



# Fluids and Lubricants Specifications

Diesel engine-generator sets  
with **Series 2000 and 4000 MTU engines**

A001064/10E



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# 1 Preface

## 1.1 General information

### Definition of MTU

MTU refers to Rolls-Royce Power Systems AG and MTU Friedrichshafen GmbH or an affiliated company pursuant to Section §15 AktG (German Stock Corporation Act) or a controlled company (joint venture).

### Used symbols and means of representation

The following instructions are highlighted in the text and must be observed:

#### Important

This field contains product information which is important or useful for the user. It refers to instructions, work and activities that have to be observed to prevent damage or destruction to the material.

#### Note:

A note provides special instructions that must be observed when performing a task.

### Fluids and lubricants

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.

| Test standard | Designation                                |
|---------------|--|
| DIN           | Federal German Standards Institute         |
| EN            | European Standards                         |
| ISO           | International Standards Organization       |
| ASTM          | American Society for Testing and Materials |
| IP            | Institute of Petroleum                     |

### Applicability of this document

These Fluids and Lubricants Specifications apply to fluids and lubricants for diesel engine-generator sets with the following engines:

- Series 2000Gx5
- Series 2000Gx6
- Series 4000Gx3, application groups 3B, 3D, 3E, 3F, 3G
- Series 4000Gx4

Note: Please ignore references to other series in this document.

### Up-to-dateness of this document

The Fluids and Lubricants Specifications are revised or supplemented as required. Before using them, make sure you have the latest version (publication number A001064/..). The latest version is available at: <http://www.mtu-solutions.com>.

### Warranty

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 worldwide standard quality of the named products.

#### Important

Fluids and lubricants for diesel engine-generator sets can 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.

MTU recommends consultation with the suppliers of all fluids and lubricants to request the relevant safety data sheets prior to storing, handling and using these fluids and lubricants.

## Safe disposal

#### Important

To prevent environmental pollution and infringements of statutory requirements, used fluids and lubricants must be disposed of in accordance with local regulations.  
Never dispose of or burn the used oil in the fuel tank.

The regulations for the disposal of fluids and lubricants differs from place to place. Environmental protection is one of the fundamental corporate objectives of MTU. We therefore recommend the recycling of fluids and lubricants wherever possible. If recycling is not available, MTU recommends contacting the local waste disposal authority, before dispose any fluids and lubricants to determine the best option. 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.

## Registered trademarks

All brand names are registered trademarks of the manufacturer concerned.

## Preservation

The document "Preservation and Re-preservation Specifications" (publication number A001070/..) contains all information on:

- Preservation
- Re-preservation and de-preservation
- Permissible preservatives

The latest version is available at: <http://www.mtu-solutions.com>.

## 2 Lubricants

### 2.1 Engine oils – General information

#### Important

Dispose of used fluids and lubricants in accordance with local regulations.  
Used oil must never be disposed of via the combustion engine!

#### Engine oil requirements for MTU approval

The conditions of MTU for the approval of engine oils for diesel engines are defined in the delivery standards and available under these numbers:

- MTL 5044: Engine oils for diesel engines; Requirements
- MTL 5051: Initial operation and corrosion inhibitor oil for internal preservation of engines

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

Approved diesel engine oils are divided into the following quality groups:

- Oil category 1: Standard quality / Single and multigrade oils
- Oil category 2: Higher quality / Single and multigrade oils
- Oil category 2.1: Multigrade oils with a low ash-forming additive content (low SAPS 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 are oils with a low sulfur and phosphor content and an ash-forming additive content of  $\leq 1\%$ .

They are only approved if the sulfur content in the fuel does not exceed 50 mg/kg. When using diesel particulate filters, it is advisable to use these oils to avoid fast coating of the filter with ash particles.

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.

#### Important

The use of engine oils not approved by MTU can mean that statutory emission limits can no longer be observed. This can be a punishable offense.

#### Important

Mixing different engine oils is strictly prohibited!

Changing to another oil grade can be done together with an oil change. The remaining oil quantity in the engine oil system is not critical in this regard.

This procedure also applies to MTU's own engine oils in the regions Europe, Middle East, Africa, America and Asia.

#### Important

When changing to an engine oil in Category 3, note that the improved cleaning effect of these engine oils can result in the loosening of engine contaminants (e.g. carbon deposits).

It may be necessary therefore to reduce the oil change interval and oil filter service life (one time during change).

#### Special features

##### MTU engine oils for diesel engines

At MTU, the following single and multigrade oils are available in the individual regions:

| Manufacturer & sales region                            | Product name  | SAE grade | Oil category | Part No.  |
|--|---|-----------|--------------|---|
| MTU Friedrichshafen<br>Europe<br>Middle East<br>Africa | Diesel Engine Oil DEO COM(enhanced corrosion protection)        | 30        | 2            | 20 l canister: X00078581<br>210 l barrel: X00078580<br>IBC: X00078579   |
|  | Diesel Engine Oil DEO SAE 10W-40(enhanced corrosion protection) | 10W-40    | 3.1          | 20 l canister: X00078578<br>210 l barrel: X00078577<br>IBC: X00078576   |
|  | Diesel Engine Oil DEO SAE 15W-40                                | 15W-40    | 2            | 20 l canister: X00070830<br>210 l barrel: X00070832<br>IBC: X00070833<br>Loose items: X00070835 (only on request) |
|  | Power Guard® DEO SAE 40   | 40        | 2            | 20 l canister: X00062816<br>210 l barrel: X00062817<br>IBC: X00064829   |
| MTU America<br>America                                 | Power Guard® SAE 15W-40 Off Highway Heavy Duty                  | 15W-40    | 2.1          | 5 gallons: 800133<br>55 gallons: 800134<br>IBC: 800135  |
|  | Power Guard® SAE 40 Off Highway Heavy Duty                      | 40        | 2            | 5 gallons: 23532941<br>55 gallons: 23532942   |
| MTU Asia<br>Asia                                       | Diesel Engine Oil DEO SAE 15-W40                                | 15W-40    | 2            | 18 l canister: 64247/P<br>200 l barrel: 65151/D   |
| MTU Asia<br>China                                      | Diesel Engine Oil - DEO 15W-40                                  | 15W-40    | 2            | 20 l canister: 64242/P<br>205 l barrel: 65151/D   |
|  | Diesel Engine Oil - DEO 10W-40                                  | 10W-40    | 2            | 20 l canister: 60606/P  |
|  | Diesel Engine Oil - DEO 5W-30                                   | 5W-30     | 3            | 20 l canister: 60808/P  |
| MTU Asia<br>Indonesia                                  | Diesel Engine Oil - DEO 15W-40                                  | 15W-40    | 2            | 20 l canister: 64242/P<br>205 l barrel: 65151/D   |
| MTU India Pvt. Ltd.<br>India                           | Diesel Engine Oil - DEO 15W-40                                  | 15W-40    | 2            | 20 l canister: 63333/P<br>205 l barrel: 65151/P   |
|  | Diesel Engine Oil - DEO 40                                      | 40        | 2            | 20 l canister: 73333/P<br>205 l barrel: 75151/D   |

### Restrictions for certain applications

- Series 2000 Gx6
- Series 4000 Gx3, application groups 3F, 3G

#### Important

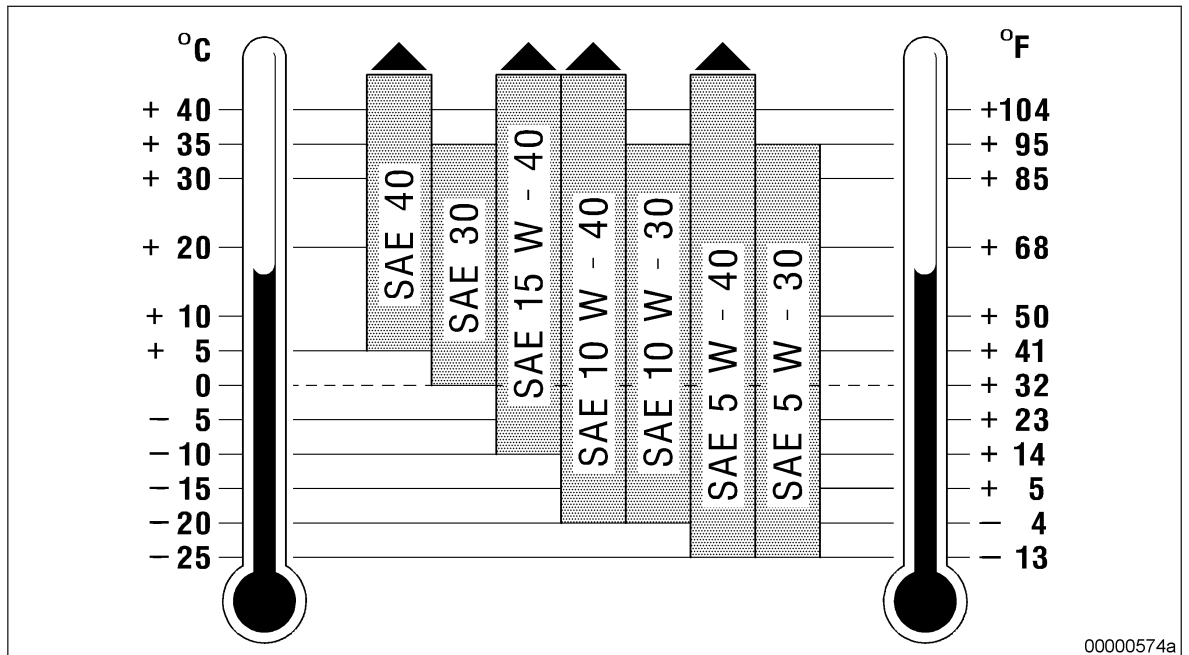
Oils in oil category 1 must not be used!

### 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. Guide values for the temperature limits of the individual viscosity classes, see (→ Figure 1).

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





00000574a

Figure 1: Viscosity grade chart

## 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 are guide values based on operational experience and are valid for applications with a standard load profile.

## Oil change intervals

| Oil category      | Without centrifugal oil filter | With centrifugal oil filter or by-pass filter |
|-------------------|--------------------------------|---|
| 1                 | 250 operating hours            | 500 operating hours                           |
| 2                 | 500 operating hours            | 1000 operating hours                          |
| 2.1 <sup>1)</sup> | 500 operating hours            | 1000 operating hours                          |
| 3                 | 750 operating hours            | 1500 operating hours                          |
| 3.1 <sup>1)</sup> | 750 operating hours            | 1500 operating hours                          |

Table 1:

<sup>1)</sup> = To be used in conjunction with fuels with max. 50 mg/kg sulfur content.

### Important

The oil change intervals in the table (→ Table 1) are recommended guide values when using diesel fuels with < 0.5 % sulfur content. The defined limit values for the used oil (→ Table 2) must be observed. The numbers of operating hours quoted for oils must be confirmed by means of oil analysis.

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

- Extreme climatic conditions
- High engine startup frequency
- Frequent and prolonged idling or low-load operation
- High fuel sulfur content of 0.5 to 1.5% by weight (see "Use of High-Sulfur Fuel")

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 13), 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 samples are to be analyzed at specific intervals (see "Laboratory Analysis").
- 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).

## 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

### 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.

Analyses of the wear-metal content to determine the degree of engine wear are not part of the standard procedure. 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.

The measurement of the wear-metal element contents can only be regarded as a monitoring task. A sudden increase is an indication to check/inspect the oil filter. If wear particles are found, and EDX analysis can determine their composition, which helps to identify the affected component.

### 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 specified test methods and limit values (Analytical Limit Values for Used Diesel Engine Oils) (→ Table 2) 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 used diesel engine oils

| Characteristics of the engine oil              | Test method                              | Limit values   |
|--|--|--|
| Viscosity at 100 °C<br>max. mm <sup>2</sup> /s | ASTM D445<br>DIN 51562<br>DIN 51569-1    | SAE 30<br>SAE 5W-30<br>SAE 10W-30  |
|  |  | SAE 40<br>SAE 5W-40<br>SAE 10W-40<br>SAE 15W-40<br>SAE 20W-40                |
| min. mm <sup>2</sup> /s                        |  | SAE 30<br>SAE 5W-30<br>SAE 10W-30  |
|  |  | SAE 40<br>SAE 5W-40<br>SAE 10W-40<br>SAE 15W-40<br>SAE 20W-40                |
| Flashpoint °C (COC)                            | ASTM D92<br>DIN EN ISO 2592              | Min. 190   |
| Flashpoint °C (PM)                             | ASTM D93<br>DIN EN ISO 2719              | min. 140   |
| Soot content (by weight %)                     | DIN 51452<br>CEC-L-82-97                 | Max. 3.0 (Oil category 1)<br>Max. 3.5 (Oil category 2, 2.1, 3 and 3.1)       |
| Total base number<br>(mg KOH/g)                | ASTM D2896<br>ISO 3771<br>DIN 51639      | Min. 50% of new-oil value  |
| Proportion of water (vol. %)                   | ASTM D6304<br>EN 12937<br>ISO 6296       | max. 0.2   |
| Oxidation (A/cm) <sup>1)</sup>                 | DIN 51453 <sup>1)</sup>                  | Max. 25  |
| Ethylene glycol (mg/kg)                        | ASTM D2982                               | max. 100   |
| Additive element contents                      | DIN 51399-1<br>DIN 51399-2<br>ASTM D5158 | To confirm that the new oil is identical with the oil grade of the used oils |

Table 2:

<sup>1)</sup> = only possible if there are no ester compounds

### 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) of more than 8 mgKOH/g
- Shorten oil draining intervals (see oil change intervals)
- Series 4000: TBO (Time Between Overhaul) for cylinder head: Shorten time between overhauls (→ Page 35)

Figure (→ Figure 2) shows the recommended minimum total base numbers for new and used oils depending on the sulfur content of the diesel fuel.

For the total base numbers (TBN) of the approved engine oil, see (→ Page 13).

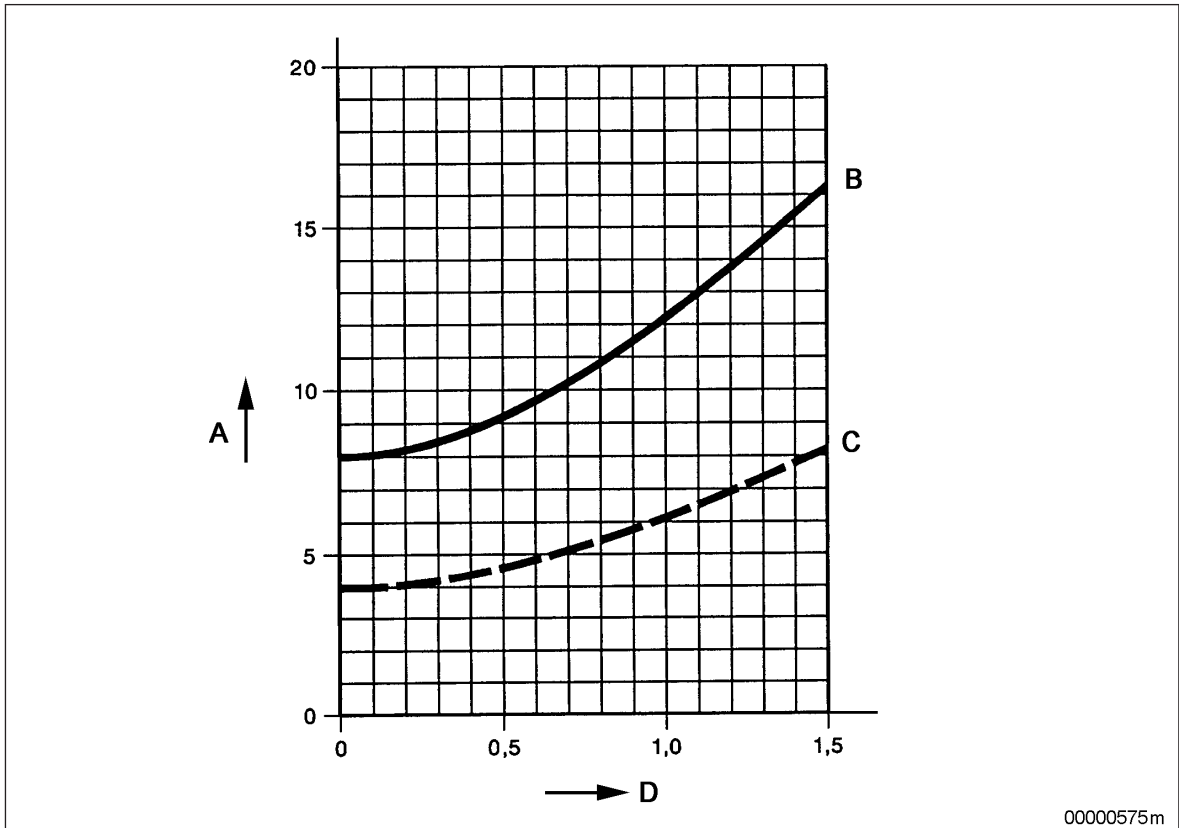


Figure 2: Engine oil Total Base Numbers depending on the Diesel Fuel's Sulfur Content

- |   |  |
|---|--|
| A Total base number in mgKOH/g, ISO 3771              | C Minimum total base number for used oil |
| B Recommended minimum total base number for fresh oil | D Sulfur content of fuel in % weight     |

### 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 oil
- Determination of water content in oil

### Test Package for North America

The MTU Advanced Fluid Management System is available in North America, which contributes to preventive maintenance through innovative diagnostics.

For the MTU Advanced Fluid Management System for engine oils, see (→ Page 16).

## 2.2 Series-based usability for engine oils

### Series-based usability of engine oils by the oil categories

| Series                                 | Approved engine oils   |  |   |
|--|--|--|---|
|  | Oil category 1   | Oil category 2 and 2.1 (Low SAPS)  | Oil category 3 and 3.1 (Low SAPS)   |
| 2000Gx5                                | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 67)</li> <li>• Multigrade oils (→ Page 69)</li> </ul> | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 70)</li> <li>• Multigrade oils (→ Page 73)</li> <li>• Multigrade oils (Low SAPS) (→ Page 83)</li> </ul> | <ul style="list-style-type: none"> <li>• Multigrade oils (→ Page 87)</li> <li>• Multigrade oils (Low SAPS) (→ Page 92)</li> </ul> |
| 2000Gx6                                | Not approved   | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 70)</li> <li>• Multigrade oils (→ Page 73)</li> <li>• Multigrade oils (Low SAPS) (→ Page 83)</li> </ul> | <ul style="list-style-type: none"> <li>• Multigrade oils (→ Page 87)</li> <li>• Multigrade oils (Low SAPS) (→ Page 92)</li> </ul> |
| 4000Gx3, application groups 3B, 3D, 3E | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 67)</li> <li>• Multigrade oils (→ Page 69)</li> </ul> | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 70)</li> <li>• Multigrade oils (→ Page 73)</li> <li>• Multigrade oils (Low SAPS) (→ Page 83)</li> </ul> | <ul style="list-style-type: none"> <li>• Multigrade oils (→ Page 87)</li> <li>• Multigrade oils (Low SAPS) (→ Page 92)</li> </ul> |
| 4000Gx3, application groups 3F, 3G     | Not approved   | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 70)</li> <li>• Multigrade oils (→ Page 73)</li> <li>• Multigrade oils (Low SAPS) (→ Page 83)</li> </ul> | <ul style="list-style-type: none"> <li>• Multigrade oils (→ Page 87)</li> <li>• Multigrade oils (Low SAPS) (→ Page 92)</li> </ul> |
| 4000Gx4                                | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 67)</li> <li>• Multigrade oils (→ Page 69)</li> </ul> | <ul style="list-style-type: none"> <li>• Single-grade oils (→ Page 70)</li> <li>• Multigrade oils (→ Page 73)</li> <li>• Multigrade oils (Low SAPS) (→ Page 83)</li> </ul> | <ul style="list-style-type: none"> <li>• Multigrade oils (→ Page 87)</li> <li>• Multigrade oils (Low SAPS) (→ Page 92)</li> </ul> |

## 2.3 Fluorescent dyestuffs for detecting leaks in the lube oil circuit

The fluorescent dyestuffs listed below are approved for detection of leaks in the lube oil circuit.

| Manufacturer           | Product name                               | Concentration for use | Part No.  | Container size                              | Storage stability <sup>1)</sup> |
|------------------------|--|-----------------------|-----------|---|---------------------------------|
| Chromatech Europe B.V. | D5 1000A Chromatint Fluorescent Yellow 175 | 0.04 % - 0.07 %       | X00067084 | 16 kg                                       | 2 years                         |
| Cimcool, Cincinnati    | Producto YFD-100                           | 0.5 % - 1.0 %         |           | 5 gallons (canister)<br>55 gallons (barrel) | 6 months                        |

Table 3:

<sup>1)</sup> = ex works delivery, based on original and hermetically sealed containers in frost-free storage (> 5 °C).

The fluorescence (light-yellow color tone) of both dyestuffs is made visible with a UV lamp (365 nm).

## 2.4 Lubricating greases

### Requirements

The conditions of MTU for the approval of lubricating greases are specified in the delivery 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 shutoff flaps fitted between turbocharger and charge-air cooler (see Special-purpose lubricants)
- Coupling internal centering

### Lubricating greases for applications at high temperatures

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

- Aero Shell Grease 15
- Optimol Inertox Medium

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

### Greases for internal centerings of couplings

Greases for internal centerings:

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

## Special-purpose lubricants

### Oil for 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.

### Lubricating greases for curved tooth couplings

Depending on the application, the following lubricants have been approved for curved tooth 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.

## 2.5 MTU Advanced Fluid Management System for engine oils – Test package for North America

A sophisticated system for diagnostics and preventive maintenance is available in North America. This system allows the following:

- Optimized oil change intervals
- Extended engine service life
- Detection of minor problems before they become major problems
- Maximization of diesel engine-generator set's reliability
- Higher resale value of diesel engine-generator set

For full information on the MTU Advanced Fluid Management System available in North America, please contact an authorized MTU service partner.

The following test packages from MTU Advanced Fluid Management System can be ordered from authorized MTU service partners in North America:

- BMP32  
Extended test – monitoring of wear and contamination
- AMP51R  
Extended Test Plus – extension of the oil change intervals

The following engine oil parameters can be determined:

| Engine oil parameters                   | BMP32 | AMP51R |
|---|-------|--------|
| 24 elementary metals *                  | ✓     | ✓      |
| percent water *                         | ✓     | ✓      |
| Viscosity at 40 °C for ISO engine oils  | ✓     | ✓      |
| Viscosity at 100 °C for SAE engine oils | ✓     | ✓      |
| Percent fuel dilution **                | ✓     | ✓      |
| Percent soot **                         | ✓     | ✓      |
| Oxidation/nitration                     | -     | ✓      |
| Total base number **                    | -     | ✓      |
| Total acid number                       | -     | ✓      |

\* Samples of non-engine oils submitted with Order No. BMP32, are only examined spectrometrically for metals and the proportion of water and viscosity are determined.

\*\* Samples of non-engine oils submitted with Order No. AMP51R are not examined for fuel dilution, soot content and base number.

The MTU Advanced Fluid Management System with trend analysis provides information for maximizing system reliability. The following guidelines must be followed to obtain the best results.

### Samples must be taken:

- While the engine is operating under normal conditions or immediately after stopping the engine while the engine is still at operating temperature
- Every 250 hours at the same point
- By means of suction pump via dipstick tube or sampling cock in filter return

Note: The software offered by MTU for online reporting with trend analyses shows the procedure for optimizing evaluation of the gathered information after completion of the analysis.

Note: The MTU Advanced Fluid Management System works together with independent test laboratories accredited according to ISO 17025 A2LA. This accreditation is the highest level of quality obtainable by a test laboratory in North America.



# 3 Coolants

## 3.1 Coolants – General information

### Coolant

#### Definition

Coolant = coolant additive (concentrate) + fresh water to predefined mixing ratio  
Ready for use in engine

The corrosion-inhibiting effect of coolant is only ensured with the coolant circuit fully filled.

Apart from that, only the corrosion inhibitors approved for internal preservation of the coolant circuit provide proper corrosion protection when the medium was drained. This means that after draining the coolant the cooling circuit must be preserved if no more coolant is to be filled. The procedure is described in the Preservation and Represervation Specifications (publication number A001070/..).

