie it to the engine at a clearly visible location. Keep this check sheet with the engine until completion of de-preservation.		

Monitoring Sheet for Engines in Special Packing

Engine model: ..... Engine No. ..... Date of delivery: .....

The following checks are to be made before, during and at the end of the engine storage period and correct execution must be confirmed by date and signature.

Note:

With new products, entry of the delivery date is mandatory.

No.	Task	Date	Name
1	Visual check of special packing for damage Relative humidity: ..... %		
2	Relative humidity: ..... %		
3	Relative humidity: ..... %		
4	Relative humidity: ..... %		
5	Relative humidity: ..... %		
6	Relative humidity: ..... %		
7	Relative humidity: ..... %		
8	Relative humidity: ..... %		
9	Relative humidity: ..... %		
10	Relative humidity: ..... %		
11	Relative humidity: ..... %		
12	Relative humidity: ..... %		
13	Humidity indicator check before opening the envelope Relative humidity: ..... %		
14	De-preservation completed		
15	Date of scheduled initial operation of engine		
Repairs	Tasks completed		
	To the laminated aluminum foil or packing box		

Important NOTE: Inform MTU during the warranty period:

Inform MTU

- If two or all three humidity indicators are pink.
- If external corrosion on the engine or damage to rubber hose connections is found when the engine is depreserved.

Inform MTU in good time before initial operation of the engine.

Check Sheet for De-Preservation of Engines in Special Packing

Check sheet for engine de-preservation			
Attention!			
Before opening the envelope, read this check sheet carefully and follow the instructions exactly, especially those requiring contact with MTU.			
1.	Read off the humidity status at the indicators and enter on the Monitoring Sheet.	6.	Record the date of de-preservation on the Monitoring Sheet.
Attention:a. If all 3 indicator sections show blue, everything is in order b. If the 30% and 40% sections are partly or totally pink, check the envelope for damage. Report damaged envelopes to MTU. c. If all three fields are pink, do NOT open the envelope, report to MTU.		7.	Do not remove the sealing covers from the engine openings (turbocharger inlet, exhaust manifold outlet, coolant inlet and outlet, connecting flanges for vent lines on coolant distribution pipes) until these are to be used.
2.	If the humidity readings are in order and there are no visible signs of faults/damage, remove the laminated aluminium foil from the engine.	8.	Compliance with the initial-operation instructions in the engine documentation is mandatory.
3.	Check the exposed engine externally for corrosion or damage. Enter date and findings on the Monitoring Sheet.		
4.	Inspect visually all rubber-hose connections, they must not be brittle or swollen.		
5.	Report any faults to MTU immediately and await their reply. Do not prepare the engine for installation or make changes. Store the engine in a dry and covered location.		

9 Flushing and Cleaning Specifications for Engine Coolant Systems

General Information

These cleaning specifications are for the engine cooling systems in MTU diesel engines

In the course of time, sludge deposits from ageing coolant additives can accumulate in the cooling system. Reduced cooling capacity, clogged vent lines and drain points and dirty coolant level sight-glasses can result.

Below-standard water quality or incorrect coolant preparation can also heavily contaminate the system.

If such conditions occur, the coolant system is to be flushed out with fresh water, repeatedly if necessary.

If these flushing sequences are insufficient or if the system is too heavily contaminated, the system and all affected parts must be cleaned.

Only clean, fresh water (no river or sea water) must be used for flushing.

Only MTU-approved or corresponding products at the specified concentrations may be used for cleaning. The specified cleaning procedure is to be complied with.

Immediately after flushing or cleaning, fill the cooling systems with treated engine coolant as stipulated in the current MTU Fluids and Lubricants Specifications A001061 (→ Page 33).

Fluids and lubricants (e.g. treated engine coolant), used flushing water, cleaning agents and cleaning solutions can be hazardous materials. Certain regulations must be obeyed when handling, storing and disposing of these substances.

These regulations are contained in the manufacturer's instructions, legal requirements and technical guidelines valid in the individual countries. Great differences can apply from country to country so that no generally valid statement on the applicable regulations for fluids and lubricants etc. can be made in this publication.

Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. MTU accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants / cleaning agents which it has approved.

	Scrap oil heat exchangers from engines with bearing or piston seizures or friction damage!