Coolants must be prepared from suitable fresh water and a coolant additive approved by MTU. Conditioning of the coolant takes place outside the engine.

#### Important

Mixtures of various coolant additives and supplementary additives (also in coolant filters and filters downstream of plant components) are not permitted!

The conditions for the approval of coolant additives are specified in the following delivery standards (MTL):

- MTL 5048: Corrosion inhibiting antifreeze
- MTL 5049: Water-soluble corrosion inhibitor

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

#### To prevent cooling system damage:

- When topping up (following loss of coolant) it must be ensured that not only water but also concentrate is added. The specified antifreeze and/or corrosion inhibitor concentration must be maintained.
- Flushing with water is required at every change to a different coolant product. For flushing and cleaning specifications for engine coolant circuits, see (→ Page 121).
- The corrosion inhibitor concentration must not exceed 55 % by volume (max. antifreeze) corrosion inhibitor. Concentrations in excess of this reduce antifreeze protection and heat dissipation. Only exception: BASF G206 (special application)
- The coolant must not contain any oil or copper residue (in solid or dissolved form).
- The majority of corrosion inhibitors currently approved for internal coolant circuit preservation are water-soluble and do not provide antifreeze protection. Make sure that the engine is stored safe from frost, because a certain amount of coolant remains in the engine after draining.
- A coolant circuit can not usually be drained completely, i.e. residual quantities of used coolant or fresh water from a flushing procedure remain in the engine. These residual quantities can result in the dilution of a coolant to be filled (mixed from a concentrate or use of a ready mixture). This dilution effect is higher the more add-on components there are on the engine. Check the coolant concentration in the coolant circuit and adapt it if necessary.

#### Important

All coolants approved in these Fluids and Lubricants Specifications generally relate only to the coolant circuit of MTU engines. In the case of complete propulsion plants, the operating fluids approvals of the component manufacturer must be observed!

#### Important

For corrosion-related reasons, it is not permissible to operate an engine with pure water without the addition of an approved corrosion inhibitor!

## Special features

### MTU coolants

The following coolant additives are available from MTU:

| Manufacturer & sales region   | Product name                                   | Part No.  |
|---|--|---|
| MTU Friedrichshafen,<br>MTU Asia<br>Europe<br>Middle East<br>Africa<br>Asia | <b>Antifreeze</b>                              |   |
|   | Coolant AH 100 Antifreeze Concentrate          | X00057231 (20 l)<br>X00057230 (210 l)<br>X00068202 (1000 l)                                   |
|   | Coolant AH 50/50 Antifreeze Premix             | X00070528 (20 l)<br>X00070530 (210 l)<br>X00700527 (1000 l)<br>(sales region: England)        |
|   | Coolant AH 40/60 Antifreeze Premix             | X00070533 (20 l)<br>X00070531 (210 l)<br>X00700532 (1000 l)<br>(sales region: England, Spain) |
|   | Coolant AH 35/65 Antifreeze Premix             | X00069382 (20 l)<br>X00069383 (210 l)<br>X00069384 (1000 l)<br>(sales region: Italy)          |
|   | Coolant RM 30 (40%) Antifreeze Premix          | X00073922 (20 l)<br>X00073916 (205 l)<br>X00073923 (1000 l)                                   |
|   | <b>Coolant without antifreeze</b>              |   |
|   | Coolant CS 100 Corrosion Inhibitor Concentrate | X00057233 (20 l)<br>X00057232 (210 l)<br>X00070455 (1000 l)                                   |
|   | Coolant CS 10/90 Corrosion Inhibitor Premix    | X00069385 (20 l)<br>X00069386 (210 l)<br>X00069387 (1000 l)<br>(sales region: Italy)          |
|   | MTU America<br>America                         | <b>Antifreeze</b>   |
| Power Cool <sup>®</sup> Off-Highway Coolant 50/50 Premix                    |  | 23533531 (5 gallons)<br>23533532 (55 gallons)   |
| Power Cool <sup>®</sup> Universal 50/50 mix                                 |  | 800069 (1 gallon)<br>800071 (5 gallons)<br>800084 (55 gallons)                                |
| Power Cool <sup>®</sup> Universal 35/65 mix                                 |  | 800085 (5 gallons)<br>800086 (55 gallons)   |
| Power Cool <sup>®</sup> 3149 Concentrate                                    |  | 23528572 (55 gallons)<br>23528571 (1000 l)  |
| <b>Coolant without antifreeze</b>   |  |   |
| Power Cool <sup>®</sup> Plus 6000 Concentrate                               |  | 23533526 (1 gallon)<br>23533527 (5 gallons)<br>colored green                                  |

### Note

For ready mixtures, the proportion of coolant additive (concentrate) is always named first.

Example:

- Coolant AH 40/60 Antifreeze Premix = 40 % coolant additive by volume / 60 % fresh water by volume

## 3.2 Operational monitoring

Inspection of the fresh water and continuous monitoring of the coolant are essential for trouble-free engine operation. Fresh water 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
- Determination of antifreeze content
- Determination of the concentration of coolant without antifreeze

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

### Important information

In the 4000-04-05 Series, an additional exhaust gas cooler is installed and the cooling system reacts more sensitively. A regular check of the coolant is therefore very important to ensure trouble-free engine operation. This check must be carried out annually or after 3000 operating hours and every time the coolant is filled.

The concentration, pH value and silicon content (only with coolant that contain Si) must be within the values specified in these Fluids and Lubricants Specifications.

### Important information

Due to thermal stress of the coolant in plants with preheating, a semi-annual analysis of the coolant is recommended.

### Permissible concentrations

|  | Minimum   |               |               |               | Maximum       |
|--|---|---------------|---------------|---------------|---------------|
| Emulsifiable corrosion inhibitor oils without antifreeze | 1% by volume  | -             | -             | -             | 2% by volume  |
| Antifreeze on ethylene glycol basis                      | 35% by volume   | 40% by volume | 45% by volume | 50% by volume | 55% by volume |
| with antifreeze protection up to*                        | -20 °C  | -25 °C        | -31 °C        | -37 °C        | -45 °C        |
| Antifreeze on propylene glycol-basis                     | 35% by volume   | -             | -             | -             | 50% by volume |
| with antifreeze protection up to*                        | -18 °C  | -             | -             | -             | -32 °C        |
| BASF G206  | 65% by volume for application at outside temperatures of up to -65 °C in arctic regions |               |               |               |               |

Table 4:

\* = antifreeze specifications determined as per ASTM D 1177

## Operational monitoring for permissible concentrations, coolant without antifreeze

| Permissible concentration range | Manufacturer                     | Brand name  | Reading on hand refractometer <sup>1</sup> at 20 °C (= degrees Brix) |     |      |     |      |     |
|---------------------------------|----------------------------------|---|--|-----|------|-----|------|-----|
|                                 |                                  |   | % by vol.  | 7   | 8    | 9   | 10   | 11  |
| 9 to 11% by volume              | MTU Friedrichshafen              | Coolant CS 100 Corrosion Inhibitor Concentrate            | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
|                                 |                                  | Coolant CS 10/90 Corrosion Inhibitor Premix               | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
|                                 | MTU America Inc.                 | Power Cool® Plus 6000                                     | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
|                                 | Arteco                           | Freecor NBI   | Please use test kit of manufacturer                                  |     |      |     |      |     |
|                                 | BASF SE                          | Glysacorr G93 green                                       | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
|                                 | CCI Corporation                  | A 216   | 4.9  | 5.6 | 6.3  | 7.0 | 7.7  | 8.4 |
|                                 | CCI Manufacturing IL Corporation | A 216   | 4.9  | 5.6 | 6.3  | 7.0 | 7.7  | 8.4 |
|                                 | Chevron                          | Texcool A -200  | Please use test kit of manufacturer                                  |     |      |     |      |     |
|                                 | Detroit Diesel Corporation       | Power Cool Plus 6000                                      | 4.9  | 5.6 | 6.3  | 7.0 | 7.7  | 8.4 |
|                                 | Drew Marine                      | Drewgard XTA  | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
|                                 | ExxonMobil                       | Mobil Delvac Extended Life Corrosion Inhibitor            | 4.9  | 5.6 | 6.3  | 7.0 | 7.7  | 8.4 |
|                                 | Ginouves                         | York 719  | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
|                                 | Old World Industries Inc.        | Final Charge Extended Life Corrosion Inhibitor (A 216)    | 4.9  | 5.6 | 6.3  | 7.0 | 7.7  | 8.4 |
|                                 | Valvoline                        | Zerex G-93  | 3.5  | 4.0 | 4.5  | 5.0 | 5.5  | 6.0 |
| 7 to 11% by volume              | Arteco                           | Havoline Extended Life Corrosion Inhibitor XLI [EU 32765] | 2.6  | 3.0 | 3.4  | 3.7 | 4.1  | 4.4 |
|                                 | Chevron Lubricants               | Delo XLI Corrosion Inhibitor - Concentrate                | 2.6  | 3.0 | 3.4  | 3.7 | 4.1  | 4.4 |
|                                 | Nalco                            | Alfloc (Maxitreat) 3443                                   | 1.75   | 2.0 | 2.25 | 2.5 | 2.75 | 3.0 |
|                                 |                                  | Alfloc (Maxitreat) 3477                                   | 1.75   | 2.0 | 2.25 | 2.5 | 2.75 | 3.0 |
|                                 | PrixMax Australia Pty. Ltd.      | PrixMax RCP   | 2.6  | 3.0 | 3.4  | 3.7 | 4.1  | 4.4 |
|                                 | Total                            | WT Supra  | 2.6  | 3.0 | 3.4  | 3.7 | 4.1  | 4.4 |
| 5 to 6% by volume               | Detroit Diesel Corporation       | Power Cool 3000   | Please use test kit of manufacturer                                  |     |      |     |      |     |
|                                 | Fleetguard                       | DCA-4L  |  |     |      |     |      |     |
|                                 | Penray                           | Pencool 3000  |  |     |      |     |      |     |

| Permissible concentration range | Manufacturer               | Brand name<br>% by vol. | Reading on hand refractometer <sup>1)</sup> at 20 °C (= degrees Brix) |   |   |    |    |    |
|---------------------------------|----------------------------|-------------------------|---|---|---|----|----|----|
|                                 |                            |                         | 7   | 8 | 9 | 10 | 11 | 12 |
| 3 to 4% by volume               | Detroit Diesel Corporation | Power Cool 2000         | Please use test kit of manufacturer                                   |   |   |    |    |    |
|                                 | ImproChem                  | Cool-C18                |   |   |   |    |    |    |
|                                 | Nalco                      | Alfloc 2000             |   |   |   |    |    |    |
|                                 |                            | Nalco 2000              |   |   |   |    |    |    |
|                                 |                            | Nalcool 2000            |   |   |   |    |    |    |
|                                 |                            | Trac 102                |   |   |   |    |    |    |
|                                 | Penray                     | Pencool 2000            |   |   |   |    |    |    |

Table 5:

<sup>1)</sup> = concentration determination by means of suitable hand refractometer

Calibrate the hand refractometer with clean water at coolant temperature. The coolant temperature should be 20 °C. Observe the specifications of the manufacturer.

### Operational monitoring of permissible concentrations, antifreeze on ethylene glycol basis

The concentration is determined using a suitable glycol refractometer and direct reading of the scale value in % by vol.

### Calibration table for antifreeze for special applications

| Reading on hand refractometer at 20 °C (= degrees Brix) |               | Corresponds to a concentration of |
|---|---------------|-----------------------------------|
| I. Propylene glycol antifreeze                          | II. BASF G206 |                                   |
| 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                     |

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| Reading on hand refractometer at 20 °C (= degrees Brix) |               | Corresponds to a concentration of |
|---|---------------|-----------------------------------|
| I. Propylene glycol antifreeze                          | II. BASF G206 |                                   |
|   | 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                     |

Table 6:

### 3.3 Series-based usability of coolant additives

All details are based on the coolant circuit on the engine side, no allowance is made for external add-on components.

**Important**

In the case of an engine coolant circuit with no light metal elements but with external add-on components containing light metal (e.g. cooling system or preheater), the coolant approvals for cooling systems containing light metal shall apply. If you have any doubts about a coolant application, consult your contact person at MTU.

For details and special information, see section “Coolants” (→ Page 17)

Any deviant special agreements between the customer and MTU remain valid.

| Series             | Cooling system containing light metals | Coolant without antifreeze   |
|--------------------|--|--|
| 2000Gx5<br>2000Gx6 | Yes                                    | <ul style="list-style-type: none"> <li>• Concentrates for cooling systems containing light metal, see (→ Page 99)</li> <li>• Ready mixtures for cooling systems containing light metal, see (→ Page 100)</li> </ul>  |
| 4000Gx3<br>4000Gx4 | No *                                   | <ul style="list-style-type: none"> <li>• Concentrates for cooling systems containing light metal, see (→ Page 101)</li> <li>• Ready mixtures for cooling systems containing light metal, see (→ Page 103)</li> </ul> |

| Series             | Cooling system containing light metals | Antifreeze  |  |
|--------------------|--|---|--|
| 2000Gx5<br>2000Gx6 | Yes                                    | <ul style="list-style-type: none"> <li>• Concentrates for cooling systems containing light metal, see (→ Page 104)</li> <li>• Concentrates for special applications, see (→ Page 107)</li> <li>• Ready mixtures for cooling systems containing light metal, see (→ Page 108)</li> </ul> | <ul style="list-style-type: none"> <li>• Concentrates based on ethylene glycol (suitable for series with and without light metal), see (→ Page 119)</li> </ul>   |
| 4000Gx3<br>4000Gx4 | No *                                   | <ul style="list-style-type: none"> <li>• Concentrates for cooling systems containing light metal, see (→ Page 111)</li> <li>• Concentrates for special applications, see (→ Page 115)</li> <li>• Ready mixtures for cooling systems containing light metal, see (→ Page 116)</li> </ul> | <ul style="list-style-type: none"> <li>• Concentrates based on ethylene glycol (suitable for series with and without light metal), see (→ Page 119)</li> <li>• Ready mixture based on propylene glycol for series free of light metal, see (→ Page 120)</li> </ul> |

\* In the case of an engine coolant circuit with no light metal elements but with external add-on components containing light metal (e.g. cooling system or preheater), the coolant approvals for cooling systems containing light metal shall apply.



## 3.4 Unsuitable materials in the coolant circuit

### Components made of copper, zinc and brass materials

Unless various preconditions are observed, components made of copper, zinc and brass materials in the coolant circuit can cause an electrochemical reaction in conjunction with base metals (e.g. aluminum). As a result, components made of base metals are subject to corrosion or even corrosive pitting. The coolant circuit becomes leaky at these points.

### Requirements

Based on current knowledge, the following materials and coatings must not be used in an engine coolant circuit because negative mutual reactions can occur even with approved coolant additives.

### Metallic materials

- No galvanized surfaces  
The entire cooling system must be free of zinc components. This also applies to coolant supply and drain lines as well as to storage containers
- No copper-based alloys as material with the use of coolant containing nitrite, with the exception of the following two alloys:
  - CuNi10Fe1Mn corresponds to CW-352-H
  - CuNi30Mn1Fe corresponds to CW-354-H
- Do not use components containing brass in the coolant circuit (e.g. coolers made of CuZn30) if exposed to ammoniacal solutions (e.g. amines, ammonium, ...) and solutions containing nitrite or sulfide. Stress-corrosion cracking is possible in the presence of tensile stress and a critical potential area. "Solutions" refer to cleaning agents, coolants and similar substances.

### Non-metallic materials

- Do not use EPDM or silicone elastomers if emulsifiable corrosion inhibitor oils are used or other oils are introduced to the coolant circuit.

### Coolant filter / filter downstream of plant components

- If such filters are used, only products that do not contain additives may be used.  
Supplementary additives such as silicates, nitrites etc. can diminish the protective effect or service life of a coolant and, possibly, attack the materials installed in the coolant circuit.

### Information:

In case of doubt about the use of materials on the engine / add-on components in coolant circuits, consultation with the respective MTU specialist department must be held.

## 3.5 Fresh water requirements

### For preparation of coolant without antifreeze protection

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 exceeded, de-mineralized water can be added to reduce the hardness or mineral content.

| Parameters  | Minimum            | Maximum                                       |
|---|--------------------|---|
| Sum of alkaline earth metals *)<br>(Water hardness) | 0 mmol/l<br>0°d    | 2.7 mmol/l<br>15°d                            |
| pH value at 20 °C                                   | 5.5                | 8,0   |
| Chloride ions                                       |                    | 100 mg/l                                      |
| Sulphate ions                                       |                    | 100 mg/l                                      |
| Anions total  |                    | 200 mg/l                                      |
| Bacteria  |                    | 10 <sup>3</sup> CFU (colony forming unit )/ml |
| Fungi, yeasts                                       | are not permitted! |   |

\*) Common designations for water hardness in various countries:

1 mmol/l = 5.6°d = 100 mg/kg CaCO<sub>3</sub>

- 1°d = 17.9 mg/kg CaCO<sub>3</sub>, USA hardness
- 1°d = 1.79° French hardness
- 1°d = 1.25° English hardness

## 3.6 Antifreezes

The preceding Fluids and Lubricants Specifications used the designation "Corrosion inhibiting antifreeze". This designation will be replaced with immediate effect to "Antifreeze".

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

Most of the antifreezes approved at MTU are based on ethylene glycol.

Exceptions:

- Ready mixture Fleetguard PG XL based on propylene glycol (→ Page 120)
- Concentrate BASF G206 as a mixture of ethylene glycol and propylene glycol

Provided that they are used in approved concentrations, antifreezes approved by MTU provide effective protection against corrosion, see Operational monitoring (→ Page 20).

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

### Important

For the coolant additives approved for the individual series, see (→ Page 24).

Special approvals presently in effect remain valid.

### Important

Coolant additives containing nitrite must not be used in conjunction with coolers that contain brass!

### Note:

- Propylene glycol-based 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.
- The product BASF G206 is available for use at extremely low temperatures (< -40 °C).
- Flushing with water is required at every change to a different coolant product. For flushing and cleaning specifications for engine coolant circuits, see (→ Page 121).

## 3.7 Coolant without antifreeze

The preceding Fluids and Lubricants Specifications used the designation "water-soluble corrosion inhibiting antifreeze". This designation will be replaced with immediate effect with "coolant without antifreeze".

Engine coolant without antifreeze is required in the case of higher coolant temperatures or larger temperature gradients in heat exchangers, e.g. in TB systems (with plate-core heat exchanger) and TE systems.

Provided that they are used in adequate concentration, coolants without antifreeze approved by MTU provide effective corrosion protection. The relevant concentration range for use is listed in the section on operational monitoring.

### Important

For approved coolant additives for the individual engine series, refer to section "Approved coolants" (→ Page 24).

Special arrangements presently in effect remain valid.

### Important

Coolant additives containing nitrite must not be used in conjunction with coolers that contain brass!

Flushing with water is required at every change to a different coolant product. For preserved engines (new engines, field engines, reserve stock engines, etc.), a flushing run must be carried out prior to filling with engine coolant if the engines were preserved with an emulsifiable corrosion inhibitor. The necessary work is described in the section "Flushing and cleaning specifications for engine coolant circuits" (→ Page 121).

## 3.8 Emulsifiable corrosion-inhibiting oils

**Emulsifiable corrosion-inhibiting oils must not be used with the following Series:**

- Series 2000
- Series 4000

Special approval presently in effect remain valid.

### 3.9 Limit values for coolants

| pH value when using:  |              |           |
|---|--------------|-----------|
| - Emulsifiable corrosion inhibiting oil                         | Min. 7.5     | Max. 9.5  |
| - Antifreeze  | Min. 7.5     | Max. 9.0  |
| - Coolant without antifreeze for engines containing light metal | Min. 7.5     | Max. 9.0  |
| - Coolant without antifreeze for engines free of light metal    | Min. 7.5     | Max. 11.0 |
| Silicon (valid for coolants containing Si)                      | Min. 25 mg/l |           |

*Table 7:*

The coolant must be changed in case of non-compliance with the above specifications.

**Note:**

For a holistic appraisal of a coolant function, apart from the above-mentioned limit values the respective coolant-specific characteristic data and the fresh water quality used must be taken into consideration.

### 3.10 Storage capability of coolant concentrates

The storage capability specifications refer to coolant concentrates in original, hermetically sealed packing with storage temperatures up to max. 30 °C.

The instructions of the manufacturer must also be observed.

| Coolant concentrate                   | Limit value     | Brand name / Comments   |
|---------------------------------------|-----------------|---|
| Emulsifiable corrosion-inhibiting oil | 6 months        |   |
| Antifreeze                            | Approx. 3 years | Observe manufacturer's specifications   |
| Products containing propylene glycol  | 3 years         | BASF G206   |
| Coolant without antifreeze            | 6 months        | Nalco Trac 102  |
|                                       | 1 year          | Detroit Diesel Corp. Power Cool 3000<br>Penray Pencool 3000   |
|                                       | 2 years         | Arteco Freecor NBI<br>Chevron Texcool A-200<br>Detroit Diesel Corp. Power Cool 2000<br>ImproChem Cool-C 18<br>– Nalco Alfloc 2000<br>Nalco Nalcool 2000<br>Nalco Nalco 2000<br>Penray Pencool 2000<br>PrixMax RCP   |
|                                       | 3 years         | BASF Glyscorr G93 green<br>Drew Marine Drewgard XTA<br>Ginouves York 719<br>MTU Friedrichshafen Coolant C150<br>MTU America Power Cool® Plus 6000<br>Nalco Alfloc (Maxitreat) 3477<br>Valvoline ZEREX G-93  |
|                                       | 5 years         | Arteco Havoline Extended Life Corrosion Inhibitor XLI [EU 032765]<br>CCI Corporation A216<br>CCI Manufacturing IL A216<br>Chevron Delo XLI Corrosion Inhibitor Concentrate<br>Detroit Diesel Corp. Power Cool Plus 6000<br>ExxonMobil Mobil Delvac Extended Life Corrosion Inhibitor<br>Fleetguard DCA-4L<br>Old World Industries Final Charge Extended Life Corrosion Inhibitor (A216)<br>Total WT Supra |

Table 8:

#### Note:

For reasons of corrosion protection, do not store in galvanized bins. Take this requirement into account when coolant must be transferred.

Containers must be hermetically sealed and stored in a cool, dry place. Frost protection must be provided in winter.

Further information can be obtained from the product and safety data sheets for the individual coolants.

### 3.11 Color additives for detection of leaks in the coolant circuit

The following listed fluorescent dyes are approved as additives for coolant without antifreeze for the detection of leaks.

| Manufacturer                                 | Product name                      | Part No.  | Container size | Storage stability <sup>1)</sup> |
|--|-----------------------------------|-----------|----------------|---------------------------------|
| Chromatech Inc.<br>Chromatech Europe<br>B.V. | D11014 Chromatint<br>Uranine Conc | X00066947 | 20 kg          | 2 years                         |

Table 9: Approved dye additives

<sup>1)</sup> = based on original and hermetically sealed containers in frost-free storage (> 5 °C)

#### Application:

Approx. 40 g dye must be added to 180 l coolant.

This dye quantity is already very generous and must not be exceeded.

The fluorescence (yellow color tone) is easily recognizable in daylight. In dark rooms, UV light can be used with a wave length of 365 nm.



### 3.12 MTU Advanced Fluid Management System for coolant – Test package for North America

A sophisticated system for diagnostics and preventive maintenance is available in North America. This system allows the following:

- Optimization of the coolant change intervals
- Evaluation of metal migration
- Evaluation of the coolant's corrosive properties
- Detection of the causes of problems in the cooling system in connection with blown cylinder-head gaskets, electrical ground problems, localized overheating and contaminants within and outside the system

For full information on the MTU Advanced Fluid Management System available in North America, please contact an authorized MTU service partner.

The following test packages from MTU Advanced Fluid Management System can be ordered from authorized MTU service partners in North America:

- C-P92  
Basic test – For monitoring the corrosivity of the coolant and for detecting metal migration
- C-P94  
Extended test – Identification of the causes of leaks in the combustion system, grounding problems and contamination in the plant
- C-P93  
Extended Test Plus – Monitoring of corrosivity and metal migration plus HPLC analysis and IC analysis for confirmation of the determined contamination of the corrosion inhibitor

The following coolant parameters can be determined:

| Coolant parameters  | C-P92 | C-P94 | C-P93 |
|---|-------|-------|-------|
| 15 elementary metals  | ✓     | ✓     | ✓     |
| Glycol percentage   | ✓     | ✓     | ✓     |
| Freezing point  | ✓     | ✓     | ✓     |
| Boiling point   | ✓     | ✓     | ✓     |
| pH value  | ✓     | ✓     | ✓     |
| Total hardness  | ✓     | ✓     | ✓     |
| SCA number  | ✓     | ✓     | ✓     |
| Nitrite   | ✓     | ✓     | ✓     |
| Specific conductivity   | ✓     | ✓     | ✓     |
| Carboxylic acid   | ✓     | ✓     | ✓     |
| Sensory parameters (color, oil, fuel, magnetic precipitation, amagnetic precipitation, odor and foam)           | ✓     | ✓     | ✓     |
| Contamination and corrosion inhibitor through IC (chloride, sulfate, nitrite, nitrate, phosphate and glycolate) | -     | ✓     | ✓     |
| HPLC  | -     | -     | ✓     |

The MTU Advanced Fluid Management System with trend analysis provides information for maximizing system reliability. The following guidelines must be followed to obtain the best results.

#### Samples must be taken:

- While the engine is operating under normal conditions or immediately after stopping the engine while the engine is still at operating temperature
- Every 250 hours at the same point

Note: The software offered by MTU for online reporting with trend analyses shows the procedure for optimizing evaluation of the gathered information after completion of the analysis.

Note: The MTU Advanced Fluid Management System works together with independent test laboratories accredited according to ISO 17025 A2LA. This accreditation is the highest level of quality obtainable by a test laboratory in North America.

# 4 Liquid Fuels

## 4.1 Diesel fuels – General information

### Important

Dispose of used fluids and lubricants in accordance with local regulations.  
Used oil must never be disposed of via the combustion engine!

### 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.

### Important

Diesel fuels are not available worldwide in the quality required according to (→ Table 10).  
The fuel properties depend on many factors, in particular, region, time of year and storage.

### Important

If the fuel is to be stored in storage tanks for an extended period of time, we strictly recommend the use of B0 fuel.  
MTU Friedrichshafen provides project-specific consultation on request.  
We recommend to determine the oxidation stability (EN ISO 12205 / ASTM D 2274) to check the quality.

Unsuitable fuel usually leads to a reduced service life of engine components and can also cause engine damage.

Further details on fuel qualities, tank care and filtration are available in the publication "Useful information on fuels, tank systems and filtration" (publication number A060631/..).

| Characteristics of the fuel                        |         | Test method |                 | Limit values   |
|--|---------|-------------|-----------------|--|
|  |         | ASTM        |                 |  |
| Composition  |         |             |                 | The diesel fuel must be free of inorganic acids, visible water, solid foreign matter and chlorine compounds. |
| Total contamination (= elements insoluble in fuel) | max.    | D6217       | EN 12662        | 24 mg/kg   |
| Density at 15 °C                                   | min.    | D1298       | EN ISO 3675     | 0.820 g/ml   |
|  | max.    | D4052       | EN ISO 12185    | 0.860 g/ml   |
| API gravity at 60 °F                               | min.    | D287        |                 | 41   |
|  | max.    |             |                 | 33   |
| Viscosity at 40 °C                                 | min.    | D445        | EN ISO 3104     | 1.5 mm <sup>2</sup> /s   |
|  | max.    |             |                 | 4.5 mm <sup>2</sup> /s   |
| Flashpoint (closed crucible)                       | greater | D93         | DIN EN ISO 2719 | 55 °C  |

<sup>1)</sup> Filter plugging point or Cold Filter Plugging Point (CFPP) denotes the temperature at which a test filter is blocked under defined conditions by precipitated paraffins. This characteristic is used for diesel fuels as per DIN EN 590 to describe the climatic requirements (e.g. summer and winter diesel).

<sup>2)</sup> The cloud point is the temperature at which a liquid product becomes turbid in the test glass due to precipitation of paraffin. This must not be higher than the ambient temperature.

Note: 1% by weight = 10000 mg/kg = 10000 ppm

| Characteristics of the fuel                          |                          | Test method     |                                       | Limit values                   |
|--|--------------------------|-----------------|---------------------------------------|--------------------------------|
|  |                          | ASTM            |                                       |                                |
| Boiling curve:                                       |                          | D86             | EN ISO 3405                           |                                |
| - Initial boiling point                              |                          |                 |                                       | 160 to 220 °C                  |
| - Volume share at 250 °C                             | max.                     |                 |                                       | 65% by volume                  |
| Recovery at 350 °C                                   | min.                     |                 |                                       | 85% by volume                  |
| - Residue and loss                                   | max.                     |                 |                                       | 3% by volume                   |
| Fatty acid methyl ester content (FAME) ("Biodiesel") | max.                     |                 | EN 14078<br>Internal MTU<br>procedure | 7.0% by volume                 |
| Proportion of water: (absolute, no free water)       | max.                     | D6304           | EN ISO 12937                          | 200 mg/kg                      |
| Carbon residue from 10% distillation residue         | max.                     | D189            | EN ISO 10370                          | 0.30% by weight                |
| Oxide ash:   | max.                     | D482            | EN ISO 6245                           | 0.01% by weight<br>(100 mg/kg) |
| Sulfur content:<br>2000Gx5, 4000Gx3, 4000Gx4         | max.                     | D5453,<br>D2622 | EN ISO 20846,<br>EN ISO 20884         | 0.5% by weight<br>(5000 mg/kg) |
| Sulfur content:<br>2000Gx6                           |                          |                 |                                       | 0.05% by weight<br>(500 mg/kg) |
| Cetane number  | min.                     | D613            | EN ISO 5165,<br>EN ISO 15195          | 45                             |
| Cetane index   | min.                     | D976            | EN ISO 4264                           | 42                             |
| Copper corrosion<br>3 hrs at 50 °C                   | Max. degree of corrosion | D130            | EN ISO 2160                           | 1 a                            |
| Oxidation stability(Rancimat)                        | min.                     |                 | EN 15751                              | 20 hours                       |
| Oxidation stability                                  | max.                     | D2274           | EN ISO 12205                          | 25 g/m <sup>3</sup>            |
| Lubricity at 60 °C<br>(HFRR value)                   | max.                     | D6079           | EN ISO 12156-1                        | 520 µm                         |
| Filter plugging point (CFPP)                         |                          | D6371           | DIN EN 116                            | See <sup>1</sup>               |
| Cloud Point  |                          | D2500           | DIN EN 23015                          | See <sup>2</sup>               |
| Neutralization number                                | max.                     | D974            |                                       | 0.2 mg KOH/g                   |

<sup>1</sup>) Filter plugging point or Cold Filter Plugging Point (CFPP) denotes the temperature at which a test filter is blocked under defined conditions by precipitated paraffins. This characteristic is used for diesel fuels as per DIN EN 590 to describe the climatic requirements (e.g. summer and winter diesel).

<sup>2</sup>) The cloud point is the temperature at which a liquid product becomes turbid in the test glass due to precipitation of paraffin. This must not be higher than the ambient temperature.

Note: 1% by weight = 10000 mg/kg = 10000 ppm

Table 10: Applicable fuel limit values

## 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.

The fuel supplier must ensure that the fuel can still be used at extremely low temperatures and correct engine operation can be guaranteed. Extremely low temperatures must be noted, which can be expected under the given geographical and other local conditions.

The operator must ensure that fuel necessary for the corresponding climatic requirements is used.

**Note:**

The engines are certified for operation with the fuels approved in these Fluids and Lubricants Specifications.

The component TBO specified in the maintenance schedule relates to operation of the engine with diesel fuel as per DIN EN 590.

For operation with a high sulfur content in the fuel, the following must be observed:

**Series 4000**

When a fuel with sulfur content > 1500 mg/kg is used, the times specified in the maintenance schedule for component TBO of the cylinder head may be reduced, see following table (→ Page 37)

**TBO cylinder head as a function of sulfur content in the fuel**

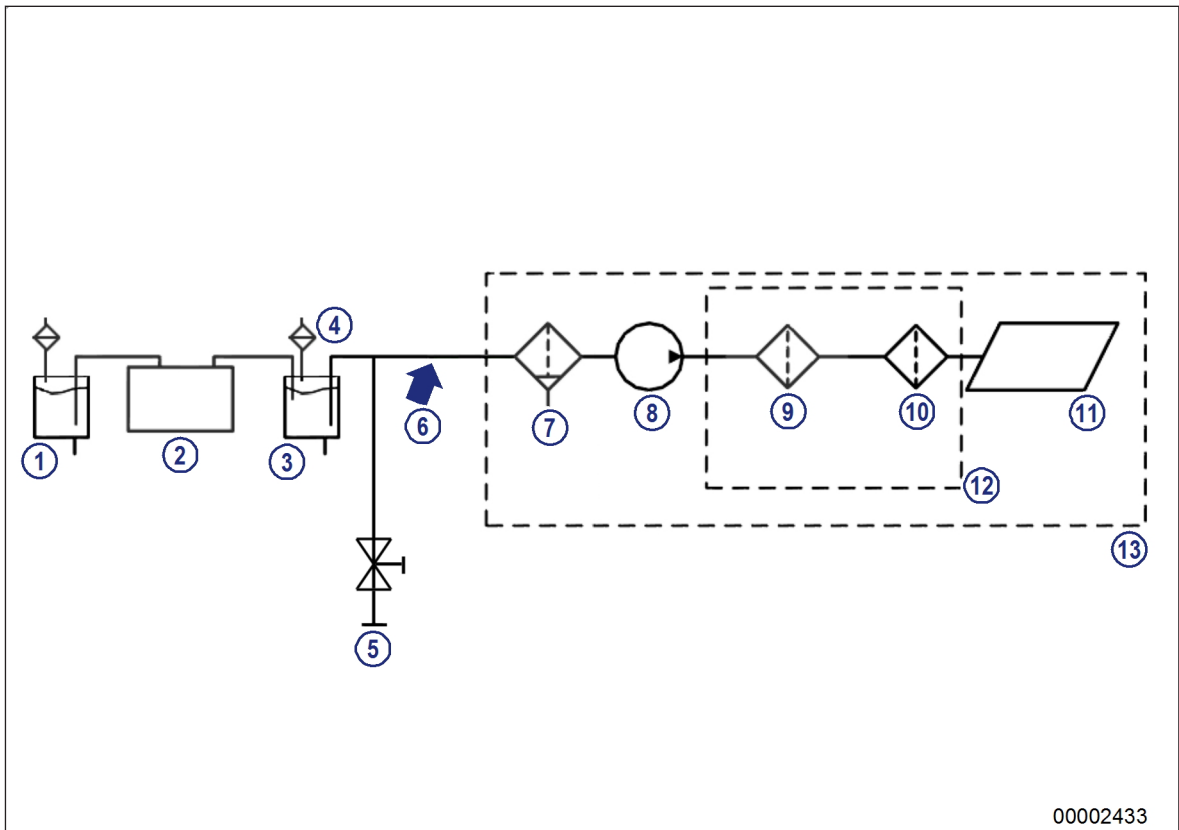
| Sulfur content in fuel (mg/kg) | TBO cylinder head (h)             |
|--------------------------------|-----------------------------------|
| <1500                          | According to maintenance schedule |
| 1500 to 3000                   | 12000 <sup>1)</sup>               |
| 3000 to 4000                   | 7000 <sup>1)</sup>                |
| 4000 to 5000                   | 5000 <sup>1)</sup>                |

Table 11:

<sup>1)</sup>= If the TBO cylinder head specified in the maintenance schedule is shorter, the shorter TBO shall always apply.

**Important**

If the sulfur content in the fuel is > 0.5 % by weight (> 5000 ppm), please consult with MTU Friedrichshafen (Application).



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Figure 3: Fuel system

- |                              |  |                     |
|------------------------------|--|---------------------|
| 1 Fuel tank                  | 6 Interface for fuel specification             | 11 Injection system |
| 2 Fuel conditioning (option) | 7 Fuel prefilter with water separator (option) | 12 Engine filter    |
| 3 Last tank before engine    | 8 Fuel low-pressure pump                       | 13 Engine scope     |
| 4 Tank ventilation filter    | 9 Intermediate filter (option)                 |                     |
| 5 Sample extraction          | 10 Main filter                                 |                     |

### Note:

The limit values named in the table (→ Table 10) must be observed at the interface [(→ Figure 3), item 6] at the latest to guarantee safe and efficient engine operation. This applies in particular to water and total contamination.

### Important

In addition to the limit values listed in the table (→ Table 10), a particle distribution in the fuel in acc. with ISO 4406 must be observed, see (→ Table 12).

## Particle distribution for fuels

| Particle distribution   | Test method<br><br>ASTM |   | Limit values  |  |
|---|-------------------------|---|---|--|
|   |                         |   | Series 2000 Gx6,<br>Series 4000 Gx3,<br>Series 4000 Gx4 | Series 2000 Gx5                                    |
| Particle distribution for fuel between last tank before engine and prefilter [(→ Figure 3), item 6] | D7619<br>D7647          | Coding of number of particles as per ISO 4406 | max. ISO Code 18/17/14 for 4/6/14 µm particle size      | max. ISO Code 21/20/17 for 4/6/14 µm particle size |

Table 12:

| Important   |
|---|
| The limit values named in the table (→ Table 12) must already be observed in the feed between the last tank before the engine and the prefilter (if necessary, with water separator). |

For plants without a prefilter, this refers to the feed between the last tank and the scope of supply of MTU. For the analysis of the fuel quality, an interface (sample extraction cock) must be provided for sample extraction during operation.

For existing plants without an accessible feed, a sample extraction point in the last tank before the scope of supply of MTU is permissible.

### Note:

With poorer particle distribution, it is necessary to integrate further / more-optimized filter stages in the fuel system to achieve the operational life of fuel filters and components of the injection system.

For the limit values named for the interface, it has been validated that prefilters approved by MTU provide sufficient filtration.

MTU shall not provide warranty cover for damage and impairment to engines caused by the following usage:

- Fuel grades not approved by MTU (see (→ Table 10), (→ Table 12), (→ Page 40))
- Prefilters not approved by MTU

## Laboratory analysis

An order for fuel analysis can be placed with MTU.

The following data is required:

- Fuel specifications
- Sampling point
- Serial number of engine from which fuel sample was taken

Submit the following:

- 1.0 liters of fuel
- 2.0 liters of fuel (with additional determination of cetane number)

## Test Package for North America

The MTU Advanced Fluid Management System is available in North America, which contributes to preventive maintenance through innovative diagnostics.

MTU Advanced Fluid Management System for fuels, see (→ Page 65).

## 4.2 Series-dependent approval of fuel grades for MTU engines

### 4.2.1 Distillate fuels according to DIN EN 590 and ASTM D975

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

| Approved fuels<br>Fuel specifications   | Series 2000   |   |
|---|---|---|
|   | 2000Gx5   | 2000Gx6   |
| <b>DIN EN 590: 2017-10</b> <ul style="list-style-type: none"> <li>• Summer and winter quality</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>  | Approved  | Approved  |
| <b>ASTM D975-19</b> <ul style="list-style-type: none"> <li>• Grade 1-D</li> <li>• S 15, S 500, S 5000</li> <li>• Density: 0.820 to 0.860 g/ml</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Viscosity min. 1.5 mm<sup>2</sup>/s</li> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Sulfur content max. 500 mg/kg</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Viscosity min. 1.5 mm<sup>2</sup>/s</li> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Sulfur content max. 500 mg/kg</li> </ul> |
| <b>ASTM D975-19</b> <ul style="list-style-type: none"> <li>• Grade 2-D</li> <li>• S 15, S 500, S 5000</li> <li>• Density: 0.820 to 0.860 g/ml</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Sulfur content max. 500 mg/kg</li> </ul>  | Approved if: <ul style="list-style-type: none"> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Sulfur content max. 500 mg/kg</li> </ul>  |



| Approved fuels<br>Fuel specifications   | Series 4000   |   |
|---|---|---|
|   | 4000Gx3   | 4000Gx4   |
| <b>DIN EN 590: 2017-10</b> <ul style="list-style-type: none"> <li>• Summer and winter quality</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>  | Approved  | Approved  |
| <b>ASTM D975-19</b> <ul style="list-style-type: none"> <li>• Grade 1-D</li> <li>• S 15, S 500, S 5000</li> <li>• Density: 0.820 to 0.860 g/ml</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Viscosity min. 1.5 mm<sup>2</sup>/s</li> <li>• Cetane number min. 45 or cetane index min. 42</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Viscosity min. 1.5 mm<sup>2</sup>/s</li> <li>• Cetane number min. 45 or cetane index min. 42</li> </ul> |
| <b>ASTM D975-19</b> <ul style="list-style-type: none"> <li>• Grade 2-D</li> <li>• S 15, S 500, S 5000</li> <li>• Density: 0.820 to 0.860 g/ml</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Cetane number min. 45 or cetane index min. 42</li> </ul>  | Approved if: <ul style="list-style-type: none"> <li>• Cetane number min. 45 or cetane index min. 42</li> </ul>  |

## 4.2.2 British Standard 2869

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

| Approved fuels<br>Fuel specifications  | Series 2000  |              |
|--|--------------|--------------|
|  | 2000Gx5      | 2000Gx6      |
| <b>BS 2869:2017</b> <ul style="list-style-type: none"> <li>Part 1 Class A2</li> <li>Density: max. 860 kg/m<sup>3</sup></li> <li>Viscosity: max. 4.5 mm<sup>2</sup>/s. If viscosity min. 4.5 mm<sup>2</sup>/s: Preheating required</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Not approved | Not approved |
| <b>BS 2869:2017</b> <ul style="list-style-type: none"> <li>Part 2 Class D</li> <li>Density: max. 860 kg/m<sup>3</sup></li> <li>Viscosity: max. 4.5 mm<sup>2</sup>/s. If viscosity min. 4.5 mm<sup>2</sup>/s: Preheating required</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>  | Not approved | Not approved |
| Approved fuels<br>Fuel specifications  | Series 4000  |              |
|  | 4000Gx3      | 4000Gx4      |
| <b>BS 2869:2017</b> <ul style="list-style-type: none"> <li>Part 1 Class A2</li> <li>Density: max. 860 kg/m<sup>3</sup></li> <li>Viscosity: max. 4.5 mm<sup>2</sup>/s. If viscosity min. 4.5 mm<sup>2</sup>/s: Preheating required</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved     | Approved     |
| <b>BS 2869:2017</b> <ul style="list-style-type: none"> <li>Part 2 Class D</li> <li>Density: max. 860 kg/m<sup>3</sup></li> <li>Viscosity: max. 4.5 mm<sup>2</sup>/s. If viscosity min. 4.5 mm<sup>2</sup>/s: Preheating required</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>  | Approved     | Approved     |

### 4.2.3 Chinese distillate fuels according to GB 19147-2013 and GB 252-2015

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

| Approved fuels<br>Fuel specifications  | Series 2000           |                       |
|--|-----------------------|-----------------------|
|  | 2000Gx5               | 2000Gx6               |
| <p><b>GB 19147-2013</b></p> <ul style="list-style-type: none"> <li>• Grade 0</li> <li>• III: S max. 350 mg/kg</li> <li>• IV: S max. 50 mg/kg</li> <li>• V: S max. 10 mg/kg</li> <li>• Density: 0.820 to 0.860 g/ml*</li> <li>* deviating values: Approval possible project-specifically. If the density is too low, this can result in a power reduction. In the framework of power re-adjustment, it is possible that the engine operational values change</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> <li>• Neutralization number: Max 0.2 mgKOH/g</li> <li>• Viscosity at 40 °C: 1.5 to 4.5 mm<sup>2</sup>/s</li> </ul> | Approved              | Approved              |
| <p><b>GB 252-2015</b></p> <ul style="list-style-type: none"> <li>• Grade 0</li> <li>• Density: 0.820 to 0.860 g/ml*</li> <li>* deviating values: Approval possible project-specifically. If the density is too low, this can result in a power reduction. In the framework of power re-adjustment, it is possible that the engine operational values change</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> <li>• Neutralization number: Max 0.2 mgKOH/g</li> <li>• Viscosity at 40 °C: 1.5 to 4.5 mm<sup>2</sup>/s</li> </ul>   | Approval upon request | Approval upon request |

| Approved fuels<br>Fuel specifications  | Series 4000 |          |
|--|-------------|----------|
|  | 4000Gx3     | 4000Gx4  |
| <b>GB 19147-2013</b> <ul style="list-style-type: none"> <li>• Grade 0</li> <li>• III: S max. 350 mg/kg</li> <li>• IV: S max. 50 mg/kg</li> <li>• V: S max. 10 mg/kg</li> <li>• Density: 0.820 to 0.860 g/ml*<br/>* deviating values: Approval possible project-specifically. If the density is too low, this can result in a power reduction. In the framework of power re-adjustment, it is possible that the engine operational values change</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> <li>• Neutralization number: Max 0.2 mgKOH/g</li> <li>• Viscosity at 40 °C: 1.5 to 4.5 mm<sup>2</sup>/s</li> </ul> | Approved    | Approved |
| <b>GB 252-2015</b> <ul style="list-style-type: none"> <li>• Grade 0</li> <li>• Density: 0.820 to 0.860 g/ml*<br/>* deviating values: Approval possible project-specifically. If the density is too low, this can result in a power reduction. In the framework of power re-adjustment, it is possible that the engine operational values change</li> <li>• Proportion of water: Max. 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> <li>• Neutralization number: Max 0.2 mgKOH/g</li> <li>• Viscosity at 40 °C: 1.5 to 4.5 mm<sup>2</sup>/s</li> </ul>   | Approved    | Approved |

## 4.2.4 Heating oil

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

### Heating oil

| Approved fuels<br>Fuel specifications  | Series 2000  |  |
|--|--|--|
|  | 2000Gx5  | 2000Gx6  |
| <b>DIN 51603-1:2017-03, heating oil EL Standard</b> <ul style="list-style-type: none"> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Lubricity max. 520 <math>\mu\text{m}</math></li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (<math>\rightarrow</math> Page 35)</li> </ul>   | Approved if: <ul style="list-style-type: none"> <li>• Density at 15 °C min. 0.820 g/ml</li> <li>• Sulfur content max. 500 mg/kg</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Sulfur content max. 500 mg/kg</li> </ul> |
| <b>DIN 51603-1:2017-03, heating oil EL low-sulfur</b> <ul style="list-style-type: none"> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Lubricity max. 520 <math>\mu\text{m}</math></li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (<math>\rightarrow</math> Page 35)</li> </ul> | Approved   | Approved   |
| <b>DIN 51603-6:2017-03, heating oil EL alternative</b>   | Not approved   | Not approved   |

| Approved fuels<br>Fuel specifications  | Series 4000  |              |
|--|--------------|--------------|
|  | 4000Gx3      | 4000Gx4      |
| <b>DIN 51603-1:2017-03, heating oil EL Standard</b> <ul style="list-style-type: none"> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Lubricity max. 520 <math>\mu\text{m}</math></li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (<math>\rightarrow</math> Page 35)</li> </ul>   | Approved     | Approved     |
| <b>DIN 51603-1:2017-03, heating oil EL low-sulfur</b> <ul style="list-style-type: none"> <li>• Cetane number min. 45 or centane index min. 42</li> <li>• Lubricity max. 520 <math>\mu\text{m}</math></li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (<math>\rightarrow</math> Page 35)</li> </ul> | Approved     | Approved     |
| <b>DIN 51603-6:2017-03, heating oil EL alternative</b>   | Not approved | Not approved |