Test equipment, auxiliary materials and fluids and lubricants

MTU test kit or electric pH-value measuring instrument

- Fresh water
- Prepared engine coolant
- Superheated steam
- Compressed air

Approved Cleaning Products

Manufacturer	Product name	Concentration for use		Order No.
For coolant systems:				
Henkel	P3-Neutrasel 5268	2% by volume	Liquid	4)
Henkel	P3-Saxin	2 % by weight	Powder	4)
Novamax	Grision 5716	2 % by weight	Powder	4)
Nalco	Maxi Clean 2	2% by volume	Liquid	40495
For sub-assemblies:				
Henkel	P3-FD1)	3 to 5% by weight	Powder	4)
Henkel	Porodox2)	5 to 10% by weight	Powder	4)
Kluthe	Hakutex 60	100% by volume	Liquid	50602
Novamax	Euron 13083)	5 to 10% by weight	Powder	4)

1) For greasy lime deposits

2) Preferred for heavy lime deposits

3) For heavy lime deposits

4) Not stocked by MTU

Flushing Engine Coolant Systems

Drain engine coolant.

Measure pH-value of the fresh water (MTU test kit or electric pH-value measuring device).

Fill coolant system with fresh water.

- Never pour cold water into a hot engine!

Preheat, start and run engine until warm.

Run engine for approx. 30 minutes at increased speed.

Take flush-water sample (engine-coolant-sample extraction cock).

Shut down engine and drain flush water.

Measure pH-value of the flush-water sample (MTU test kit or electric pH-value measuring device).

If pH-value after flushing is only slightly above pH-value of fresh water, (pH-value difference < 1):
Fill system with treated coolant and start engine.

If pH-value after flushing is still significantly above pH-value of fresh water, (pH-value difference > 1):
Fill system with fresh flush water and repeat flushing process.

If the pH-value after 4 or 5 flushing sequences is still significantly above pH-value of fresh water, (pH-value difference > 1):
Clean coolant system and, if necessary, the components also.

For further information, see Operating Instructions for engine in question.

Cleaning Engine Coolant Systems

Prepare concentrated solution of detergent (for coolant systems) in warm fresh water.

In the case of powdered products, stir until the detergent is completely dissolved and without sediment.

Pour solution together with fresh water into coolant system.

Start engine and run until warm.

Run engine for approx. 2 hours at increased speed.

Shut down engine.

Drain off cleaning agents and flush the engine cooling system with fresh water.

Take flush-water sample (engine-coolant-sample extraction cock).

Measure pH-value of the flush-water sample (MTU test kit or electric pH-value measuring device).

If pH-value after flushing is only slightly above pH-value of fresh water, (pH-value difference < 1):
Fill system with treated coolant and start engine.

If pH-value after flushing is still significantly above pH-value of fresh water, (pH-value difference > 1):
Cleaning components

For further information, see Operating Instructions for engine in question.

Cleaning components

Remove, disassemble and clean components that are exposed to heavy sludge deposits e.g. expansion tanks, preheating units, heat exchangers (coolant cooler, oil heat-exchanger, intercooler, charge-air preheater, fuel preheater etc.) and lower sections of pipework.

Before cleaning, examine degree of contamination on water sides.

If greasy lime deposits are found, first degrease the water side.

Stubborn deposits caused by oil mist in intercoolers can be removed with Kluthe Hakutex 60.

Remove hard lime deposits with a decalcifying product.

In the event of stubborn lime deposits, a 10% inhibited hydrochloric solution may have to be used.
Dissolve deposits on and in heat-exchange elements in a heated cleaning bath.

Use only approved detergents in the permissible concentration.
Always follow the manufacturer's instructions when preparing cleaning baths!

- Deposits on the oil side can also be dissolved in a kerosene bath.
- The period spent in the cleaning bath depends on the type and degree of contamination, as well as the temperature and activity of the bath.

Clean individual components such as housings, covers, pipes, sight glasses, heat-exchanger elements and similar with superheated steam, a nylon brush (soft) and a powerful water jet.