## 4.2.5 Marine distillate fuels according to ISO 8217:2018-10

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

| Approved fuels<br>Fuel specifications   | Series 2000  |  |
|---|--|--|
|   | 2000Gx5  | 2000Gx6  |
| <b>DMX</b> <ul style="list-style-type: none"> <li>Proportion of water: 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Not approved   | Not approved   |
| <b>DMZ</b> <ul style="list-style-type: none"> <li>Proportion of water: 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Not approved   | Not approved   |
| <b>DMA</b> <ul style="list-style-type: none"> <li>Proportion of water: 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Not approved   | Not approved   |
| <b>DMB</b>  | Not approved   | Not approved   |
| Approved fuels<br>Fuel specifications   | Series 4000  |  |
|   | 4000Gx3  | 4000Gx4  |
| <b>DMX</b> <ul style="list-style-type: none"> <li>Proportion of water: 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Viscosity &gt; 4.5 mm<sup>2</sup>/s:<br/>Preheating required</li> </ul>  | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF) if:               <ul style="list-style-type: none"> <li>Viscosity &gt; 4.5 mm<sup>2</sup>/s:<br/>Preheating required</li> </ul> </li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |
| <b>DMZ</b> <ul style="list-style-type: none"> <li>Proportion of water: 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Viscosity 1.5 to 4.5 mm<sup>2</sup>/s</li> <li>Outside the limit range between 1.5 and 4.5 mm<sup>2</sup>/s:<br/>Approval following co-ordination with MTU possible</li> <li>Density 0.820 to 0.870 g/ml</li> <li>Cetane number min. 45 or cetane index min. 42</li> </ul> | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF) if:               <ul style="list-style-type: none"> <li>Viscosity &gt; 4.5 mm<sup>2</sup>/s:<br/>Preheating required</li> </ul> </li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |

| Approved fuels<br>Fuel specifications   | Series 4000   |  |
|---|---|--|
|   | 4000Gx3   | 4000Gx4  |
| <b>DMA</b> <ul style="list-style-type: none"> <li>• Proportion of water: 200 mg/kg</li> <li>• Total contamination: Max. 24 mg/kg</li> <li>• Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>• Viscosity 1.5 to 4.5 mm<sup>2</sup>/s</li> <li>• Outside the limit range between 1.5 and 4.5 mm<sup>2</sup>/s: Approval following co-ordination with MTU possible</li> <li>• Density 0.820 to 0.870 g/ml</li> <li>• Cetane number min. 45 or centane index min. 42</li> </ul> | <ul style="list-style-type: none"> <li>• Approved (except G44F, G44LF, G94F, G94LF) if:               <ul style="list-style-type: none"> <li>- Viscosity &gt; 4.5 mm<sup>2</sup>/s: Preheating required</li> </ul> </li> <li>• G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |
| <b>DMB</b>  | Not approved  | Not approved   |

## 4.2.6 Aviation turbine fuel

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

| Approved fuels<br>Fuel specifications           | Series 2000  |              |
|---|--------------|--------------|
|   | 2000Gx5      | 2000Gx6      |
| <b>F-34 / F-35</b><br>• JP-8                    | Not approved | Not approved |
| <b>F-44</b><br>• JP-5                           | Not approved | Not approved |
| <b>F-63</b><br>• In accordance with DCSEA 108/A | Not approved | Not approved |

| Approved fuels<br>Fuel specifications           | Series 4000  |   |
|---|--------------|---|
|   | 4000Gx3      | 4000Gx4   |
| <b>F-34 / F-35</b><br>• JP-8                    | Not approved | Not approved  |
| <b>F-44</b><br>• JP-5                           | Not approved | Not approved  |
| <b>F-63</b><br>• In accordance with DCSEA 108/A | Approved     | <ul style="list-style-type: none"> <li>• Approved (except G44F, G44LF, G94F, G94LF)</li> <li>• G44F, G44LF, G94F, G94LF: Generally not approved, approval upon request</li> </ul> |



## 4.2.7 NATO diesel fuels

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

### Diesel fuel NATO Code F-54

| Approved fuels<br>Fuel specifications   | Series 2000  |  |
|---|--|--|
|   | 2000Gx5  | 2000Gx6  |
| <b>NATO Code F-54 in accordance with TL 9140-0001 Edition 8</b> <ul style="list-style-type: none"> <li>Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Lubricity: Max. 520 µm</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>                                  | Approved if: <ul style="list-style-type: none"> <li>Sulfur content max. 500 mg/kg</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Sulfur content max. 500 mg/kg</li> </ul>   |
| <b>NATO Code F-54 in accordance with STANAG 7090 Edition 4</b> <ul style="list-style-type: none"> <li>Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04</li> <li>Density: min. 0.820 g/ml</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Lubricity: Max. 520 µm</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Sulfur content max. 500 mg/kg</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Sulfur content max. 500 mg/kg</li> </ul>   |
| Approved fuels<br>Fuel specifications   | Series 4000  |  |
|   | 4000Gx3  | 4000Gx4  |
| <b>NATO Code F-54 in accordance with TL 9140-0001 Edition 8</b> <ul style="list-style-type: none"> <li>Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Lubricity: Max. 520 µm</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>                                  | Approved   | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF)</li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |
| <b>NATO Code F-54 in accordance with STANAG 7090 Edition 4</b> <ul style="list-style-type: none"> <li>Approval if fuel corresponds to diesel fuel DIN EN 590:2014-04</li> <li>Density: min. 0.820 g/ml</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Lubricity: Max. 520 µm</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved   | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF)</li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |

## Diesel fuel NATO Code F-75

| Approved fuels<br>Fuel specifications   | Series 2000  |   |
|---|--|---|
|   | 2000Gx5  | 2000Gx6   |
| <b>NATO-Code F-75 in accordance with TL 9140-0003</b> <ul style="list-style-type: none"> <li>Reduced power possible due to min. density of 0.815 g/ml</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>  | Not approved   | Not approved  |
| <b>NATO-Code F-75 in accordance with STANAG 1385</b> <ul style="list-style-type: none"> <li>Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml</li> <li>max. sulfur content 1.0 %</li> <li>Adapt oil and oil change interval</li> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Not approved   | Not approved  |
| Approved fuels<br>Fuel specifications   | Series 4000  |   |
|   | 4000Gx3  | 4000Gx4   |
| <b>NATO-Code F-75 in accordance with TL 9140-0003</b> <ul style="list-style-type: none"> <li>Reduced power possible due to min. density of 0.815 g/ml</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>  | Approved   | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF)</li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul>  |
| <b>NATO-Code F-75 in accordance with STANAG 1385</b> <ul style="list-style-type: none"> <li>Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml</li> <li>max. sulfur content 1.0 %</li> <li>Adapt oil and oil change interval</li> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Cetane number min. 45 or cetane index min. 42</li> </ul> | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF) if:               <ul style="list-style-type: none"> <li>Cetane number min. 45 or cetane index min. 42</li> </ul> </li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |

## Diesel fuel NATO Code F-76

| Approved fuels<br>Fuel specifications  | Series 2000                                   |   |
|--|---|---|
|  | 2000Gx5                                       | 2000Gx6                                       |
| <b>NATO Code F-76 in accordance with STANAG 1385 Edition 6</b> <ul style="list-style-type: none"> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Generally not approved, approval upon request | Generally not approved, approval upon request |
| <b>NATO-Code F-76 in accordance with DEF-STAN 91-4 Issue 8</b> <ul style="list-style-type: none"> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Generally not approved, approval upon request | Generally not approved, approval upon request |
| <b>NATO-Code F-76 in accordance with MIL-DTL-16884N</b> <ul style="list-style-type: none"> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>        | Generally not approved, approval upon request | Generally not approved, approval upon request |

| Approved fuels<br>Fuel specifications  | Series 4000   |  |
|--|---|--|
|  | 4000Gx3   | 4000Gx4  |
| <b>NATO Code F-76 in accordance with STANAG 1385 Edition 6</b> <ul style="list-style-type: none"> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved if: <ul style="list-style-type: none"> <li>Cetane number min. 45 or centane index min. 42</li> </ul> | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF) if:               <ul style="list-style-type: none"> <li>Cetane number min. 45 or centane index min. 42</li> </ul> </li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |
| <b>NATO-Code F-76 in accordance with DEF-STAN 91-4 Issue 8</b> <ul style="list-style-type: none"> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul> | Approved  | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF)</li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul>   |
| <b>NATO-Code F-76 in accordance with MIL-DTL-16884N</b> <ul style="list-style-type: none"> <li>Proportion of water: Max. 200 mg/kg</li> <li>Total contamination: Max. 24 mg/kg</li> <li>Particle distribution in accordance with table "Particle distribution for fuel", see chapter (→ Page 35)</li> </ul>        | Approved if: <ul style="list-style-type: none"> <li>Cetane number min. 45 or centane index min. 42</li> </ul> | <ul style="list-style-type: none"> <li>Approved (except G44F, G44LF, G94F, G94LF) if:               <ul style="list-style-type: none"> <li>Cetane number min. 45 or centane index min. 42</li> </ul> </li> <li>G44F, G44LF, G94F, G94LF: Not approved</li> </ul> |

## 4.2.8 Paraffinic diesel fuel according to DIN EN 15940

Selected paraffinic diesel fuels according to DIN EN 15940 are currently in the qualification phase.

### Important information

Project-specific approval from MTU Friedrichshafen GmbH is possible upon request.

## 4.2.9 B20 diesel fuel

B20 diesel fuel is a diesel fuel with a biodiesel share of 20%.

### Important information

Project-specific approval from MTU Friedrichshafen GmbH is possible upon request.

The following section provides additional information on B20 diesel fuel.

### Use of B20 diesel fuels

Biodiesel mixtures consist of fuels which are obtained from biological raw materials and mixed with conventional diesel fuel. For instance, B20 denotes a mixture comprising 20% biodiesel and 80% fuel based on crude oil/mineral oil. MTU engines were not specially designed to be operated with biodiesel mixtures. For this reason, the use of biodiesel mixtures may have negative effects in terms of engine power, service and maintenance requirements, emissions and service life.

Operators of MTU engines therefore need to be clear about the effects that biodiesel may have on their engines, and must take all of the necessary measures to ensure the reliability and safety of their engines. This letter provides MTU customers with important information the use of biodiesel mixtures in MTU engines and explains the potential impact these fuels may have on the MTU warranty. Please read this information carefully before using biodiesel mixtures in MTU engines.

#### 1. Regarding the use of approved biodiesel mixtures

At present, only biodiesel mixtures with up to 7% biodiesel (in accordance with DIN EN 590) or 5% biodiesel (in accordance with ASTM D 975) are approved for use in the MTU Fluids and Lubricants Specifications.

Although biodiesel mixtures with up to 20% biodiesel (B20) are not yet approved in the MTU Fluids and Lubricants Specifications, at present they can be used in the engines listed below in section 6, AS LONG AS the following requirements are met:

- The biodiesel complies with DIN EN 14214 or ASTM D 6751.
- The B20 fuel grade corresponds with DIN EN 16709.
- The distilled diesel fuel added to the biodiesel is approved in the latest version of the MTU Fluids and Lubricants Specifications.
- The operator complies with the operating requirements given in section 2 and the additional maintenance recommendations from section 5.

### Important information

The provisions with regard to requirements placed on fuel may differ depending on legislation and application of the engine. The operator is responsible for ensuring that only fuels which comply with the applicable provisions are used in the engines.

#### 2. Operating requirements for the use of B20

The following operating requirements must be met when biodiesel mixtures are used in MTU engines:

- a For engines used in standby gensets, an additive must be used to improve the oxidation stability of the biodiesel.
- b All engines used in fire-fighting pumps, fire-extinguishing equipment or police equipment must be thoroughly rinsed with pure, high-quality distilled diesel fuel which complies with the Fluids and Lubricants Specifications each time they are operated with a biodiesel mixture. Furthermore, an additive must be used in these engines to improve the oxidation stability of the biodiesel.
- c All engines which are only used seasonally or which are not operated for extended periods between uses must be thoroughly rinsed with pure, high-quality distilled diesel fuel which complies with the Fluids and Lubricants Specifications before they are decommissioned.
- d Biodiesel mixtures can not be used in engines equipped with an exhaust gas aftertreatment system (e.g. catalytic converters, particle filters (DPF) and/or systems for reducing NOx emissions, e.g. SCR systems).

### **3. Impact on the MTU warranty**

The manufacturer shall not be responsible for failures which can be attributed to the use of fuels not approved in the MTU Fluids and Lubricants Specifications and such failures shall therefore not be covered by the MTU warranty. MTU shall reject all warranty claims connected to the use of biodiesel mixtures with a biodiesel content of more than 7% (in accordance with DIN EN 590) or 5% (in accordance with ASTM D 975) if the operator is unable to prove that the operating requirements and recommendations contained in this letter were met and strictly followed. Regardless of this, MTU shall on no account be liable for providing compensation for costs arising from the effects described below in section 4.

#### **Important information**

All properties guaranteed by MTU in terms of assured characteristics with regard to engine power and/or availability in operation only apply to the cases in which fuels approved by MTU are used and the engine demonstrates no defects or damage arising from operation with fuels not approved in the MTU Fluids and Lubricants Specifications.

### **4. Effects of biodiesel on engines/exclusion of liability**

The biodiesel contained in biodiesel mixtures is a natural product and therefore undergoes natural aging processes. These may have a negative effect on the engines in which the biodiesel mixtures are used. The effects that biodiesel may have on engines are explained below.

**Important: THESE EFFECTS ARE NOT FAULTS CAUSED BY THE ENGINE MANUFACTURER. THEY ARE THEREFORE EXCLUDED FROM THE MTU WARRANTY. MTU SHALL NOT ASSUME ANY LIABILITY FOR COSTS ARISING FROM THE EFFECTS DESCRIBED BELOW.**

- The formation of deposits may cause components to become "sticky", which potentially restricts their movement. On engines with long downtimes, this can result in a situation where the engine can no longer be started. This is why additives for improving the oxidation stability of the biodiesel must be employed when biodiesel mixtures are used in standby gensets. MTU SHALL ACCEPT NO LIABILITY IN THE EVENT THAT THE ENGINE IN AN STANDBY GENSET CAN NOT BE STARTED AS A RESULT OF THE FORMATION OF DEPOSITS.
- The formation of deposits may have an adverse effect on the interaction of components inside the unit. This results in an increased risk of components failing, and even the breakdown of entire cylinders. The high operating temperatures in the surroundings encourage the formation of mineral deposits, other deposits and encrustations which may render the valve unable to correctly regulate the fuel supply. This means that it is no longer possible for the quantity of fuel required at full load to be injected into the engine, thereby reducing the maximum engine power.
- The viscosity properties of biodiesel are less favorable at low temperatures. The use of biodiesel at low temperatures may therefore cause the fuel filter to become clogged.
- On all engines, lubricating the piston skirts with oil leads to a small amount of fuel entering the engine oil. This is generally of little importance with conventional diesel fuels in accordance with the MTU Fluids and Lubricants Specifications since the fuel evaporates quickly upon reaching the operating temperature. On the other hand, biodiesel evaporates much less effectively, with the result that more biodiesel accumulates in the oil. Aging of the biodiesel can therefore cause residues to form, filters to become clogged and ultimately cause the engine to come to a stop, resulting in significantly shorter oil change intervals.
- Compared to conventional diesel fuels according to the MTU Fluids and Lubricants Specifications, biodiesel has a lower energy density. Operating the engine with B20 results in a power reduction of approximately 2% and an increase in fuel consumption of around 3%.
- Biodiesel contains chemical components which can interact with the sensors in the exhaust gas recirculation system in such a way that incorrect data is reported to the engine control system. This can have consequences such as engine operation being adapted to the wrong values and emissions therefore no longer complying with the applicable provisions. This is why biodiesel must not be used in engines which feature exhaust gas recirculation (EGR) and/or exhaust gas aftertreatment systems.
- Compared to conventional diesel fuels according to the MTU Fluids and Lubricants Specifications, biodiesel has a higher water solubility, meaning that a higher proportion of water should be expected depending on the fuel temperature. This can lead to increased corrosion and faster microbe growth in the fuel system. Due to the higher proportion of water in biodiesel, reduced water separator performance must be expected.
- Biodiesel is a solvent. After switching over to a biodiesel mixture, impurities and certain deposits may become loose in the tank and lines, causing the fuel filter to be subjected to an increased accumulation of these. Biodiesel mixtures may also strip paint when they come into contact with painted surfaces.
- On engines with exhaust gas aftertreatment systems, the functioning of the catalytic converter may be impaired as biodiesel mixtures can contain a higher proportion of trace elements (e.g. calcium, magnesium, sodium, potassium and phosphorus) than conventional diesel fuels according to the MTU Fluids and Lubricants Specifications. This means that the legally prescribed emissions limits are not complied with and the operating license becomes invalid. Furthermore, legally prescribed technologies for checking emissions on these engines (e.g. NOx monitoring diagnostics) lead to a significant decrease in engine power. The above-mentioned trace elements may also result in excess ash formation and accumulations in the soot filters and catalytic converters. Excess ash formation results in a constantly rising exhaust back pressure and can therefore cause a slow reduction in engine power.

The above-mentioned points do not constitute a complete risk assessment. MTU is unable to assess all biodiesel variants and their long-term effects on MTU products.

## 5. Additional maintenance recommendations

The following requirements must be met to ensure the quality and availability of your engine:

- Select the highest possible content of distilled fuel. Only use fuels approved in the MTU Fluids and Lubricants Specifications.
- After switching over to a biodiesel mixture, replace the fuel filters after 50 operating hours at the latest (in order to remove the impurities which become loose from the tank and lines).
- The fuel filters and fuel prefilters must be renewed every 250 operating hours.
- Install a fuel preheating system if the engine is operated at temperatures below 0 °C (32 °F). This can reduce the negative effect on the fuel supply.
- Follow the recommendations below with regard to engine oil and maintenance:
  - If biodiesel mixtures are used, the change intervals for engine oil and filters must be halved in comparison to the intervals stated in the MTU Fluids and Lubricants Specifications.
  - The component TBO for the LP fuel pump, the O-rings in the LP fuel system as well as the valves in the fuel filter head is shortened to TBO/3.
  - In addition to changing the oil and filters on time, the engine oil and filters must be analyzed regularly in order to ensure that the oil quality is correct. Interval: Every 100 operating hours or every three months, depending on which comes first. A decision must be made to either further reduce or extend the change intervals on the basis of the results.
  - The oil and oil filter must be replaced before biodiesel is used.
  - High-quality engine oil must be used. Operating the engine without high-quality category 2 oil leads to a deterioration in oil quality. The MTU Fluids and Lubricants Specifications contain a list of approved oil types.
- Use a suitable tank and line system:
  - Do not use any components which contain zinc, copper or NBR seals.
  - Ensure that the system can be filled up to the fill line.
  - Minimize the entry of atmospheric oxygen through the tank vent in the event of temperature fluctuations, etc. (e.g. by installing a pressure relief valve and filter; contact your tank supplier to do this).
  - It is recommended to use a tank vent with humidity separator.
- For systems without a water separator: Retrofit a water separator to reduce the risk of microbe growth and corrosion in the fuel system.
- Regular maintenance of the water separator is mandatory. Separated water must be drained off daily, depending on the water quantity.
- Avoid extended engine downtimes and out-of-service periods (more than one week). If downtimes can not be avoided, a suitable additive must be used to improve oxidation stability. MTU has approved an additive that is specifically certified for MTU diesel engines. When this additive is used, B20 can be stored for up to four months, depending on the storage conditions and quality of the biodiesel. Prior to this point, we provided an additive on request.
- For engines used seasonally, we strongly recommend rinsing the fuel system, including the fuel tank, with pure, high-quality distilled diesel fuel in accordance with the MTU Fluids and Lubricants Specifications before the engine is decommissioned for a relatively long period (more than one week).
- Prevent biodiesel from coming into contact with painted surfaces to avoid damaging and stripping the paint.
- Furthermore, always ensure that the most recent version of the Fluids and Lubricants Specifications is available and its contents are observed.

More extensive preventative measures are additionally required for some applications. Our Customer Service department is available to answer any questions you may have on this topic.

## 6. Affected engines

This customer information applies to the following engine series:



| Series                                       | Remarks                            |
|--|------------------------------------|
| S1600Gx0                                     | All years of manufacture           |
| S2000Gx2                                     | All years of manufacture           |
| S2000Gx3                                     | With metal low-pressure fuel lines |
| S2000Gx4                                     | All years of manufacture           |
| S2000Gx5                                     | All years of manufacture           |
| S2000Gx6                                     | All years of manufacture           |
| S4000Cx0                                     | All years of manufacture           |
| S4000Cx1                                     | All years of manufacture           |
| S4000Gx1                                     | With metal low-pressure fuel lines |
| S4000Gx2                                     | All years of manufacture           |
| S4000Gx3                                     | All years of manufacture           |
| S4000Gx4 except for G44F, G44LF, G94F, G94LF | All years of manufacture           |
| S4000Mx0                                     | All years of manufacture           |
| S4000Mx1                                     | All years of manufacture           |
| S4000Mx3                                     | All years of manufacture           |
| S1163Mx4                                     | All years of manufacture           |
| S8000Mx1                                     | All years of manufacture           |

Table 13:

Should you have any questions about this customer information, please contact your local MTU representative.

## 4.3 Biodiesel – Biodiesel admixture

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

### General information

- We can make no comment with regard to the level of FAME resistance of the fuel system, which is not part of our scope of supply.
- 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 catalyst which may be installed by the vehicle / equipment manufacturers at their own risk.

#### Important information

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 noncompliance with our specifications on operation using FAME. All resultant irregularities and consequential damage lie outside our responsibility.

### Use of B20 fuels

#### Important information

Information on the use of B20 fuels can be obtained from the chapter (→ Page 53).

The following engines are approved/not approved for operation with 100% FAME in compliance with DIN EN 14214:2014-06.

### Approved/non-approved engines for operation with 100% FAME

| Series    | Approved / Not approved  | Conversion necessary |
|-----------|--------------------------|----------------------|
| SUN       | No approval              |                      |
| 700       | No approval              |                      |
| 750       | No approval              |                      |
| OM 457 LA | From series introduction | no                   |
| 460       | From series introduction | no                   |
| 900       | From series introduction | no                   |
| 500       | From series introduction | no                   |
| S40       | No approval              |                      |
| S50       | No approval              |                      |
| S60       | No approval              |                      |
| 183       | No approval              |                      |
| 2000      | No approval              |                      |
| 396       | No approval              |                      |
| 4000      | No approval              |                      |
| 538       | No approval              |                      |
| 595       | No approval              |                      |
| 956       | No approval              |                      |

| Series | Approved / Not approved | Conversion necessary |
|--------|-------------------------|----------------------|
| 1163   |                         | No approval          |
| 8000   |                         | No approval          |

Table 14:

| Important information  |
|--|
| Diesel fuel with a FAME content of max. 7% in compliance with DIN EN 590:2014-04 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. |

## Fuel

- The fuel must comply with DIN EN 14214:2014-06. 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 100% 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, 900 and 500 engines, special equipment is available which facilitates an increase in the engine oil change intervals for operation with 100% FAME (→ Table 15). This involves fitting the engines with special equipment Code MK21 (special unit pump) and Code MK04 (fuel prefilter with heated water separator).

## Effects on the engine oil change interval with operation with 100% FAME

| 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 standard 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 standard interval required for operation with fossil diesel fuels |

Table 15:

| Important information  |
|--|
| The relevant engine oil change intervals must be complied with without fail!<br>Exceeding the engine oil change intervals can cause engine damage! |

- Operation with 100% FAME requires shortened fuel filter change intervals. A new fuel filter must be fitted each time the engine oil is changed.
- FAME has a high cleaning effect, which results in a risk of clogging by loosened deposits. If a switch has been made to FAME, a fuel filter and engine oil change should therefore be carried out after approx. 25 operating hours.
- 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 100% FAME involves a reduction of approx.8% to 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 FAME-free diesel fuel.

### **Vegetable oils as an alternative to diesel fuel**

#### **Important information**

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)!

## 4.4 Heating oil EL

Heating oil differs from diesel fuel mainly because of the following non-specified characteristics:

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

If the heating requirements comply with the specifications of the diesel fuel DIN EN 590:2014-04 (summer and winter quality), there are no technical reasons why it can not be used in the diesel engine

## 4.5 Supplementary fuel additives

### Supplementary fuel additives

The engines are designed such 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 (→ Page 62) and biocides (→ Page 62) provide an exception.