In order to avoid damage:

- Do not use hard or sharp-edged tools (steel brushes, scrapers etc.) (oxide protective layer)
- Do not set the water-jet pressure too high (damage, e.g. to cooling fins)

After cleaning, blow through the heat exchanger elements with low-pressure steam in the direction opposite to operational flow, rinse with clear water (until pH-value difference is < 1) and blow dry with compressed or hot air.

Check that all components are in perfect condition, repair or replace as necessary.

Flush oil and engine coolant sides of heat-exchanger elements with corrosion-inhibiting oil.

- This step may be omitted if the heat exchanger is installed and taken into service immediately after cleaning.

After re-installing all components, flush engine-coolant system once.

Check coolant system for leaks during initial operation of engine.

For further information, see the Maintenance Manual for the engine in question.

Changes to MTU Fluids & Lubricants Specifications A001061/ Version 31 → 32

General section:

Serial No.	Page	Topic	Action	Measure
1	05	Specifications for MTU approval of engine oils	Change	Units for sulfur content in fuel changed from **ppm to mg/kg**
2	06	Engine oils for Series 1800:	Change	**Safety warning revised**
5	06	Restrictions on applications for Series 595, 1163, 8000	Change	**Safety warning revised**
6	06	Warning	Change	**Safety warning relocated** (now immediately after title "Selection of viscosity grades")
7	06	Selection of viscosity grades	Addition	Caption below **Fig. 1** (Page 07)
8	07	Key to Table 3	Change	Use only in connection **with fuel with a sulfur content max. 350 mg/kg**
9	09	Table 4	Addition	Line, Soot: In Limit Values column at max. 3.5% by wt. (Oil Categories 2,3 and **3.1**)
10	09	Table 4	Deletion	Line **Oxidation** (Page 10) Line **Nitration** (Page 10)
11	10	Table 5	Deletion	Line, Nitration: In Test Method column **DIN 51453**
12	10	Table 5	Change	Line, Nitration: In Limit Values column max. **20** A/cm
13	11	High melting-point greases	Change /addition	…**high-temperature grease (up to 250 °C)** must be used
14	12	Greases for coupling internal centerings	Addition	Esso Unirex N3 **(stable up to approx. 160°C)**
15	13	Coolants for Series 1800	Change	**Safety warning revised**
18	14	Restrictions on use of emulsifiable corrosion-inhibiting oils	Change of title	**Emulsifiable corrosion-inhibiting oils must not be used with the following Series**
19	16	Table 6 Water-soluble corrosion-inhibitors	Change	**Deleted** from concentration range **9-11% by vol.** • Atreco Havoline Extended Life … • Chevron Texaco Extended Life … • Caltex XL Corrosion Inhibitor… **Added** to concentration range **7-11% by vol** • Atreco Havoline Extended Life … • Chevron Texaco Extended Life … • Caltex XL Corrosion Inhibitor…
20	16	Table 6 Water-soluble corrosion-inhibitors	Change	All **Ondeo Nalco products** renamed **Nalco**
21	17	Table 7	Addition: New col.	**Column 4** Column title: **Product**
22	17	Table 7	Addition	In Line 2 column 4: **Nalco Alfloc 3477**

Serial No.	Page	Topic	Action	Measure
	17	Table 7	Addition	**Line 6**
23	17	Table 7	Addition	In Line 6: Column 1:**3.5** Column 2:**2.6** Column 3:**4.9** Column 4:**1.75** Column 5: **7% by vol.**
24	17	Table 7	Addition	Values in column 4: Line 7: **2.0** Line 8: **2.25** Line 9: **2.5** Line 10: **2.75** Line 11: **3.0**
25	19	Table 10	Change	All **Ondeo Nalco** products renamed **Nalco**
26	22	Table 11	Addition	Line: Sulfur: **Added** in Test Method column ASTM **D5453** / ISO **EN20846**
27	22	Table 11	Addition	Line: Lubricity **Added** in Test Method column ASTM **D6079**
28	22	Table 11	Change	Line: Lubricity 0.46 mm changed to **460 µm**
29	23	Distillate fuels	Change	Grade Nr.1-D **(S15, S500, S5000)** ASTM D 975-**06** Grade Nr.2-D **(S15, S500, S5000)** ASTM D 975-**06**
30	23	Distillate fuels	Addition	**Safety warning**
31	23	Marine distillate	Addition	DMA as per ISO 8217 • **Series 4000: Approved for specific projects only**
32	23	Biodiesel	Change	Fatty acid methyl ester
33	23	Biodiesel	Change	Ether to ester
34	25	Low-sulfur diesel fuels	Change	Units for sulfur content in fuel changed from **ppm** to **mg/kg** (Page 25)
35	26	Heating oil EL	Addition	differs … because of the following characteristics: **- Lubricity** (Page 26)
36	27	Microorganisms in fuel	Addition	**Overconcentration must always be avoided.**
37	27	Microorganisms in fuel	Addition	**For prophylactic use, the appropriate concentration must be identified in consultation with the relevant manufacturer.**
38	28	Table 14	Deletion	Line: Sewage gas Zeile: Landfill gas