#### Important information

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

### Diesel fuels with sulfur content < 500 mg/kg

On Series 362, 396, 538, 652, 595, 956, 1163-02 and -03 engines with cylinder heads not fitted with valve seat inserts, the use of low-sulfur fuel (< 500 mg/kg) can lead to increased valve seat wear. If anti-wear additives are mixed in, this wear can be reduced. The approved supplementary additives must be mixed with the fuel in the predefined concentration. The additive must be filled before every refueling.

### Approved anti-wear additives

| Manufacturer  | Brand name | Concentration for use |
|---|------------|-----------------------|
| The Lubrizol Corporation<br>29400 Lakeland Boulevard<br>Wickliffe, Ohio 44092<br>USA<br>Tel.<br>01 440-943-4200                     | ADX 766 M  | 250 to 350 mg/kg      |
| Tunap Industrie GmbH<br>Bürgermeister-Seidl-Str. 2<br>82515 Wolfratshausen<br>Tel. +49 (0) 8171 1600-0<br>Fax. +49 (0) 8171 1600-91 | Tunadd PS  | 250 to 350 mg/kg      |

Table 16:

#### Important information

The use of anti-wear additives is not permitted on engines/plants with exhaust aftertreatment!

### 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.

The biocides approved by MTU are listed in table (→ Page 62).

### Approved biocides

Biocides should have a pure hydrocarbon structure, i.e. should only consist of the following components:

- Carbon
- Hydrogen
- Oxygen
- Nitrogen

They must not contain inorganic substances because they can cause damage to the engine. The use of halogenated biocides is prohibited due to their effects on the engine system and the environment.

A release for biocides that meet the above requirements is possible upon request.

| Manufacturer  | Brand name                                | Concentration for use                        |
|---|---|--|
| ISP Biochema Schwaben GmbH<br>Ashland Specialty Ingredients<br>Luitpoldstrasse 32<br>87700 Memmingen<br>Tel. +49 (0)8331 9580 0<br>Fax. +49 (0)8331 9580 51 | Bakzid                                    | 100 ml / 100 l                               |
| Maintenance Technologies<br>Paddy's Pad 1056 CC t/a Maintenance Technologies<br>Tel. +27 21 786 4980<br>Cell +27 82 598 6830                                | Diesecure Fuel Decontainment              | 1 : 1200 (833 mg/kg)                         |
| Adolf Würth GmbH & Co. KG<br>Reinhold Würth-Straße 12-17<br>74653 Künzelsau<br>Tel. +49 (0) 7940 15-2248  | Diesecure Fuel Decontainment              | 1 : 1200 (833 mg/kg)                         |
| Schülke und Mayr<br>22840 Norderstedt<br>Tel. +49 (0) 40 52100-00<br>Fax. +49 (0) 40 52100-244  | grotamar 71<br>grotamar 82<br>StabiCor 71 | 0.5 l / ton<br>1.0 l / 1000 l<br>0.5 l / ton |
| DOW®<br><a href="https://www.dow.com/en-us/about-dow/locations">https://www.dow.com/en-us/about-dow/locations</a>   | Kathon™ FP 1.5 Biocide                    | 100-200 mg/kg                                |
| Supafuel Marketing CC<br>PO Box 1167<br>Allens Nek 1737<br>Johannesburg<br>South Africa<br>Tel. +27 83 6010 846<br>Fax. +27 86 6357 577                     | Dieselfix / Supafuel                      | 1:1200 (833 mg/kg)                           |
| Wilhelmsen Ships Service AS<br>Willem Barentszstraat 50<br>3165 AB Rotterdam-Albrtand-swaard<br>Tel. +31 10 487 7777<br>Fax. +31 10 487 7888<br>Netherlands | DieselPower MAR 71 (Biocontrol MAR 71)    | 333 ml / ton                                 |

Table 17:

## Flow improvers

Flow improvers can not prevent paraffin precipitation but they do influence the size of the crystals and thus 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.

## 4.6 Unsuitable materials in the diesel fuel circuit

### Components made of copper and zinc materials

Even small amounts of zinc, lead and copper may leave deposits in diesel fuel injection systems, particularly in modern, state-of-the-art injection systems. For this reason, levels of zinc, lead or copper in tanks, fuel lines and filter elements shall not exceed the manufacturer's validated specifications.

Avoid using materials containing these metals as this may initiate catalytic reactions in the fuel leading to undesirable deposits in the injection system.

### Requirements

Based on current knowledge, the following materials and coatings must not be used in a diesel fuel circuit because negative mutual reactions can occur even with approved coolant additives.

#### Metallic materials

- Zinc, also as surface protection
- Zinc-based alloys
- Copper
- Copper-based alloys with the exception of CuNi10 and CuNi30 (e.g. seawater cooler)
- Tin, also as surface protection
- Magnesium-based alloys

#### Non-metallic materials

- Elastomers: Nitrile butadiene rubber, natural rubber, chloroprene rubber, butyl rubber, EPDM
- Silicone elastomer
- Fluorosilicone elastomer
- Polyurethane
- Polyvinyl

#### Information:

In case of doubt about the use of materials on the engine / add-on components in coolant circuits, consultation with the respective MTU specialist department must be held.



## 4.7 MTU Advanced Fluid Management System for fuels – Test package for North America

A sophisticated system for diagnostics and preventive maintenance is available in North America. This system allows the following:

For full information on the MTU Advanced Fluid Management System available in North America, please contact an authorized MTU service partner.

The following test packages from MTU Advanced Fluid Management System can be ordered from authorized MTU service partners in North America:

- F-PDFM1  
Basic test – For checking the degree of contamination of the diesel fuel.  
The test determines existing metallic elements and examines the proportion of water and contamination with bacteria and particles.
- F-PDFM2  
Extended test – Includes the basic test plus an examination for determination of the degree of contamination, any possible filter contamination and ignition behavior of the engine.
- F-PDFM3  
Extended Test Plus – Includes the extended text plus a lubricity analysis.  
Maintenance of the correct lubricity has a positive effect on the service life of the components of the engine fuel system.

The following fuel parameters can be determined:

| Fuel parameter                                | F-PDFM1 | F-PDFM2 | F-PDFM3 |
|---|---------|---------|---------|
| 24 elementary metals                          | ✓       | ✓       | ✓       |
| Viscosity at 40 °C                            | -       | ✓       | ✓       |
| Percent sulfur                                | -       | ✓       | ✓       |
| Water and sediment                            | ✓       | ✓       | ✓       |
| Pour point                                    | ✓       | ✓       | ✓       |
| Thermal stability                             | ✓       | ✓       | ✓       |
| Bacteria, fungi and mildew                    | ✓       | ✓       | ✓       |
| Flashpoint according to Pensky-Marten         | -       | ✓       | ✓       |
| Calculated centane index                      | -       | ✓       | ✓       |
| Distillation                                  | -       | ✓       | ✓       |
| Cloud point                                   | -       | ✓       | ✓       |
| Percentage of water according to Karl Fischer | ✓       | ✓       | ✓       |
| Particle content                              | ✓       | ✓       | ✓       |
| Density according to API                      | -       | ✓       | ✓       |
| Lubricity                                     | -       | -       | ✓       |

The MTU Advanced Fluid Management System with trend analysis provides information for maximizing system reliability. The following guidelines must be followed to obtain the best results.

### Samples must be taken:

- While the engine is operating under normal conditions or immediately after stopping the engine while the engine is still at operating temperature
- Every 250 hours at the same point

Note: The software offered by MTU for online reporting with trend analyses shows the procedure for optimizing evaluation of the gathered information after completion of the analysis.

Note: The MTU Advanced Fluid Management System works together with independent test laboratories accredited according to ISO 17025 A2LA. This accreditation is the highest level of quality obtainable by a test laboratory in North America.

## 5 Approved Engine Oils and Lubricating Greases

### 5.1 Single-grade oils – Category 1, SAE grades 30 and 40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

#### Single-grade oils

| Manufacturer                              | Brand name                 | SAE viscosity class | TBN             |                  |             | Remarks                       |
|---|----------------------------|---------------------|-----------------|------------------|-------------|-------------------------------|
|   |                            |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |                               |
| Addinol Lube Oil                          | Addinol Marine MS4011      | 40                  | X               |                  |             |                               |
|   | Addinol Turbo Diesel MD305 | 30                  |                 | X                |             |                               |
|   | Addinol Turbo Diesel MD405 | 40                  |                 | X                |             |                               |
| Aegean Oil SA                             | Vigor Super D              | 40                  | X               |                  |             |                               |
| Castrol Ltd.                              | Castrol MLC                | 30, 40              |                 | X                |             |                               |
| Cepsa Lubricantes                         | Cepsa Rodaje Y Proteccion  | 30                  | X               |                  |             | Enhanced corrosion protection |
| Gulf Oil International                    | Gulf Superfleet            | 40                  | X               |                  |             |                               |
| LPC S.A.                                  | Cyclon D Prime             | 30, 40              | X               |                  |             |                               |
| Motor Oil (Hellas)                        | EMO Turbo Champion Plus    | 30, 40              | X               |                  |             |                               |
|   | EMO Turbo Champion         | 40                  |                 | X                |             |                               |
| Petrobras Distribuidora S.A.              | Marbrax CCD-310            | 30                  |                 | X                |             |                               |
|   | Marbrax CCD-410            | 40                  |                 | X                |             |                               |
| PT. Pertamina Lubricants                  | Meditiran SMX              | 40                  | X               |                  |             |                               |
| PTT Public Comp.                          | PTT Navita MTU Type 1      | 40                  | X               |                  |             |                               |
| Repsol Lubricantes y Especialidades, S.A. | Repsol Serie 3             | 30, 40              |                 | X                |             |                               |
|   | Repsol Marino 3            | 30                  |                 | X                |             |                               |
|   | Repsol Marino 3 SAE 40     | 40                  |                 |                  | X           |                               |
| SRS Schmierstoff Vertrieb GmbH            | SRS Rekord                 | 30, 40              |                 | X                |             |                               |
| Shell International Petroleum Company     | Shell Gadinia S3           | 30, 40              |                 | X                |             |                               |
|   | Shell Rimula R3            | 30, 40              | X               |                  |             |                               |
|   | Shell Rimula R3+           | 30                  | X               |                  |             |                               |
|   | Sirius                     | 30                  | X               |                  |             |                               |
|   | Shell Sirius Monograde     | 30, 40              | X               |                  |             |                               |
| SK Lubricants                             | SD 5000                    | 40                  | X               |                  |             |                               |
| Total Lubrificants                        | Total Caprano TD 30        | 30                  |                 | X                |             |                               |
|   | Total Caprano TD 40        | 40                  |                 | X                |             |                               |

| Manufacturer | Brand name            | SAE viscosity class | TBN             |                  |             | Remarks |
|--------------|-----------------------|---------------------|-----------------|------------------|-------------|---------|
|              |                       |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| United Oil   | XD 7000 Extra Duty-3U |                     | X               |                  |             |         |
|              | XD 7000 Extra Duty-4U |                     | X               |                  |             |         |

Table 18:

## 5.2 Multigrade oils - Category 1, SAE grades 15W-40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

### Important information

<sup>2)</sup> = Engine oils marked <sup>2)</sup> are also permitted for the "Series 60"

### Multigrade oils

| Manufacturer                        | Brand name                 | SAE viscosity class | TBN             |                  |             | Remarks |
|-------------------------------------|----------------------------|---------------------|-----------------|------------------|-------------|---------|
|                                     |                            |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Addinol Lube Oil                    | Addinol Super Star MX 1547 | 15W-40              |                 | X                |             |         |
| Advanced Lubrication Specialties    | Translub 15W40 CI-4        | 15W-40              |                 | X                |             |         |
| BP p.l.c.                           | BP Vanellus Multi          | 15W-40              | X               |                  |             |         |
| ENI S.p.A                           | eni i-Sigma universal DL   | 15W-40              | X               |                  |             |         |
| Exxon Mobil Corporation             | Mobil Delvac Super 1400E   | 15W-40              | X               |                  |             |         |
| Exxon Mobil Corporation             | Mobil Delvac XHP           | 15W-40              | X               |                  |             |         |
| Gulf Oil International              | Gulf Superfleet            | 15W-40              | X               |                  |             |         |
| Manufacture Zavod imeni Shau-myana  | M5z/14D <sub>2</sub> CE    | 15W-40              |                 |                  | X           |         |
| Petrogal, S.A.                      | Galp Galaxia Super 15W-40  | 15W-40              | X               |                  |             |         |
| Singapore Petroleum Company Limited | SPC SDM 801                | 15W-40              | X               |                  |             |         |
| SRS Schmierstoff Vertrieb GmbH      | SRS Primalub               | 15W-40              | X               |                  |             |         |
| Total Lubrifiants                   | Total Caprano TD           | 15W-40              | X               |                  |             |         |
| Unil Opal                           | Intercooler 400            | 15W-40              | X               |                  |             |         |
| United Oil                          | XD 9000 Ultra Diesel-U     | 15W-40              | X               |                  |             |         |

Table 19:

## 5.3 Single-grade oils – Category 2, SAE-grades 30 and 40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

### Important information

For Series 8000 engines, the approved SAE class 40 engine oils may only be used in combination with pre-heating and oil priming ( $T_{oil} > 30\text{ °C}$ ).

### Single-grade oils

| Manufacturer  | Brand name   | SAE viscosity class | TBN             |                  |             | Remarks  |
|---|--|---------------------|-----------------|------------------|-------------|--|
|   |  |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |  |
| MTU Friedrichshafen GmbH<br>Europe<br>Middle East<br>Africa | Diesel Engine Oil DEO COM<br>(enhanced corrosion protection) | 30                  | X               |                  |             | 20 l container:<br>X00078581<br>210 l container<br>X00078580<br>IBC: X00078579   |
| MTU Friedrichshafen GmbH                                    | Power Guard® DEO SAE 40                                      | 40                  | X               |                  |             | 20 l container:<br>X00062816<br>210 l container<br>X00062817<br>IBC: X00064829   |
| MTU America Inc.  | Power Guard® SAE 40 Off-Highway<br>Heavy Duty                | 40                  |                 | X                |             | 5 gallons: 23532941<br>55 gallons: 23532942<br>Approved for Series 8000<br>[see under Important information]<br>Available through MTU America Inc.<br>Not approved for Series 2000 M72 |
| MTU India Pvt Ltd.  | Diesel Engine Oil DEO SAE 40                                 | 40                  |                 | X                |             | 20 l container: 73333/P<br>205 l container: 75151/D<br>Sale of Indian oil only intended in Indian market   |
| Addinol Lube Oil GmbH                                       | Addinol Turbo Diesel MD 407                                  | 40                  | X               |                  |             |  |
| Adnoc Distribution  | ADNOC Voyager Plus 40 CF/SL                                  | 40                  | X               |                  |             |  |
| Atak Madeni Yag Lubricants                                  | Protector MX 30  | 30                  |                 |                  | X           |  |
|   | Protector MX 40  | 40                  |                 |                  | X           |  |
| BayWa AG  | Tectrol HD 30  | 30                  |                 | X                |             |  |
|   | Tectrol HD 40  | 40                  |                 | X                |             |  |

| Manufacturer                            | Brand name                     | SAE viscosity class | TBN             |                  |             | Remarks   |
|---|--------------------------------|---------------------|-----------------|------------------|-------------|---|
|   |                                |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |   |
| Belgin Madeni Yaglar                    | Lubex Marine M                 | 30                  |                 | X                |             |   |
|   | Lubex Marine M                 | 40                  |                 | X                |             |   |
|   | Lubex Marine LTM-30            | 30                  |                 | X                |             |   |
|   | Lubex Marine LTM-40            | 40                  |                 | X                |             |   |
| Bucher AG Langenthal                    | Motorex Monolube               | 30                  |                 | X                |             |   |
| Castrol Ltd.                            | Castrol HLX                    | 30, 40              |                 | X                |             | Approved for fast commercial vessels up to 1500 h, Series 595, 1163 |
| Cepsa Lubricants                        | Cepsa Petrel HDL 40            | 40                  |                 |                  | X           |   |
| Chevron Lubricants (Texaco)             | Ursa Premium TDX               | 40                  |                 | X                |             |   |
|   | Delo 400                       | 30, 40              |                 | X                |             |   |
|   | Delo Gold                      | 40                  |                 | X                |             |   |
| Chevron - Lyteca - (Texaco)             | Ursa Premium TDX               | 40                  |                 | X                |             |   |
| Delek                                   | Delkol Super Diesel            | 40                  |                 | X                |             |   |
|   | Delkol Super Diesel MT Mono    | 40                  | X               |                  |             |   |
| ENOC Marketing L.L.C.                   | ENOC Strata Super Duty         | 40                  |                 | X                |             |   |
| Exxon Mobil Corporation                 | Mobil Delvac 1630              | 30                  |                 | X                |             | Not approved for Series 2000 M72                                    |
|   | Mobil Delvac 1640              | 40                  |                 | X                |             | Not approved for Series 2000 M72                                    |
|   | Mobilgard ADL 30               | 30                  |                 | X                |             | Not approved for Series 2000 M72                                    |
|   | Mobilgard ADL 40               | 40                  |                 | X                |             | Not approved for Series 2000 M72                                    |
| Fuchs Petrolub SE                       | Titan Universal HD             | 30, 40              | X               |                  |             |   |
|   | Titan Universal HD 30 MTU      | 30                  | X               |                  |             | Enhanced corrosion protection                                       |
| Gulf Oil International                  | Gulf Superfleet Plus           | 40                  | X               |                  |             |   |
| Gulf Western Oil, Australia             | Turboil                        | 40                  |                 |                  | X           |   |
| GS Caltex Corporation                   | Kixx D1 40                     | 40                  | X               |                  |             |   |
| Hyrax Oil Sdn Bhd                       | Hyrax Top Deo                  | 40                  | X               |                  |             |   |
| Koçak Petrol Ürünleri San. ve TIC. Ltd. | Speedol Ultra HDX 30 TBN 12    | 30                  |                 | X                |             |   |
|   | Speedol Ultra HDX 40 TBN 12    | 40                  |                 | X                |             |   |
|   | Speedol Deniz Dizel Motor Yağı | 30, 40              |                 | X                |             |   |
|   | Speedol Ultra HDX              | 30, 40              | X               |                  |             |   |
| Kuwait Petroleum                        | Q8 T 750                       | 30, 40              | X               |                  |             |   |
| LPC S.A.                                | Cyclon D Super                 | 40                  |                 | X                |             |   |

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| Manufacturer                              | Brand name                   | SAE viscosity class | TBN             |                  |             | Remarks  |
|---|------------------------------|---------------------|-----------------|------------------|-------------|--|
|   |                              |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |  |
| Manufacture Zavod imeni Shau-myana Ltd.   | M-14D2CE                     | 40                  |                 |                  | X           |  |
| Motor Oil, Hellas                         | EMO SHPD Plus                | 30, 40              |                 | X                |             |  |
| OOO Lukoil International                  | Lukoil Avantgarde M 40       | 40                  | X               |                  |             |  |
| Oryx Energies                             | Supreme RR                   | 40                  |                 |                  | X           |  |
| Panolin AG                                | Panolin Extra Diesel         | 40                  | X               |                  |             |  |
| Paz Lubricants & Chemicals                | Pazl Marine S 40             | 40                  | X               |                  |             |  |
| Petrobras Distribuidora S.A.              | Marbrax CCD-310-AP           | 30                  |                 | X                |             |  |
|   | Marbrax CCD-410-AP           | 40                  |                 | X                |             |  |
| Petrogal, S.A.                            | Galp Galaxia 40              | 40                  |                 | X                |             |  |
| Prista Oil Holding EAD                    | Prista SHPD 40               | 40                  |                 |                  | X           |  |
| PTT Public Comp.                          | PTT Navita MTU Type 2        | 40                  |                 | X                |             |  |
|   | Navita Plus, SAE 40          | 40                  |                 | X                |             |  |
| Repsol Lubricantes y Especialidades, S.A. | Repsol Diesel Serie 3 MT     | 40                  |                 |                  | X           |  |
| Shell International Petroleum Company     | Shell Sirius X               | 30                  |                 |                  | X           |  |
|   | Shell Sirius X               | 40                  |                 |                  | X           |  |
| Sonol                                     | Seamaster 40                 | 40                  | X               |                  |             |  |
| SRS Schmierstoff Vertriebs GmbH           | SRS Rekord plus 30           | 30                  |                 | X                |             |  |
|   | SRS Rekord plus 40           | 40                  |                 | X                |             |  |
|   | SRS Antikorrol M plus        | 30                  |                 | X                |             | Enhanced corrosion protection<br>Only permitted for run-in and series acceptance |
|   | SRS Motorenöl O-278          | 40                  |                 | X                |             |  |
| Total Lubrificants                        | Total Caprano MT 30          | 30                  |                 |                  | X           |  |
|   | Total Caprano MT 40          | 40                  |                 |                  | X           |  |
|   | Total Disola MT 30           | 30                  | X               |                  |             |  |
|   | Total Disola MT 40           | 40                  | X               |                  |             |  |
|   | Total Rubia MT 30            | 30                  |                 |                  | X           |  |
|   | Total Rubia MT 40            | 40                  |                 |                  | X           |  |
| Viva Energy Australia                     | Penske Power Systems Premium | 40                  |                 |                  | X           |  |

Table 20:



## 5.4 Multigrade oils - Category 2, SAE grades 10W-40, 15W-40 and 20W-40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

### Important information

<sup>2)</sup> Engine oils marked <sup>2)</sup> are also approved for "Series 60"

### Multigrade oils

| Manufacturer                   | Brand name                         | SAE viscosity class | TBN             |                  |              | Remarks   |
|--------------------------------|------------------------------------|---------------------|-----------------|------------------|--------------|---|
|                                |                                    |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |   |
| MTU Friedrichshafen GmbH       | Diesel Engine Oil DEO SAE 15W-40   | 15W-40              |                 | X                |              | 20 l container: X00070830<br>210 l container: X00070832<br>IBC: X00070833<br>Loose items: X00070835 (only on request) |
| MTU Asia                       | Diesel Engine Oil - DEO 15W-40     | 15W-40              |                 | X                |              | 20 l container: 64247/P<br>200 l container: 65151/D   |
| MTU Asia China                 | Diesel Engine Oil - DEO SAE 15W-40 | 15W-40              |                 | X                |              | 20 l canister: X00064242/P<br>205 l barrel: 65151/D   |
|                                | Diesel Engine Oil - DEO SAE 10W-40 | 10W-40              |                 | X                |              | 20 l canister: 60606/P  |
| MTU India Pvt. Ltd.            | Diesel Engine Oil - DEO 15W-40     | 15W-40              |                 | X                |              | 20 l canister: 63333/P <sup>2)</sup><br>205 l barrel: 65151/D<br>Sale only intended in Indian market                  |
| Adnoc Distribution             | Adnoc Voyager Plus                 | 15W-40              |                 | X                |              | <sup>2)</sup>   |
| Aegean Oil S.A.                | Vigor Turbo SD 15W-40              | 15W-40              | X               |                  |              | <sup>2)</sup>   |
| Addinol Lube Oil               | Addinol Super Longlife MD1047      | 10W-40              |                 | X                |              | <sup>2)</sup>   |
|                                | Addinol Diesel Longlife MD1548     | 15W-40              |                 | X                |              | <sup>2)</sup>   |
| AP Oil                         | AP X-Super Dieselube Turbo CF-4    | 15W40               | X               |                  |              |   |
| Arabi Enertech KSC             | Burgan Ultra Diesel CH-4           | 15W-40              |                 | X                |              | <sup>2)</sup>   |
| Aral AG                        | Aral Turboral 10W-40               | 10W-40              |                 | X                |              |   |
|                                | Aral Turboral 15W-40               | 15W-40              |                 | X                |              | <sup>2)</sup>   |
| Atak Madeni Yağ Pas.San.Tic.Aş | Alpet Turbot                       | 10W40               |                 | X                |              |   |
|                                | Alpet Turbot Fleetmax              | 15W-40              |                 | X                |              |   |
|                                | Alpet Turbot SHPD                  | 15W-40              |                 | X                |              |   |
|                                | Alpet Turbot XHD                   | 10W-40              |                 | X                |              |   |
| Auto-Teile-Ring GmbH           | Cartechnic Motorenöl SAE 15W-40    | 15W-40              | X               |                  |              |   |

| Manufacturer                                   | Brand name                 | SAE viscosity class | TBN             |                  |              | Remarks |
|--|----------------------------|---------------------|-----------------|------------------|--------------|---------|
|  |                            |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Avista Oil Refining & Trading Deutschland GmbH | Avista Advantage SHPD      | 15W-40              | X               |                  |              |         |
|  | Avista Advantage UHPD      | 15W-40              | X               |                  |              |         |
|  | Pennasol Turbo Super       | 15W-40              |                 | X                |              | 2)      |
|  | MOTOR GOLD Turbotec        | 15W-40              |                 | X                |              | 2)      |
| Bahrain Petroleum Company B.S.C.               | Frontier Megatek           | 10W-40              | X               |                  |              |         |
|  | Frontier Super Plus        | 15W-40              |                 | X                |              | 2)      |
|  | Frontier Turbo             | 15W-40              |                 | X                |              |         |
|  | Frontier Turbo LD          | 10W-40              |                 | X                |              |         |
|  | Frontier Turbo Plus        | 15W-40              |                 | X                |              | 2)      |
| BayWa AG                                       | Tectrol Turbo 4000         | 10W-40              |                 | X                |              |         |
| Belgin Madeni Yaglar                           | Lubex Marine M             | 15W-40              |                 | X                |              |         |
| BP p.l.c.                                      | BP Vanellus C6 Global Plus | 10W-40              |                 | X                |              |         |
|  | BP Vanellus Multi-Fleet    | 15W-40              |                 |                  | X            | 2)      |
|  | BP Multi Mine              | 15W-40              | X               |                  |              | 2)      |
|  | BP Mine Multi 15W-40       | 15W-40              |                 | X                |              | 2)      |
|  | BP Vanellus Longdrain      | 15W-40              |                 | X                |              | 2)      |
|  | BP Vanellus Multi A        | 10W-40              |                 | X                |              | 2)      |
|  | BP Vanellus Agri           | 10W-40              |                 | X                |              | 2)      |
|  | BP Vanellus Multi A        | 15W-40              |                 | X                |              | 2)      |
|  | BP Vanellus Agri           | 15W-40              | X               |                  |              | 2)      |
|  | BP Vanellus Max Extra      | 15W-40              |                 |                  | X            | 2)      |
| Bucher AG Langenthal                           | Motorex Universal          | 10W-40              |                 | X                |              |         |

| Manufacturer                     | Brand name                             | SAE viscosity class | TBN             |                  |              | Remarks |
|----------------------------------|--|---------------------|-----------------|------------------|--------------|---------|
|                                  |  |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Castrol Ltd.                     | Castrol CRB Multi 10W-40 CI-4/E7       | 10W-40              |                 | X                |              |         |
|                                  | Castrol CRB Multi 15W-40 CI-4/E7       | 15W-40              |                 | X                |              | 2)      |
|                                  | Castrol CRB Turbo 15W-40 CH-4/E7       | 15W-40              | X               |                  |              | 2)      |
|                                  | Castrol CRB Turbomax 15W-40 CI-4/SL/E7 | 15W-40              |                 | X                |              | 2)      |
|                                  | Castrol Rivermax CRB 15W-40 CI-4/E7    | 15W-40              |                 | X                |              | 2)      |
|                                  | Castrol Rivermax RX+ 15W-40            | 15W-40              | X               |                  |              | 2)      |
|                                  | Castrol Vecton 15W-40 DH-1             | 15W-40              |                 |                  | X            | 2)      |
|                                  | Castrol RX Diesel                      | 15W-40              | X               |                  |              |         |
|                                  | Castrol RX Diesel 15W-40 CI-4/E7       | 15W-40              |                 | X                |              | 2)      |
|                                  | Castrol Vecton                         | 10W-40              |                 | X                |              |         |
|                                  | Castrol Vecton 15W-40 CI-4/E7          | 15W-40              |                 | X                |              | 2)      |
|                                  | Castrol Vecton 15W-40 CI-4 Plus/SL/E7  |                     |                 |                  | X            | 2)      |
| Cepsa                            | Cepsa Euromax SHPD                     | 15W-40              |                 | X                |              | 2)      |
| Cepsa Comercial Petroleo S.A.U.  | Traction Max SAE 15W-40                | 15W-40              |                 | X                |              | 2)      |
| Champion Chemicals N.V.          | Champion New Energy                    | 15W-40              |                 | X                |              | 2)      |
| Chevron Lubricants (Caltex)      | Delo SHP Multigrade                    | 15W-40              |                 | X                |              |         |
|                                  | Delo Gold Multigrade                   | 15W-40              | X               |                  |              |         |
|                                  | Delo Gold Ultra                        | 15W-40              |                 | X                |              | 2)      |
|                                  | Delo Gold Ultra E                      | 10W-40              |                 | X                |              |         |
|                                  | Delo Gold Ultra E                      | 15W-40              | X               |                  |              | 2)      |
|                                  | Delo 400 Multigrade                    | 15W-40              |                 |                  | X            | 2)      |
|                                  | OEC SAE 15W-40                         | 15W-40              |                 | X                |              |         |
| Chevron Lubricants (Texaco)      | Ursa Super TD                          | 15W-40              |                 | X                |              | 2)      |
|                                  | Ursa Premium TDX                       | 15W-40              |                 | X                |              | 2)      |
|                                  | Ursa Premium TDX Plus                  | 15W-40              |                 | X                |              | 2)      |
|                                  | Ursa Heavy Duty                        | 15W-40              | X               |                  |              |         |
| CPC Corporation, Taiwan          | CPC Superfleet CG4 Motor Oil           | 15W-40              | X               |                  |              |         |
| Cubalub                          | Cubalub Extra Diesel MX                | 15W-40              |                 |                  | X            | 2)      |
|                                  | Cubalub Extra Diesel                   | 15W-40              | X               |                  |              |         |
| Delek                            | Delkol Super Diesel                    | 15W-40              | X               |                  |              |         |
| Delek Industries Ltd.            | Super Diesel                           | 15W-40              |                 | X                |              |         |
| Dunwell Petro-Chemical Co., Ltd. | Apex Super Motor Oil SL/CI-4, 15W-40   | 15W-40              |                 | X                |              | 2)      |
| EKO A.B.E.E.                     | Eko Forza plus                         | 15W-40              | X               |                  |              |         |

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| Manufacturer                      | Brand name                                 | SAE viscosity class | TBN             |                  |              | Remarks  |
|-----------------------------------|--|---------------------|-----------------|------------------|--------------|--|
|                                   |  |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |  |
| Engen Petroleum Ltd.              | Engen Dieselube 600 Super                  | 15W-40              | X               |                  |              | 2)   |
|                                   | Engen Dieselube 700 Super                  | 15W-40              |                 | X                |              | 2)   |
| eni S.p.A.                        | eni i-Sigma super fleet                    | 15W-40              |                 | X                |              |  |
|                                   | eni i-Sigma performance E3                 | 15W-40              | X               |                  |              |  |
|                                   | eni i-Sigma performance E7                 | 15W-40              |                 | X                |              | 2)   |
|                                   | eni i-Sigma performance E7                 | 15W-40              | X               |                  |              | 2)   |
| Euroiltec Industry Co., Ltd.      | Casoku                                     | 15W-40              | X               |                  |              |  |
| Exol Lubricants Ltd.              | Taurus Extreme M                           | 15W-40              | X               |                  |              | 2)   |
|                                   | Taurus Extreme HST                         | 15W-40              |                 | X                |              | 2)   |
| Exxon Mobil Corporation           | Mobilgard HSD 15W-40 CH-4                  | 15W-40              | X               |                  |              |  |
|                                   | Mobilgard 1 SHC                            | 20W-40              |                 |                  | X            | Approved for fast commercial vessels up to 1500 h, 396, 1163 |
|                                   | Mobil Delvac Super 1300 C                  | 15W-40              | X               |                  |              |  |
|                                   | Mobil Delvac Super 1400                    | 15W-40              | X               |                  |              |  |
|                                   | Mobil Delvac Modern 15W-40 Super Defense   | 15W-40              | X               |                  |              |  |
|                                   | Mobil Delvac MX                            | 15W-40              |                 |                  | X            |  |
|                                   | Mobil Delvac MX Extra                      | 15W-40              |                 | X                |              |  |
|                                   | Mobil Delvac Advanced City Logistics       | 15W-40              | X               |                  |              |  |
|                                   | Mobil Delvac Legend CH-4 15W-40 Heavy Duty | 15W-40              | X               |                  |              |  |
| Finke Mineralölwerk GmbH          | AVIATICON Turbo Super Plus                 | 15W-40              | X               |                  |              | 2)   |
| Formosa Petrochemical Corporation | Formosa Marine Fleet XMT                   | 15W-40              | X               |                  |              |  |
| Fuchs Lubrifiants France          | Cofran Plura Super                         | 15W-40              |                 | X                |              | 2)   |
| Fuchs Petrolub SE                 | Fuchs Max Way                              | 15W-40              |                 | X                |              | 2)   |
|                                   | Pentotruck                                 | 15W-40              |                 | X                |              | 2)   |
|                                   | Fuchs Titan Formel Plus                    | 15W-40              |                 | X                |              |  |
|                                   | Fuchs Titan Truck                          | 15W-40              | X               |                  |              | 2)   |
|                                   | Fuchs Titan Truck Plus                     | 10W-30              |                 | X                |              |  |
|                                   | Fuchs Titan Truck Plus                     | 15W-40              |                 | X                |              | 2)   |
|                                   | Fuchs Titan Unimax Plus MC                 | 10W-40              |                 | X                |              |  |
|                                   | Fuchs Titan Unimax Ultra MC                | 10W-40              |                 | X                |              |  |
|                                   | Fuchs Titan Universal HD                   | 15W-40              | X               |                  |              |  |

| Manufacturer  | Brand name  | SAE viscosity class | TBN             |                  |              | Remarks |
|---|---|---------------------|-----------------|------------------|--------------|---------|
|   |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Gazpromneft Lubricants Ltd.                             | Belaz G-Profi Mining                                  | 15W-40              |                 | X                |              | 2)      |
|   | Belaz G-Profi Mining FF                               | 15W-40              |                 | X                |              | 2)      |
|   | G-Profi MSI 10W-40                                    | 10W-40              |                 | X                |              |         |
|   | G-Profi MSI 15W-40                                    | 15W-40              |                 | X                |              |         |
|   | G-Profi MSH 15W-40                                    | 15W-40              | X               |                  |              |         |
|   | G-Profi MSI Plus                                      | 15W-40              |                 | X                |              | 2)      |
|   | G-Profi PSE   | 15W-40              |                 | X                |              | 2)      |
|   | Gazpromneft Diesel Premium                            | 15W-40              | X               |                  |              | 2)      |
| German Mirror Lubricants and Greases Co. FZE            | Mirr Turbo Plus Diesel Engine Oil API CI-4 SAE 10W-40 | 10W-40              |                 | X                |              |         |
|   | Mirr Turbo Plus Diesel Engine Oil API CI-4 SAE 15W-40 | 15W-40              | X               |                  |              | 2)      |
|   | Mirr Turbo Diesel Engine Oil API CH-4 SAE 15W-40      | 15W-40              | X               |                  |              | 2)      |
| Ginouves Georges SAS                                    | York 849  | 15W-40              |                 | X                |              | 2)      |
| GS Caltex India Private Limited                         | Kixx Dynamic Gold                                     | 15W-40              |                 | X                |              | 2)      |
| GS Caltex Corporation                                   | Kixx HD 1   | 10W-40              |                 | X                |              |         |
|   | Kixx HD 1   | 15W-40              |                 | X                |              | 2)      |
| Gulf Oil International                                  | Gulf Super Duty VLE                                   | 15W-40              | X               |                  |              |         |
|   | Gulf Superfleet LE                                    | 10W-40              |                 | X                |              |         |
|   | Gulf Superfleet LE                                    | 15W-40              | X               |                  |              | 2)      |
|   | Gulf Superfleet Supreme                               | 10W-40              |                 | X                |              |         |
|   | Gulf Superfleet Supreme                               | 15W-40              |                 | X                |              | 2)      |
|   | Gulf Superfleet Plus                                  | 15W-40              | X               |                  |              |         |
| Gulf Western Oil, Australia                             | TOP DOG XDO   | 15W-40              | X               |                  |              | 2)      |
| HAFSA France  | Stradex 1800  | 10W-40              |                 | X                |              |         |
| Hessol Lubrication GmbH                                 | Hessol Turbo Diesel                                   | 15W-40              |                 | X                |              | 2)      |
|   | Hessol Super Longlife                                 | 10W-40              |                 | X                |              |         |
| High Industrial Lubricants & Liquids Corporation (HILL) | Fastroil Force F300 Diesel                            | 15W-40              |                 | X                |              | 2)      |
|   | Fastroil Force F500 Diesel                            | 15W-40              |                 | X                |              | 2)      |
|   | Fastroil Force F700 Diesel Pro                        | 10W-40              |                 | X                |              |         |
| Hitachi Construction Machinery CO., Ltd.                | Hitachi Premium Orange                                | 15W-40              | X               |                  |              |         |
| Huiles Berliet S.A.                                     | RTO Maxima RD   | 15W-40              | X               |                  |              | 2)      |
|   | RTO Maxima RLD  | 15W-40              |                 | X                |              | 2)      |

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| Manufacturer                           | Brand name                                      | SAE viscosity class | TBN             |                  |              | Remarks |
|--|---|---------------------|-----------------|------------------|--------------|---------|
|  |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Hyrax Oil Sdn Bhd                      | Ceypetco Enduro                                 | 15W-40              |                 | X                |              | 2)      |
|  | Hyrax Admiral 15W-40                            | 15W-40              | X               |                  |              | 2)      |
| INA Maziva Ltd.                        | INA Super Max                                   | 15W-40              |                 | X                |              | 2)      |
| Indian Oil Corporation Limited         | Servo Premium (N)                               | 15W-40              |                 | X                |              |         |
|  | Servo Pride Supreme XL                          | 15W-40              |                 | X                |              | 2)      |
| Ipiranga Produtos des Petróleo S.A.    | Ipiranga Brutus Alta Performance                | 15W-40              |                 | X                |              | 2)      |
| Kuwait National Lube Oil MfgCo (KNLOC) | Burgan Ultra Diesel CH-4                        | 15W-40              |                 | X                |              | 2)      |
| Kuwait Petroleum                       | Q8 T 750  | 15W-40              | X               |                  |              | 2)      |
|  | Q8 T 800  | 10W-40              | X               |                  |              | 2)      |
| Kocak Petrol Ürünleri San              | Speedol SHPD Tiro 15W-40                        | 15W-40              |                 | X                |              |         |
| Liqui Moly GmbH                        | Liqui Moly Marine 4T Motor Oil                  | 15W-40              |                 | X                |              | 2)      |
|  | Liqui Moly Touring High Tech SHPD               | 15W-40              |                 | X                |              | 2)      |
| Lotos Oil                              | Turdus Powertec CI-4 15W-40                     | 15W-40              |                 | X                |              | 2)      |
|  | Turdus Powertec 1000                            | 15W-40              |                 | X                |              | 2)      |
| LPC S.A.                               | Cyclon D Super                                  | 15W-40              | X               |                  |              |         |
|  | Cyclon Granit Maximum                           | 15W-40              |                 | X                |              | 2)      |
| Lubricantes de América                 | Generac Aceite                                  | 15W-40              |                 | X                |              |         |
|  | Lubral Nano Diesel                              | 15W-40              |                 | X                |              |         |
|  | Lubral Nano Diesel SAE 5W-40 API CI-4 Plus / SL | 15W-40              |                 | X                |              | 2)      |
| Lubrisa                                | Gulf Superfleet Supreme                         | 15W-40              |                 | X                |              | 2)      |
| Lukoil Lubricants Europe Oy            | Teboil Power Plus                               | 15W-40              | X               |                  |              |         |
|  | Tepoil Super HPD                                | 15W-40              |                 | X                |              |         |
|  | Tepoil Super HPD C                              | 10W-40              |                 | X                |              |         |
| Mabanol GmbH & Co. KG                  | Mabanol Argon Fleet                             | 15W-40              | X               |                  |              |         |
| Mega Lube Marketers cc.                | Megalube Diesel Engine Oil                      | 15W-40              |                 | X                |              |         |
| Meguín GmbH                            | megal Motorenoel SHPD                           | 15W-40              | X               |                  |              |         |
| Modriča Oil Refinery                   | Maxima Turbo                                    | 15W-40              |                 | X                |              |         |
| MOL-LUB Kft..                          | MOL Dynamic MK9                                 | 15W-40              |                 | X                |              |         |
|  | MOL Mk-9  | 15W-40              |                 | X                |              |         |
|  | Mol Dynamic Super Diesel                        | 15W-40              | X               |                  |              |         |
|  | Mol Dynamic Transit                             | 10W-40              |                 | X                |              | 2)      |
|  | Mol Dynamic Transit                             | 15W-40              |                 | X                |              | 2)      |
|  | MOL Super Diesel                                | 15W-40              | X               |                  |              |         |

| Manufacturer                       | Brand name                              | SAE viscosity class | TBN             |                  |              | Remarks |
|------------------------------------|---|---------------------|-----------------|------------------|--------------|---------|
|                                    |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Morris Lubricants Limited          | Versimax HD4                            | 15W-40              |                 | X                |              | 2)      |
| Motor Oil, Hellas                  | EMO SHPD Plus                           | 15W-40              |                 | X                |              |         |
| MPM International Oil Company B.V. | Motor Oil 15W-40 Super High Performance | 15W-40              |                 | X                |              | 2)      |
| NetLube Iran                       | Max Turbo                               | 15W-40              |                 | X                |              | 2)      |
| NSL OilChem Trading Pte Ltd        | Liquid Gold D-Flo X4                    | 15W-40              |                 | X                |              | 2)      |
| Oman Oil Marketing Company SAOG    | Omanoil Maximo Super 15W40 CH-4         | 15W-40              | X               |                  |              | 2)      |
| Orlen Oil                          | Mogul Diesel DTT Extra                  | 15W-40              |                 |                  | X            | 2)      |
|                                    | Platinum Ultor                          | 15W-40              | X               |                  |              | 2)      |
|                                    | Platinum Ultor Plus                     | 15W-40              |                 |                  | X            | 2)      |
| OOO "LLK-International"            | BELAZ CI-4                              | 15W-40              | X               |                  |              | 2)      |
|                                    | Lukoil Avantgarde Extra                 | 15W-40              | X               |                  |              | 2)      |
|                                    | Lukoil Avantgarde Ultra                 | 15W-40              |                 | X                |              |         |
|                                    | Lukoil Avantgarde NP                    | 15W-40              |                 | X                |              |         |
|                                    | Lukoil Avantgarde Ultra Plus            | 10W-40              |                 | X                |              |         |
| Oryx Energies                      | Enduro 600                              | 15W-40              |                 | X                |              |         |
| Panolin AG                         | Panolin Universal SFE                   | 10W-40              |                 | X                |              |         |
|                                    | Panolin Diesel Synth                    | 10W-40              |                 | X                |              |         |
| PDVSA CA                           | PDV Ultradiesel                         | 15W-40              |                 | X                |              | 2)      |
| Petrobras Colombia Combustibles    | Petrobras Top Turbo T2                  | 15W-40              | X               |                  |              |         |
| Petrobras Distribuidora S.A.       | Lubrax Nautica Diesel                   | 15W-40              |                 | X                |              | 2)      |
| Petro-Canada Lubricants            | Duron                                   | 15W-40              |                 | X                |              | 2)      |
|                                    | Duron XL                                | 15W-40              |                 | X                |              | 2)      |
| Petrogulf Oil Manufacturing LLC    | Paramount Extreme Action 15W40 CI-4     | 15W-40              |                 | X                |              | 2)      |
| Petrogal, S.A.                     | Galp Galaxia LD star                    | 15W-40              |                 | X                |              |         |
| Petron Corporation                 | Petron Rev-x Premium Multi Grade        | 15W-40              |                 | X                |              | 2)      |
| Petronas Lubricants International  | Petronas Urania 3000                    | 15W-40              |                 | X                |              | 2)      |
|                                    | Petronas Urania LD7                     | 15W-40              |                 | X                |              |         |
|                                    | Petronas Urania LD 7                    | 10W-40              | X               |                  |              |         |
|                                    | Petronas Urania Supremo CI-4            | 10W-40              | X               |                  |              | 2)      |
|                                    | Petronas Urania Supremo CI-4            | 15W-40              | X               |                  |              | 2)      |
| Petromin Corporation               | Petromin Turbomaster XD                 | 15W-40              |                 | X                |              | 2)      |
|                                    | Petromin Turbomaster XD 15W40 CI-4      | 15W-40              |                 | X                |              | 2)      |
| Phillips 66 Lubricants             | Conoco Hydroclear Power D               | 15W-40              |                 |                  | X            |         |

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| Manufacturer                                       | Brand name                            | SAE viscosity class | TBN             |                  |              | Remarks |
|--|---------------------------------------|---------------------|-----------------|------------------|--------------|---------|
|  |                                       |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Prista Oil Holding EAD                             | Prista Turbo Diesel                   | 15W-40              | X               |                  |              |         |
|  | Pro Auto HDEO E7 15W-40               | 15W-40              |                 | X                |              | 2)      |
| PT Pertamina Lubricants                            | Meditran SX                           | 15W-40              |                 | X                |              | 2)      |
|  | Meditran SX Plus                      | 15W-40              |                 | X                |              |         |
| PTT Oil and Retail Business Public Company Limited | Navita Plus                           | 15W-40              |                 | X                |              | 2)      |
| PTT Public Limited                                 | Navita Plus SAE 15W-40                | 15W-40              | X               |                  |              |         |
| Puma Lubricants                                    | Puma Power Motor Oil                  | 15W-40              |                 | X                |              | 2)      |
| Qatar Lubricants Company Ltd.                      | QALCO Topaz HMF                       | 15W-40              | X               |                  |              |         |
| Qingdao Copton Technology Co., LTD.                | Copton CH-4 Diesel Engine Oil         | 15W-40              | X               |                  |              |         |
| Raloy Lubricantes, S.S. de C.V.                    | Raloy Diesel Power                    | 15W-40              |                 | X                |              | 2)      |
| Raj Petro Specialities P Ltd.                      | Zoomol Rforce 3100 RF1                | 15W-40              | X               |                  |              | 2)      |
|  | Zoomol Rforce 3100 RF4                | 15W-40              |                 | X                |              | 2)      |
| Ravensberger Schmierstoffvertrieb GmbH             | RAVENOL Expert SHPD                   | 10W-40              |                 | X                |              |         |
|  | RAVENOL Mineralöl Turbo Plus SHPD     | 15W-40              | X               |                  |              | 2)      |
| Repsol Lubricantes y Especialidades, S.A.          | Repsol Diesel Turbo THPD              | 15W-40              |                 |                  | X            | 2)      |
|  | Repsol Diesel Super Turbo             | 15W-40              |                 | X                |              | 2)      |
|  | Repsol Diesel Super Turbo SHPD        | 15W-40              | X               |                  |              | 2)      |
|  | Repsol Neptuno S-Turbomar             | 15W-40              | X               |                  |              | 2)      |
| RN-Lubricants, LLC                                 | Rosneft Revolux D2                    | 15W-40              | X               |                  |              |         |
|  | Rosneft Revolux D3                    | 15W-40              |                 | X                |              | 2)      |
|  | Rosneft Revolux D5                    | 15W-40              |                 | X                |              |         |
| ROWE Mineralölwerk GmbH                            | ROWE Hightec Formula GT SAE 10W-40 HC | 10W-40              |                 | X                |              |         |
|  | ROWE Hightec Turbo HD 15W-40 Plus     | 15W-40              |                 | X                |              | 2)      |
| S.A.E.L.   | Gulf Gulfleet Long Road               | 15W-40              | X               |                  |              |         |



| Manufacturer                          | Brand name                            | SAE viscosity class | TBN             |                  |              | Remarks                          |
|---------------------------------------|---------------------------------------|---------------------|-----------------|------------------|--------------|----------------------------------|
|                                       |                                       |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |                                  |
| Shell International Petroleum Company | Shell Rimula MV                       | 15W-40              |                 |                  | X            | 2)                               |
|                                       | Shell Rimula R3 MV                    | 15W-40              | X               |                  |              | 2)                               |
|                                       | Shell Rimula R3 X                     | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula R4                       | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula R4 Plus                  | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula R4 X                     | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula RT4                      | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula RT4 X                    | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula T3                       | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula T4                       | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Rimula X                        | 15W-40              |                 | X                |              |                                  |
|                                       | Shell Rotella T2                      | 15W-40              |                 | X                |              |                                  |
|                                       | Shell Rotella T Multigrade            | 15W-40              |                 | X                |              | 2)                               |
|                                       | Shell Sirius                          | 15W-40              |                 | X                |              | 2)                               |
|                                       | Eicher Premium Plus Diesel Engine Oil | 15W-40              |                 | X                |              | 2)                               |
| Shanghai HIRI Lubricants R & D Centre | HIRI                                  | 15W-40              | X               |                  |              |                                  |
| Singapore Petroleum Company Limited   | SDM 900 SAE 15W40                     | 15W-40              |                 | X                |              |                                  |
| Sinopec Lubricant Co., Ltd.           | Sinopec Tulux T500                    | 15W-40              |                 | X                |              | 2)                               |
| SK Lubricants Co. Ltd.                | ZIC X5000 10W-40                      | 10W-40              |                 | X                |              |                                  |
|                                       | ZIC X5000                             | 15W-40              | X               |                  |              | 2)                               |
|                                       | ZIC X7000 CI-4 10W-40                 | 10W-40              |                 | X                |              |                                  |
|                                       | ZIC X7000 CI-4                        | 15W-40              | X               |                  |              | 2)                               |
| SRS Schmierstoff Vertrieb GmbH        | SRS Motorenöl O-236                   | 15W-40              | X               |                  |              | 2) Enhanced corrosion protection |
|                                       | SRS Multi-Rekord top                  | 15W-40              |                 | X                |              | 2)                               |
|                                       | SRS Multi Rekord plus                 | 15W-40              | X               |                  |              |                                  |
|                                       | SRS Turbo Rekord                      | 15W-40              | X               |                  |              | 2)                               |
|                                       | SRS Turbo Rekord NG                   | 15W-40              |                 | X                |              | 2)                               |
|                                       | SRS Cargolub TFE                      | 15W-40              |                 | X                |              |                                  |
|                                       | SRS Cargolub TFX                      | 10W-40              |                 | X                |              |                                  |
| Tesla Technoproducts FZE              | Denebola Saheli Ultra XS 1120         | 15W-40              |                 | X                |              | 2)                               |
| Top 1 Oil Products Company            | Top 1 Transport                       | 15W-40              |                 | X                |              | 2)                               |