Serial No.	Page	Topic	Action	Measure
39	28	Table 15	Deletion	Line: Setting, gas pressure, entry gas train Line: Entry, gas mixer
			Change	Line: Entry Tecjet: Column: Limit value: **80 - 100** Remarks column: … **Lower gas pressures on enquiry**
			Change	Line: Oil vapors (…): Limit value column: **<** 0.4
	29		Deletion / Change	Line: Dust <3 µm: Limit value column: **Analysis** deleted Remarks column: If available. Consultation with MTU.
	29		Change	Line: Total sulfur Limit value column: **150** Remarks column: Consultation with MTU
			Deletion	Line: H_2S Line: Chlorine Line Fluorine Line: Chlorine + Fluorine Line NH_3
40	31	Types of preservation	Change	…Chapter **8**
41	53	General	Addition	*Fluids and Lubricants for Hydrostatic Drive Systems (fans, generator drive)* Only approved engine oils as listed below may be used as operating fluids in the hydraulic system. *Fluids and Lubricants for Transmissions* Mechanical manual shift transmissions from ZF Co. Friedrichshafen: The current, permissible fluids and lubricants for ZF transmissions can be downloaded free-of-charge from the following Internet address: “www.ZF.com“ Menüpunkt Service / Technische Information / ZF Schmierstoffliste / Sprache auswählen / TE-ML16. Voith hydrodynamic transmission: The current, permissible fluids and lubricants for Voith transmissions can be downloaded free-of-charge from the following Internet address: „www.Voithturbo.com“ Menüpunkt Produkte & Anwendungen / Schiene / Hydrodynamische Antriebe / Druckschriften / (Titel) Datenblatt - (Marktbereich) Hydrodynamische Antriebe / Kraftübertragungsöle für Turbogetriebe

Serial No.	Page	Topic	Action	Measure
42	69	Preservation of Cooling, Lubrication and Fuel Systems	Change	Fill the cooling system with coolant consisting of **3**% emulsifiable corrosion-inhibiting oil and water **or 10% BASF Glysacorr P113 and water**
43	69	Preservation of Cooling, Lubrication and Fuel Systems	Deletion	Reference to → Page 33
44	69	Preservation of Cooling and Lubrication Systems	Change	Fill the cooling system with coolant consisting of **3**% emulsifiable corrosion-inhibiting oil and water **or 10% BASF Glysacorr P113 and water**
45	69	Preservation of Cooling and Lubrication Systems	Deletion	Reference to → Page 33

Approved Fluids and Lubricants:

Serial No.	Page	Topic	Action	Manufacturer	Brand
1	From 33	Single-grade Oils - Category 1	Change	**Old:** Chevron Texaco **New:** Chevron	
2		Single-grade Oils - Category 1	Deletion	Chevron	Texaco Ursa LA
3	From 35	Multi-grade Oils - Category 1	Change	**Old:** Chevron Texaco **New:** Chevron	
4		Multi-grade Oils - Category 1	Addition	Fuchs	Titan Universal HD: Addition: SAE-viscosity grade **15W-40**
5		Multi-grade Oils - Category 1		Beijing Petroleum	You Ya Wong
6			Addition	Shell Tongyi (Beijing) Petroleum Chemical Co. Ltd.	You Ya Wong
7	From 37	Single-grade Oils - Category 2	Change	**Old:** Chevron Texaco **New:** Chevron	
8		Single-grade Oils - Category 2	Deletion	Chevron	Caltex Delo SHP
9		Single-grade Oils - Category 2	Change	**Old:** Chevron Texaco -Lyteca- **New:** Chevron -Lyteca-	
10	From 37	Single-grade Oils - Category 2	Addition	Paz Lubricants & Chemicals	Pazl Marine S 40
11			Change	Exxon Mobil	Mobil Delvac 1630 **approved for Series 8000**
12				Shell	Shell Sirius X **approved for Series 8000**
13	From 39	Multi-grade Oils - Category 2	Addition	BP plc.	BP Vanellus C7 Global
14				Castrol Ltd.	Castrol Tection Plus
15				ENI	Agip Sigma Truck
16				Exxon Mobil	Mobil Delvac XHP (10W-40)
17				Igol, France	Protruck 100 X (10W-40) Protruck 100 X (15W-40)
18				Italiana Petroli	IP Tarus Turbo IP Turbo Plus
19				Prista Oil Ltd.	Prista Turbo Diesel
20				Shell	Shell Rimula X
21				Sinopec	Great Wall Century supreme
22				SRS Schmierstoff Vertriebs GmbH	Wintershall Multi-Rekord top
23			Change	**Old:** Chevron Texaco **New:** Chevron	
24	From 43	Multi-grade Oils - Category 3	Change	**Old:** Chevron Texaco **New:** Chevron	
25		Multi-grade Oils - Category 3	Change	Chevron	**Texaco** Ursa Premium FE **Texaco** Ursa Super TDX

Serial No.	Page	Topic	Action	Manufacturer	Brand
26	ab 43	Multi-grade Oils - Category 3	Addition	Cepsa	Cepsa Eurotech LS
27				Chevron Texaco	Caltex Delo XLD Multigrade
28		Multi-grade Oils - Category 3	Addition	Kuwait Petroleum	Q8 T 905
29				Prista Oil AD	Prista UHPD
30				SRS Schmierstoff Vertriebs GmbH	Wintershall TFF Wintershall TLA
31		Multi-grade Oils - Category 3	Deletion	Meguin	Megol Motorenöl Super LL Dimo Megol Motorenöl Diesel Truck Performance
32		Multi-grade Oils - Category 3	Change	Ginouves	York 847 **10W-40**
33				Yacco	TBN **8-10mgKOH/g**
34				Ravensberger Schmierstoffvertrieb GmbH	Ravenol Performance Truck (10W-40) Ravenol Super Performance Truck **(5W-40)**
35	46	Multi-grade Oils - Category 3.1	Change	**Old:** Chevron Texaco **New:** Chevron	
36		Multi-grade Oils - Category 3.1	Deletion	Chevron	Caltex Delo XLD Multigrade
37				Cepsa Lubricants	Cepsa Eurotech LS
38				SRS Schmierstoff Vertrieb GmbH	Wintershall TLA
39	ab 47	Corrosion-inhibiting Antifreeze Concentrates	Addition	Arteco	Freecor SPC **[EU Code 502247]**
40		Corrosion-inhibiting Antifreeze Concentrates	Change	Deutsch BP	Aral Antifreeze **SF** Castrol Antifreeze **SF**
41				MOL-Lub	EVOX Extra **G**48 Antifreeze concentrate
42	47	Corrosion-inhibiting Antifreeze Concentrates	Deletion	**Old:** Ineos C2272 **New:** Ineos	
43	ab 49	Corrosion-inhibiting Antifreeze Concentrates for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset Engines	Change	**Old:** Chevron Texaco **New:** Chevron	

Serial No.	Page	Topic	Action	Manufacturer	Brand
44		Corrosion-inhibiting Antifreeze Concentrates for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset engines	Addition	OAO Technoform	Cool Stream C (Runtime): 9000 / 3
45	49	Corrosion-inhibiting Antifreeze Ready Mixes for light-alloy-free Series 2000 C&I and Series 4000 C&I/Genset engines	Change	**Old:** Chevron Texaco **New:** Chevron	
46	51	Corrosion-inhibiting Oils for Internal Preservation of the Cooling System	Addition	BASF	Brand column: Glysacorr P113 Remarks column: 10%
47	53	Approved Fluids and Lubricants, Series 1800 PowerPack	**Addition: Chapter 7 complete**		