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| Manufacturer             | Brand name                                  | SAE viscosity class | TBN             |                  |              | Remarks |
|--------------------------|---|---------------------|-----------------|------------------|--------------|---------|
|                          |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | > 12 mgKOH/g |         |
| Total Lubrificants       | Total Caprano Energy FE                     | 15W-30              |                 | X                |              |         |
|                          | Total Caprano TDH                           | 15W-40              |                 | X                |              | 2)      |
|                          | Total Caprano TDI                           | 15W-40              |                 | X                |              | 2)      |
|                          | Total Disola W                              | 15W-40              |                 | X                |              |         |
|                          | Total Genlub TDX                            | 15W-40              | X               |                  |              |         |
|                          | Total Rubia TIR 6400                        | 15W-40              | X               |                  |              |         |
|                          | Total Rubia Works 1000                      | 15W-40              |                 | X                |              | 2)      |
|                          | Hitachi Genuine Engine Oil 15W40 DH-1       | 15W-40              |                 | X                |              | 2)      |
| Unil Opal                | Medos 700                                   | 15W-40              |                 |                  | X            | 2)      |
| Valvoline EMEA           | All-Fleet Extra SAE 15W-40                  | 15W-40              | X               |                  |              | 2)      |
|                          | All-Fleet Plus                              | 15W-40              | X               |                  |              | 2)      |
|                          | NextGen All-Fleet extra                     | 15W-40              |                 | X                |              | 2)      |
|                          | Premium Blue Classic                        | 15W-40              |                 | X                |              | 2)      |
|                          | Valvoline All-Fleet Extra                   | 15W-40              |                 | X                |              | 2)      |
|                          | Valvoline Premium Blue 7800                 | 15W-40              |                 | X                |              |         |
| Viscolube                | Revivoil - Re Refined High-Tech HD Motoroil | 15W-40              | X               |                  |              | 2)      |
| Viva Energy Australia    | Penske Power Systems Premium                | 15W-40              | X               |                  |              | 2)      |
| Wolf Oil Corporation NV. | Wolf Vitaltech 15W40                        | 15W-40              |                 | X                |              | 2)      |
| Wunsch Öle GmbH          | Wunsch Rekord TLM-TU 10W-40                 | 10W-40              |                 | X                |              |         |
| YPF ZA.                  | Extravida XV 200                            | 15W40               |                 | X                |              | 2)      |

Table 21:

## 5.5 Multigrade oils – Category 2.1 (Low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

### Important information

<sup>2)</sup> Engine oils marked <sup>2)</sup> are also approved for Series 60 engines

### Multigrade oils

| Manufacturer                    | Brand name                                     | SAE viscosity class | TBN             |                  |             | Remarks   |
|---------------------------------|--|---------------------|-----------------|------------------|-------------|---|
|                                 |  |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |   |
| MTU America Inc.                | Power Guard® SAE 15W-40 Off-Highway Heavy Duty | 15W-40              | X               |                  |             | 5 gallons: 800133<br>55 gallons: 800134<br>IBC: 800135<br>Available through MTU America Inc.<br><sup>2)</sup> |
| Bucher AG Langenthal            | Motorex Focus CF                               | 15W-40              | X               |                  |             | <sup>2)</sup>   |
| BP p.l.c.                       | BP Vanellus Eco                                | 15W-40              | X               |                  |             | <sup>2)</sup>   |
| Canroyal Oil Lubricants / Dist. | Canroyal Synthetic Diesel Engine Oil           | 15W-40              | X               |                  |             | <sup>2)</sup>   |
| Castrol Ltd.                    | Castrol CRB Mining 15W-40                      | 15W-40              | X               |                  |             | <sup>2)</sup>   |
|                                 | Castrol CRB Mining 15W-40 CK-4                 |                     | X               |                  |             | <sup>2)</sup>   |
|                                 | Castrol CRB Turbo G4 15W-40                    | 15W-40              | X               |                  |             | <sup>2)</sup>   |
|                                 | Castrol Hypuron                                | 10W-30              |                 | X                |             |   |
|                                 | Castrol RX Super 15W-40 CJ-4/E9                | 15W-40              | X               |                  |             | <sup>2)</sup>   |
| Champion Chemicals N.V.         | Champion OEM Specific 15W40 MS                 | 15W-40              | X               |                  |             |   |
| Chevron Lubricants (Chevron)    | Delo 400 LE                                    | 15W-40              | X               |                  |             | <sup>2)</sup><br>Also approved for Series 4000-04 T   |
|                                 | Delo 400 LE Synthetic                          | 5W-40               |                 | X                |             |   |
|                                 | Delo 400 MGX                                   | 15W-40              | X               |                  |             | <sup>2)</sup>   |
|                                 | Delo 400 SDE                                   | 15W-40              | X               |                  |             | <sup>2)</sup>   |
|                                 | Delo 400 XLE                                   | 10W-30              |                 | X                |             |   |
|                                 | Delo 400 XLE                                   | 15W-40              |                 | X                |             | <sup>2)</sup>   |
|                                 | Delo 400 XSP                                   | 5W-40               |                 | X                |             |   |
| Chevron Lubricants (Texaco)     | Ursa Ultra LE                                  | 15W-40              | X               |                  |             | <sup>2)</sup>   |

| Manufacturer                              | Brand name                              | SAE viscosity class | TBN             |                  |             | Remarks                                  |
|---|---|---------------------|-----------------|------------------|-------------|--|
|   |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |  |
| ExxonMobil Corporation                    | Mobil Delvac 1 ESP                      | 0W-30               | X               |                  |             |  |
|   | Mobil Delvac 1 ESP                      | 5W-40               |                 | X                |             |  |
|   | Mobil Delvac 1300 Super F2              | 15W-40              | X               |                  |             |  |
|   | Mobil Delvac Extreme                    | 15W-40              |                 | X                |             |  |
|   | Mobil Fleet                             | 15W-40              | X               |                  |             | 2)                                       |
|   | Mobil HDEO                              | 15W-40              | X               |                  |             | 2)                                       |
| eni S.P.A.                                | eni i-Sigma top MS                      | 15W-40              | X               |                  |             | 2)                                       |
| Fuchs Petrolub SE                         | Fuchs Titan Cargo                       | 15W-40              | X               |                  |             | 2)                                       |
|   | Fuchs Titan Cargo                       | 10W-30              | X               |                  |             |  |
|   | Fuchs Titan Cargo                       | 15W-40              | X               |                  |             | 2)                                       |
| Gulf Oil International                    | Gulf Supreme Duty XLE                   | 15W-40              | X               |                  |             | 2)                                       |
|   | Gulf Supreme Duty XLE                   | 10W-30              | X               |                  |             |  |
| Hitachi                                   | Hitachi Genuine Engine Oil 10W-40 DH-2  | 10W-40              | X               |                  |             |  |
| Kuwait Petroleum                          | Q8 Formula Truck 7000 FE                | 10W-30              | X               |                  |             |  |
|   | Q8 T 760                                | 10W-30              | X               |                  |             |  |
| Liqui Moli GmbH                           | Liqui Moli Top Tec Truck 4650           | 10W-30              | X               |                  |             |  |
| Lotos Oil                                 | Turdus Powertec 1100                    | 15W-40              | X               |                  |             | 2)                                       |
| Morris Lubricants                         | Versimax HD6                            | 15W-40              | X               |                  |             | 2)                                       |
| MPM International Oil Company B.V.        | Motor Oil 15W-40 Extra High Performance | 15W-40              | X               |                  |             | 2)                                       |
| OOO "LLK-International"                   | Lukoil Avantgarde Professional LA       | 10W-30              | X               |                  |             |  |
|   | Lukoil Avantgarde Professional LA       | 10W-40              | X               |                  |             |  |
|   | Lukoil Avantgarde Professional LA       | 15W-40              | X               |                  |             | 2)                                       |
| Panolin AG                                | Panolin Universal LA-X                  | 15W-40              | X               |                  |             | 2)                                       |
| Pennzoil Products                         | Pennzoil Long-Life Gold                 | 15W-40              |                 | X                |             | 2)                                       |
| Petro-Canada                              | Duron -E                                | 15W-40              | X               |                  |             | 2)                                       |
| Petronas Lubricants, Italy                | Petronas Urania 3000 LS                 | 15W-40              | X               |                  |             | 2)                                       |
| Phillips 66 Lubricants                    | Fleet Supreme EC                        | 15W-40              | X               |                  |             | 2)<br>Also approved for Series 4000-04 C |
|   | Guardol ECT                             | 15W-40              | X               |                  |             | 2)                                       |
|   | Kenndall Super-D XA                     | 15W-40              | X               |                  |             | 2)                                       |
| Prolube Lubricants                        | Prolube Ultraplus                       | 15W-40              | X               |                  |             | 2)                                       |
| Repsol Lubricantes Y Especialidades, S.A. | Repsol Diesel Turbo THPD Mid Saps       | 15W-40              | X               |                  |             | 2)                                       |

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| Manufacturer   | Brand name                              | SAE viscosity class | TBN             |                  |             | Remarks |
|--|---|---------------------|-----------------|------------------|-------------|---------|
|  |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Shell International Petroleum Company                              | Shell Rimula Super                      | 15W-40              |                 | X                |             | 2)      |
|  | Shell Rimula RT4L                       | 15W-40              |                 | X                |             | 2)      |
|  | Shell Rotella T                         | 15W-40              |                 | X                |             | 2)      |
|  | Shell Rotella T3                        | 15W-40              |                 | X                |             | 2)      |
|  | Shell Rotella T3 Fleet                  | 15W-40              | X               |                  |             | 2)      |
|  | Shell Rotella T5                        | 10W-30              | X               |                  |             |         |
|  | Shell Rotella T5                        | 10W-40              | X               |                  |             |         |
|  | Shell Rotella T6                        | 5W-40               |                 | X                |             |         |
|  | Shell Rimula K6                         | 15W-40              | X               |                  |             | 2)      |
|  | Shell Rimula K8                         | 10W-40              | X               |                  |             |         |
|  | Shell Rimula R5 LE                      | 10W-30              | X               |                  |             |         |
|  | Shell Rimula R5 LE                      | 10W-40              | X               |                  |             |         |
|  | Shell Rotella T Triple Protection       | 15W-40              |                 | X                |             |         |
|  | Shell Rotella T4 Triple Protection      | 15W-40              | X               |                  |             | 2)      |
|  | Shell Rimula R4 MV                      | 15W-40              | X               |                  |             | 2)      |
|  | Shell Rimula R4 L                       | 15W-40              | X               |                  |             | 2)      |
| SRS Schmierstoff Vertrieb GmbH                                     | SRS Turbo Rekord plus                   | 15W-40              | X               |                  |             | 2)      |
|  | SRS Turbo Rekord plus FE                | 10W-40              | X               |                  |             |         |
|  | SRS Turbo Rekord ultra V                | 10W-30              | X               |                  |             |         |
| Hitachi Construction Machinery Co, Ltd.                            | Hitachi Genuine Engine Oil 10W-40 DH-2  | 10W-40              | X               |                  |             |         |
| Total Lubrificants   | Total Rubia TIR 7900                    | 15W-40              | X               |                  |             |         |
|  | Total Rubia Works 2000                  | 10W-40              | X               |                  |             |         |
|  | Total Rubia Works 4000                  | 10W-40              | X               |                  |             |         |
|  | Total Rubia Works 4000                  | 15W-40              | X               |                  |             | 2)      |
|  | Total Rubia Works 4000 FE               | 10W-30              | X               |                  |             |         |
|  | Total Star Max FE                       | 10W-30              | X               |                  |             |         |
|  | Total Rubia Works 2000 FE 10W-30        | 10W-30              | X               |                  |             |         |
| Trinidad & Tobago National Petroleum Marketing Company Ltd. (NPMC) | Ultra Duty 15W-40 Engine Oil            | 15W-40              | X               |                  |             | 2)      |
| Valvoline EMEA   | Valvoline All Fleet Extra LE SAE 15W-40 | 15W-40              | X               |                  |             | 2)      |
|  | All-Fleet Extra LE NTI                  | 15W-40              | X               |                  |             | 2)      |
|  | Valvoline All Fleet Superior LE         | 10W-30              | X               |                  |             |         |
|  | Valvoline All Fleet Superior LE         | 15W-40              | X               |                  |             | 2)      |
|  | Premium Blue 8 100 15W-40               | 15W-40              | X               |                  |             | 2)      |

| Manufacturer        | Brand name                     | SAE viscosity class | TBN             |                  |             | Remarks |
|---------------------|--------------------------------|---------------------|-----------------|------------------|-------------|---------|
|                     |                                |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Valvoline LLC       | Premium Blue 8600 ES           | 10W-30              |                 | X                |             |         |
|                     | Premium Blue 8600 ES           | 15W-40              |                 | X                |             | 2)      |
| Valvoline USA       | All Fleet Plus                 | 15W-40              | X               |                  |             | 2)      |
| Verco International | April Superpro RXL 1 Gold Plus | 15W-40              | X               |                  |             | 2)      |

Table 22:

## 5.6 Multigrade oils – Category 3, SAE grades 5W-30, 5W-40, 10W-40 and 15W-40 for diesel engines

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

### Multigrade oils

| Manufacturer                                     | Brand name                    | SAE viscosity class | TBN             |                  |             | Remarks   |
|--|-------------------------------|---------------------|-----------------|------------------|-------------|---|
|  |                               |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |   |
| MTU Asia<br>China                                | Diesel Engine Oil - DEO 5W-30 | 5W-30               |                 |                  | X           | 20 l canister: 60808/P<br>Available through MTU<br>Suzhou |
| Addinol Lube Oil GmbH                            | Addinol Commercial 1040 E4    | 10W-40              |                 | X                |             |   |
|  | Addinol Ultra Truck MD 0538   | 5W-30               |                 |                  | X           |   |
|  | Addinol Super Truck MD 1049   | 10W-40              |                 |                  | X           |   |
| Aral AG  | Aral Mega Turboral            | 10W-40              |                 |                  | X           |   |
|  | Aral Mega Turboral 10W-40     | 10W-40              |                 |                  | X           |   |
|  | Aral Super Turboral           | 5W-30               |                 |                  | X           |   |
|  | Aral Super Turboral 5W-30     | 5W-30               |                 |                  | X           |   |
| Atak MadeniYağ Pas.San. Tic. Aş                  | Alpet Turbot FE               | 10W-40              |                 |                  | X           |   |
| Avia Mineralöl AG                                | Avia Turbosynth HT-E          | 10W-40              |                 |                  | X           |   |
|  | Avia Turbosynth HT-U          | 5W-30               |                 |                  | X           |   |
| Avista Oil Deutschland GmbH                      | Avista pure EVO E4            | 10W-40              |                 |                  | X           |   |
|  | Avista pure EVO SWE           | 5W-30               |                 |                  | X           |   |
|  | Avista pure EVO SWE           | 10W-40              |                 |                  | X           |   |
| Bahrain Petroleum Company<br>B.S.C.              | Frontier Turbo LDX            | 10W-40              |                 |                  | X           |   |
| BayWa AG   | Tectrol Super Truck 530       | 5W-30               |                 |                  | X           |   |
|  | Tectrol Super Truck 1040      | 10W-40              |                 | X                |             |   |
| Bucher AG Langenthal - Motorex<br>Schmiertechnik | MC Power Plus SAE 10W/40      | 10W-40              |                 |                  | X           |   |
| BP p.l.c.  | BP Energol IC-MT 10W-40       | 10W-40              |                 |                  | X           |   |
|  | BP Vanellus Max               | 5W-30               |                 |                  | X           |   |

| Manufacturer                     | Brand name                              | SAE viscosity class | TBN             |                  |             | Remarks |
|----------------------------------|---|---------------------|-----------------|------------------|-------------|---------|
|                                  |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Castrol Ltd.                     | Castrol CRB Turbomax 10W-40 E4/E7       | 10W-40              |                 |                  | X           |         |
|                                  | Castrol Enduron MT                      | 10W-40              |                 |                  | X           |         |
|                                  | Castrol Enduron Plus                    | 5W-30               |                 |                  | X           |         |
|                                  | Castrol Elixion HD                      | 5W-30               |                 |                  | X           |         |
|                                  | Castrol Vectron 10W-40 E4/E7            | 10W-40              |                 |                  | X           |         |
|                                  | Castrol Vectron Long Drain              | 10W-40              |                 |                  | X           |         |
|                                  | Castrol Vectron Long Drain 5W-30 E4/E7  | 5W-30               |                 |                  | X           |         |
|                                  | Castrol Vectron Long Drain 10W-40 E4/E7 | 10W-40              |                 |                  | X           |         |
|                                  | Castrol Vectron 5W-30 Arctic            | 5W-30               |                 |                  | X           |         |
|                                  | Castrol Vectron Fuel Saver 5W-30        | 5W-30               |                 |                  | X           |         |
|                                  | Castrol Vectron Fuel Saver E7           | 5W-30               |                 |                  | X           |         |
| Cepsa                            | Cepsa Eurotrans SHPD                    | 5W-30               |                 |                  | X           |         |
|                                  | Cepsa Eurotrans SHPD                    | 10W-40              |                 | X                |             |         |
| Cepsa Comercial Petroleo Limited | Traction Advanced LD                    | 10W-40              |                 |                  | X           |         |
| Champion Chemicals N.V.          | Champion New Energy 10W40 Ultra         | 10W-40              |                 |                  | X           |         |
| Chemicis Khavremianeh Kohan      | Chemicis Excel Plus                     | 10W-40              |                 |                  | X           |         |
| Chevron Lubricants (Caltex)      | Delo Gold Ultra T                       | 10W-40              |                 |                  | X           |         |
|                                  | Delo XLD Multigrade                     | 10W-40              |                 |                  | X           |         |
| Chevron Lubricants (Texaco)      | Ursa HD                                 | 10W-40              |                 |                  | X           |         |
|                                  | Ursa Premium FE                         | 5W-30               |                 |                  | X           |         |
|                                  | Ursa Super                              | 10W-40              |                 | X                |             |         |
|                                  | Ursa Super TDX                          | 10W-40              |                 |                  | X           |         |
|                                  | Ursa TDX                                | 10W-40              |                 |                  | X           |         |
| Deutsche Ölwerke Lubmin GmbH     | AVENO HC PT Diesel                      | 10W-40              |                 |                  | X           |         |
| eni S.P.A.                       | eni i-Sigma top                         | 10W-40              |                 |                  | X           |         |
|                                  | eni i-Sigma performance E4              | 10W-40              |                 |                  | X           |         |
| Enoc Marketing LLC               | Enoc Vulcan 770 SLD                     | 10W-40              |                 | X                |             |         |
|                                  | Enoc Vulcan SLD                         | 10W-40              |                 |                  | X           |         |
| Exxon Mobil Corporation          | Mobil Delvac XHP Extra                  | 10W-40              |                 |                  | X           |         |
|                                  | Mobil Delvac XHP Ultra 5W-30            | 5W-30               |                 |                  | X           |         |
|                                  | Mobil Delvac 1 SHC                      | 5W-40               |                 |                  | X           |         |
|                                  | Mobil Delvac 1 SHC 5W-40                | 5W-40               |                 |                  | X           |         |
| Exol Lubricants Ltd.             | Taurus Extreme M3                       | 10W-40              |                 |                  | X           |         |



| Manufacturer                                     | Brand name  | SAE viscosity class | TBN             |                  |             | Remarks |
|--|---|---------------------|-----------------|------------------|-------------|---------|
|  |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Fabrika Maziva, FAM AD                           | Fenix Ultra Sint                                    | 10W-40              |                 |                  | X           |         |
| Finke Mineralölwerk GmbH                         | AVIATICON Finko Truck LD                            | 10W-40              |                 |                  | X           |         |
| Fuchs Petrolub SE                                | Fuchs Titan Cargo SL                                | 5W-30               |                 |                  | X           |         |
|  | Fuchs Titan Cargo MC                                | 10W-40              |                 |                  | X           |         |
|  | Fuchs Max Way E4                                    | 10W-40              |                 |                  |             |         |
|  | Fuchs Max Way Ultra                                 | 5W-30               |                 |                  |             |         |
| Fuchs Lubricants France S.A.                     | Cofran Marathon                                     | 10W-40              |                 |                  | X           |         |
| Gazpromneft Lubricants Ltd,                      | G-Profi GT  | 10W-40              |                 |                  | X           |         |
| Gulf Oil International                           | Gulf Fleet Force synth.                             | 5W-30               |                 |                  | X           |         |
|  | Gulf Superfleet ELD                                 | 10W-40              |                 |                  | X           |         |
|  | Gulf Superfleet XLD                                 | 10W-40              |                 |                  | X           |         |
|  | Gulf Superfleet Synth ELD                           | 10W-40              |                 |                  | X           |         |
| High Industrial Lubricants & Liquids Corporation | Fastroil Force Ultra High Performance Diesel (UHPD) | 10W-40              |                 |                  | X           |         |
| Huiles Berliet S.A.                              | RTO Extensia RXD ECO                                | 5W-30               |                 |                  | X           |         |
| Iranol Oil Co.                                   | Iranol D40000-EIII                                  | 10W-40              |                 |                  | X           |         |
| Kuwait Petroleum                                 | Q8 T 860  | 10W-40              |                 | X                |             |         |
|  | Q8 T 860 D  | 10W-40              |                 |                  | X           |         |
|  | Q8 T 860 S  | 10W-40              |                 |                  | X           |         |
|  | Q8 T 905  | 10W-40              | X               |                  |             |         |
| Lotos Oil  | Turdus Powertec 3000                                | 10W-40              |                 |                  | X           |         |
|  | Turdus Powertec Synthetic                           | 5W-30               |                 |                  | X           |         |
| Lukoil Lubricants Europe Oy                      | Teboil Super XLD-2                                  | 5W-30               |                 |                  | X           |         |
| Meguin   | Megol Motorenöl Super LL Dimo Premium               | 10W-40              |                 |                  | X           |         |
| MOL-LUB Kft                                      | MOL Synt Diesel                                     | 10W-40              |                 | X                |             |         |
|  | MOL Dynamic Synt Diesel E4                          | 10W-40              |                 |                  | X           |         |
| Orlen Oil Sp.o.o.                                | Platinum Ultor Max                                  | 5W-30               |                 |                  | X           |         |
| OOO LLK International                            | Lukoil Avantgarde Professional                      | 5W-30               |                 |                  | X           |         |
|  | Lukoil Avantgarde Professional                      | 10W-40              |                 |                  | X           |         |
|  | Lukoil Avantgarde Professional M5                   | 10W-40              |                 |                  | X           |         |
|  | Lukoil Avantgarde Professional M6                   | 5W-30               |                 |                  | X           |         |
|  | Lukoil Avantgarde Professional M6                   | 10W-40              |                 |                  | X           |         |
|  | Lukoil Avantgarde Ultra M3                          | 15W-40              |                 |                  | X           |         |
| Panolin  | Panolin Diesel HTE                                  | 10W-40              |                 |                  | X           |         |

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| Manufacturer                             | Brand name                            | SAE viscosity class | TBN             |                  |             | Remarks |
|--|---------------------------------------|---------------------|-----------------|------------------|-------------|---------|
|  |                                       |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Petrogal, S.A.                           | Galp Galaxia Extreme                  | 5W-30               |                 | X                |             |         |
|  | Galp Galaxia Ultra XHP                | 10W-40              |                 |                  | X           |         |
| Petromin Corporation                     | Petromin Turbo Master LD              | 10W-40              |                 |                  | X           |         |
| Petronas Lubricants International        | Petronas Akros Synt Gold              | 10W-40              |                 |                  | X           |         |
|  | Arexons HD-Truck E7                   | 10W-40              |                 |                  | X           |         |
|  | Urania Maximo                         | 10W-40              |                 |                  | X           |         |
|  | Petronas Urania Optimo                | 10W-40              |                 |                  | X           |         |
|  | Urania 100 K                          | 10W-40              |                 |                  | X           |         |
|  | Urania 5000 F                         | 5W-30               |                 |                  | X           |         |
|  | Urania 5000 LD                        | 10W-40              |                 |                  | X           |         |
|  | Urania FE                             | 5W-30               |                 |                  | X           |         |
|  | Petronas Urania Maximo                | 5W-30               |                 |                  | X           |         |
| PHI OIL GmbH                             | Motordor Silver 10W40                 | 10W-40              |                 |                  | X           |         |
| Raj Petro Specialities P Ltd.            | Zoomol Rforce 8200 RF1                | 10W-40              |                 |                  | X           |         |
| Ramoil S.p.A.                            | Duglas Oil Ultra HC 10W-40 UHPDO      | 10W-40              |                 |                  | X           |         |
| Ravensberger Schmierstoff Vertrieb GmbH  | RAVENOL Super Performance Truck       | 5W-30               |                 |                  | X           |         |
|  | RAVENOL Performance Truck             | 10W-40              |                 |                  | X           |         |
| Repsol Lubricantes y Especialidades S.A. | Repsol Turbo UHPD                     | 10W-40              |                 |                  | X           |         |
|  | Repsol Diesel Turbo VHPD              | 5W-30               |                 |                  | X           |         |
|  | Repsol Diesel Turbo UHPD Urban        | 10W-40              |                 |                  | X           |         |
| RN-Lubricants, LLC                       | Rosneft Revolut D4                    | 10W-40              |                 |                  | X           |         |
| SCT Vertriebs GmbH                       | Fanfaro TRD E4 UHPD                   | 10W-40              |                 | X                |             |         |
|  | Mannol TS-6 UHPD Eco                  | 10W-40              |                 | X                |             |         |
|  | Pemco Diesel G-6 Eco UHPD             | 10W-40              |                 | X                |             |         |
| Shell International Petroleum Company    | Shell Rimula R5 M                     | 10W-40              |                 |                  | X           |         |
|  | Shell Rimula R6 M                     | 10W-40              |                 |                  | X           |         |
|  | Shell Rimula R6 ME                    | 5W-30               |                 |                  | X           |         |
|  | Shell Rimula R6 MS                    | 10W-40              |                 |                  | X           |         |
| SK Lubricants Co.                        | ZIC X7000                             | 5W-30               |                 |                  | X           |         |
| SRS Schmierstoff Vertrieb GmbH           | SRS Cargolub TFF                      | 10W-40              |                 |                  | X           |         |
|  | SRS Cargolub TFL                      | 5W-30               |                 |                  | X           |         |
|  | SRS Cargolub TFG                      | 10W-40              |                 |                  | X           |         |
|  | SRS Cargolub TFG plus                 | 10W-40              |                 |                  | X           |         |
| Tedex SA                                 | Tedex Diesel Truck UHPD (S) Motor Oil | 10W-40              |                 |                  | X           |         |

| Manufacturer                 | Brand name                      | SAE viscosity class | TBN             |                  |             | Remarks |
|------------------------------|---------------------------------|---------------------|-----------------|------------------|-------------|---------|
|                              |                                 |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |         |
| Total Lubrifiants            | Cubalub ExtraDiesel             | 10W-40              |                 |                  | X           |         |
|                              | Gulf Gulfleet Highway 10W-40    | 10W-40              |                 |                  | X           |         |
|                              | RTO Extensia ECO                | 5W-30               |                 |                  | X           |         |
|                              | Total Rubia TIR 8600            | 10W-40              |                 |                  | X           |         |
|                              | Total Rubia TIR 9200 FE         | 5W-30               |                 |                  | X           |         |
| Transnational Blenders B. V. | Engine Oil Super EHPD           | 10W-40              |                 |                  | X           |         |
| Unil Opal                    | Unil Opal LCM 800               | 10W-40              |                 |                  | X           |         |
| Valvoline EMEA               | All Fleet Superior              | 10W-40              |                 |                  | X           |         |
|                              | Profleet                        | 10W-40              |                 |                  | X           |         |
|                              | Valvoline All-Fleet Extreme NTI | 10W-40              |                 | X                |             |         |
| Wolf Oil Corporation N.V.    | Wolf Vitaltech 10W40 Ultra      | 10W-40              |                 |                  | X           |         |
|                              | Champion New Energy 10W40 Ultra | 10W-40              |                 |                  | X           |         |

Table 23:

## 5.7 Multi-grade oils – Category 3.1 (Low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40

For details and special features, see chapter "Lubricants for four-cycle engines" (→ Page 7)

### Multigrade oils

| Manufacturer                     | Brand name   | SAE viscosity class | TBN             |                  |             | Comments / material number   |
|----------------------------------|--|---------------------|-----------------|------------------|-------------|--|
|                                  |  |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |  |
| MTU EMEA                         | Diesel Engine Oil DEO SAE 10W-40 (enhanced corrosion protection) | 10W40               |                 |                  | X           | 20 l container:<br>X00078578<br>210 l container<br>X00078577<br>IBC: X00078576 |
| Addinol Lube Oil                 | Addinol Extra Truck MD 1049 LE                                   | 10W-40              | X               |                  |             |  |
| Aral AG                          | Aral Mega Turboral LA  | 10W-40              | X               |                  |             |  |
|                                  | Aral Super Turboral LA   | 5W-30               | X               |                  |             |  |
| Atak Madeni Yağ Pas.San.Tic.Aş   | Alpet Turbot MMS   | 10W-40              |                 | X                |             |  |
| Avia Mineralöl AG                | Avia Multi LSB Extra   | 10W-40              |                 | X                |             |  |
| Avista Oil Deutschland GmbH      | Avista pure EVO GER  | 10W-40              |                 | X                |             |  |
| BayWa AG                         | Tectrol Super Truck Plus XL 1040                                 | 10W-40              | X               |                  |             |  |
| Bucher AG Langenthal             | Motorex Focus QTM  | 10W-40              | X               |                  |             |  |
|                                  | Motorex / York Focus QTM   | 10W-40              | X               |                  |             |  |
|                                  | Motorex Nexus FE SAE 5W-30                                       | 5W-30               | X               |                  |             |  |
| BP p.l.c.                        | BP Vanellus Max Drain Eco  | 10W-40              |                 |                  | X           |  |
|                                  | BP Vanellus Max Eco 10W-40                                       | 10W-40              |                 |                  | X           |  |
| BVG Vertriebsgesellschaft AG     | Alpha Advanced Eco-Efficiency low SAPS                           | 10W-40              | X               |                  |             |  |
| Castrol Ltd.                     | Castrol Vecton Long Drain 10W-30 E6/E9                           | 10W-30              | X               |                  |             |  |
|                                  | Castrol Vecton Long Drain 10W-40 E6/E9                           | 10W-40              | X               |                  |             |  |
|                                  | Castrol Vecton Fuel Saver 5W-30 E6/E9                            | 5W-30               | X               |                  |             |  |
| Cepsa Comercial Petroleo, S.A.U. | Cepsa Eurotech LS 10W40 Plus                                     | 10W-40              |                 |                  | X           |  |
|                                  | Traction Pro LS  | 10W-40              |                 |                  | X           |  |
| Champion Chemilcals N.V.         | Champion OEM Specific 10W40 Ultra MS                             | 10W-40              |                 | X                |             |  |
|                                  | Champion OEM Specific 10W40 UHPD                                 | 10W-40              |                 |                  | X           |  |
| Chevron Lubricants (Caltex)      | Delo XLE Multigrade  | 10W-40              | X               |                  |             |  |

| Manufacturer                 | Brand name                          | SAE viscosity class | TBN             |                  |             | Comments / material number    |
|------------------------------|-------------------------------------|---------------------|-----------------|------------------|-------------|-------------------------------|
|                              |                                     |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |                               |
| Chevron Lubricants (Chevron) | Delo 400 RDE                        | 10W-30              |                 | X                |             |                               |
|                              | Delo 400 RDS                        | 10W-40              |                 | X                |             |                               |
|                              | Delo 400 XLE                        | 15W-40              | X               |                  |             |                               |
|                              | Delo 400 XLE HD                     | 5W-30               |                 |                  | X           |                               |
|                              | Delo 400 XLE HD                     | 10W-40              |                 |                  | X           |                               |
|                              | Delo 400 XLE SYN-HD                 | 10W-40              |                 |                  | X           |                               |
|                              | Delo 400 XLE Synthetic              | 5W-30               | X               |                  |             |                               |
|                              | Delo 400 LE Synthetic               | 5W-30               | X               |                  |             |                               |
|                              | Delo 400 XSP                        | 5W-30               | X               |                  |             |                               |
|                              | Delo 400 XSP-SD                     | 5W-30               | X               |                  |             |                               |
| Chevron Lubricants (Texaco)  | Ursa Ultra X                        | 10W-30              |                 | X                |             |                               |
| CONDAT Lubrificants          | Vicam Planet 10W40                  | 10W-40              |                 |                  | X           |                               |
| Deutsche Ölwerke Lubmin GmbH | AVENO Universal UHPD                | 10W-40              |                 |                  |             |                               |
| De Oliebron B.V.             | Tor Turbosynth LSP Plus             | 10W-40              |                 |                  | X           |                               |
| Ellis Enterprices B.V.       | Valvoline Profleet LA               | 5W-30               | X               |                  |             |                               |
| eni S.p.a.                   | eni i-Sigma top MS                  | 10W-40              | X               |                  |             |                               |
| Enoc Marketing L.L.C.        | Enoc Vulkan Green                   | 10W-40              |                 |                  | X           |                               |
| Exol Lubricants Ltd.         | Taurus Euro                         | 10W-40              |                 | X                |             |                               |
| Exxon Mobil Corporation      | Mobil Delvac 1 ESP                  | 5W-30               |                 | X                |             |                               |
|                              | Mobil Delvac 1 LE                   | 5W-30               | X               |                  |             |                               |
|                              | Mobil Delvac HD                     | 10W-40              |                 | X                |             |                               |
|                              | Mobil Delvac XHP ESP                | 10W-40              |                 |                  | X           |                               |
|                              | Mobil Delvac XHP ESP M              | 10W-40              |                 |                  | X           |                               |
|                              | Mobil Delvac XHP LE                 | 10W-40              |                 |                  | X           | 55 gallons: 800141            |
|                              | Mobil Delvac XHP Ultra LE           | 5W-30               |                 | X                |             |                               |
| Finke Mineralölwerk GmbH     | AVIATICON Finko Super Truck LA Plus | 10W-40              |                 | X                |             |                               |
| Fuchs Petrolub SE            | Titan Cargo Maxx                    | 5W-30               |                 |                  | X           |                               |
|                              | Titan Cargo Maxx                    | 10W-40              |                 |                  | X           | Enhanced corrosion protection |
|                              | Fuchs Titan Cargo EU6               | 5W-30               | X               |                  |             |                               |
|                              | Fuchs Titan Cargo LA                | 5W-30               | X               |                  |             |                               |
| Gazpromneft Lubricants Ltd.  | G-Profi GT LA                       | 10W-40              |                 |                  | X           |                               |

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| Manufacturer                       | Brand name   | SAE viscosity class | TBN             |                  |             | Comments / material number |
|------------------------------------|--|---------------------|-----------------|------------------|-------------|----------------------------|
|                                    |  |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |                            |
| Gulf Oil International             | Gulf Superfleet Synth ULE  | 5W-30               | X               |                  |             |                            |
|                                    | Gulf Superfleet XLE  | 10W-30              | X               |                  |             |                            |
|                                    | Gulf Superfleet XLE  | 10W-40              | X               |                  |             |                            |
|                                    | Gulf Superfleet Synth XLE  | 10W-30              |                 | X                |             |                            |
|                                    | Gulf Superfleet Synth XLE  | 10W-40              | X               |                  |             |                            |
|                                    | Gulf Superfleet Universal  | 5W-30               |                 |                  | X           |                            |
|                                    | Gulf Superfleet Universal  | 10W-40              |                 |                  | X           |                            |
| Helios Lubeoil                     | Helios Premium KMXX 10W-40                                       | 10W-40              | X               |                  |             |                            |
| Huiles Berliet S.A.                | RTO Extensia FP  | 10W-40              | X               |                  |             |                            |
| Igol                               | PRO 200 X  | 10W-40              | X               |                  |             |                            |
| INA Maziva d.o.o.                  | INA Super 2009 5W-30   | 5W-30               | X               |                  |             |                            |
|                                    | INA Super 2009   | 10W-40              |                 |                  | X           |                            |
| Kuwait Petroleum R&T               | Q8 905   | 10W-40              | X               |                  |             |                            |
|                                    | Q8 T 904   | 10W-40              |                 | X                |             |                            |
|                                    | Q8 T 904 FE  | 10W-30              | X               |                  |             |                            |
|                                    | Q8 T 905   | 10W-40              | X               |                  |             |                            |
|                                    | Q8 T 910   | 5W-30               | X               |                  |             |                            |
|                                    | Q8 Formula Truck 8500 FE   | 10W-30              | X               |                  |             |                            |
|                                    | Q8 Formula Truck 8700 FE   | 5W-30               | X               |                  |             |                            |
|                                    | Q8 Formula Truck 8900 FE   | 5W-30               | X               |                  |             |                            |
| LLK finland Oy                     | Teboil Super XLD-2   | 5W-30               |                 |                  | X           |                            |
| Meguin GmbH & Co. KG               | megol Motorenoel Low Saps  | 10W-40              |                 | X                |             |                            |
| Morris Lubricants                  | Ring Free Ultra  | 10W-40              |                 | X                |             |                            |
|                                    | Fendt Power Grade 10W-40   | 10W-40              |                 | X                |             |                            |
|                                    | Versimax HD8   | 10W-40              | X               |                  |             |                            |
| MPM International Oil Company B.V. | Motor Oil 10w-40 Premium Synthetic Ultra High Performance Diesel | 10W-40              |                 | X                |             |                            |
| Oel-Brack AG                       | Midland maxtra   | 10W-40              |                 | X                |             |                            |
| OMV Petrol Ofisi A.Ş               | Maximus HD-E   | 5W-30               | X               |                  |             |                            |

| Manufacturer                              | Brand name                         | SAE viscosity class | TBN             |                  |             | Comments / material number |
|---|------------------------------------|---------------------|-----------------|------------------|-------------|----------------------------|
|   |                                    |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |                            |
| OOO LLK International                     | Lukoil Avantgarde CNG              | 10W-40              | X               |                  |             |                            |
|   | Lukoil Avantgarde Professional LE  | 5W-30               |                 |                  | X           |                            |
|   | Lukoil Avantgarde Professional LE  | 10W-40              |                 |                  | X           |                            |
|   | Lukoil Avantgarde Professional LS  | 5W-30               | X               |                  |             |                            |
|   | Lukoil Avantgarde Professional LS  | 10W-40              |                 |                  | X           |                            |
|   | Lukoil Avantgarde Professional LS5 | 5W-30               | X               |                  |             |                            |
|   | Lukoil Avantgarde Professional LS5 | 10W-40              | X               |                  |             |                            |
|   | Lukoil Avantgarde Professional XLE | 5W-30               |                 |                  | X           |                            |
|   | Lukoil Avantgarde Professional XLE | 10W-40              |                 |                  | X           |                            |
| Orlen Oil                                 | Platinum Ultor Complete            | 10W-40              | X               |                  |             |                            |
|   | Platinum Ultor Optimo              | 10W-30              | X               |                  |             |                            |
|   | Platinum Ultor Progress            | 10W-40              |                 | X                |             |                            |
|   | Mogul Diesel L-SAPS                | 10W-40              |                 | X                |             |                            |
| Oscar Lubricants LLC                      | Oscar Zircon Novus                 | 10W-40              | X               |                  |             |                            |
| Panolin                                   | Panolin Diesel Synth EU-4          | 10W-40              | X               |                  |             |                            |
|   | Panolin Ecomot                     | 5W-30               |                 | X                |             |                            |
|   | Panolin Ecomot                     | 10W-30              | X               |                  |             |                            |
|   | Panolin Ecomot                     | 10W-40              | X               |                  |             |                            |
| Petro-Canada Lubricants Inc.              | Duron SHP E6                       | 10W-40              |                 | X                |             |                            |
|   | Duron UHP 5W30                     | 5W-30               | X               |                  |             |                            |
|   | Duron UHP E6                       | 5W-30               |                 |                  | X           |                            |
|   | Duron UHP E6                       | 10W-40              |                 |                  | X           |                            |
|   | Duron UHP E6 10W40                 | 10W-40              | X               |                  |             |                            |
| Petrolgal, S.A.                           | Galp Galaxia Ultra LS              | 10W-40              | X               |                  |             |                            |
| Petrolube Lubricants                      | Euromax                            | 10W-40              |                 | X                |             |                            |
| Petronas Lubricants International         | Petronas Urania 5000 E             | 5W-30               |                 |                  | X           |                            |
|   | Petronas Urania 5000 E             | 10W-40              |                 |                  | X           |                            |
|   | Petronas Urania FE LS              | 5W-30               |                 |                  | X           |                            |
|   | Petronas Urania Ecotech            | 10W-40              |                 |                  | X           |                            |
| PHI OIL GmbH                              | Motodor LSP Gold 5W30              | 5W-30               |                 |                  | X           |                            |
|   | Motodor LSP Silver                 | 10W-40              |                 | X                |             |                            |
| Prista Oil Ad                             | Prista UHPD                        | 10W-40              | X               |                  |             |                            |
| Ravensberger Schmierölvertrieb GmbH       | Ravenol Euro VI Truck              | 10W-40              | X               |                  |             |                            |
| Repsol Lubricantes y Especialidades, S.A. | Repsol Diesel Turbo UHPD MID SAPS  | 10W-40              | X               |                  |             |                            |
|   | Repsol DieselTurbo VHPD Mid Saps   | 5W-30               |                 | X                |             |                            |

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| Manufacturer                          | Brand name                              | SAE viscosity class | TBN             |                  |             | Comments / material number    |
|---------------------------------------|---|---------------------|-----------------|------------------|-------------|-------------------------------|
|                                       |   |                     | 8 to 10 mgKOH/g | 10 to 12 mgKOH/g | >12 mgKOH/g |                               |
| Rowe Mineralölwerk GmbH               | Rowe Hightec Truckstar SAE 10W-40 HC-LA | 10W-40              |                 | X                |             |                               |
| Shell International Petroleum Company | Shell Rimula K10                        | 10W-40              |                 |                  | X           | Enhanced corrosion protection |
|                                       | Shell Rimula K12                        | 5W-30               |                 | X                |             |                               |
|                                       | Shell Rimula R6 LM                      | 10W-40              | X               |                  |             | Enhanced corrosion protection |
|                                       | Shell Rimula R6 LME                     | 5W-30               |                 | X                |             |                               |
|                                       | Shell Rimula R6 LME Plus                | 5W-30               |                 | X                |             |                               |
|                                       | Shell Rimula Ultra                      | 5W-30               |                 |                  | X           |                               |
| SRS Schmierstoff Vertrieb GmbH        | SRS Antikorrol MLA                      | 10W-40              |                 | X                |             | Enhanced corrosion protection |
|                                       | SRS Cargolub TLA                        | 10W-40              | X               |                  |             |                               |
|                                       | SRS Cargolub TLS                        | 5W-30               |                 |                  | X           |                               |
|                                       | SRS Cargolub TLS plus                   | 5W-30               |                 | X                |             |                               |
|                                       | SRS Cargolub TLS top                    | 5W-30               | X               |                  |             |                               |
|                                       | SRS Turbo Diesel LA                     | 10W-40              | X               |                  |             |                               |
|                                       | SRS Cargolub low-friction engine oil LA | 10W-40              |                 | X                |             |                               |
|                                       | SRS Turbo-Rekord top FE                 | 10W-40              |                 | X                |             |                               |
|                                       | SRS Turbo-Rekord ultra FE               | 10W-40              | X               |                  |             |                               |
| Total Lubrifiants                     | Total Rubia TIR 8900                    | 10W-40              | X               |                  |             |                               |
|                                       | Total Rubia Works 2500                  | 10W-40              | X               |                  |             |                               |
|                                       | Total Rubia Works 3000                  | 10W-40              |                 | X                |             |                               |
|                                       | Total Rubia Works 3000 FE               | 5W-30               |                 |                  | X           |                               |
| Valvoline EMEA                        | Valvoline ProFleet LS                   | 5W-30               |                 |                  | X           |                               |
|                                       | Valvoline ProFleet LS                   | 10W-40              | X               |                  |             |                               |
|                                       | ProFleet LS NTI                         | 10W-40              | X               |                  |             |                               |
| Wibo Schmierstoffe GmbH               | Wibokraft Ultra AF 10W40                | 10W-40              |                 | X                |             |                               |
| Wolf Oil Corporation N.V.             | Wolf Officialtech 10W40 Ultra MS        | 10W-40              |                 | X                |             |                               |
|                                       | Wolf Officialtech 10W40 UHPD            | 10W-40              |                 |                  | X           |                               |
|                                       | Champion OEM Specific 10W40 Ultra MS    | 10W-40              |                 | X                |             |                               |

Table 24:



## 5.8 Lubricating Greases

### 5.8.1 Lubricating greases for general applications

For details and special features, see chapter "Lubricating greases" (→ Page 15)

| Manufacturer                   | Brand name                | Notes |
|--------------------------------|---------------------------|-------|
| Aral AG                        | Mehrzweckfett Arallub HL2 |       |
| BP p.l.c.                      | Energrease LS2            |       |
| Castrol Ltd.                   | Spheerol AP2              |       |
| Chevron                        | Multifak EP2              |       |
| SRS Schmierstoff Vertrieb GmbH | SRS Wiolub LFK2           |       |
| Shell Deutschland GmbH         | Shell Gadus S2 V220 2     |       |
| Total                          | Total Multis EP2          |       |
| Veedol International           | Multipurpose              |       |

Table 25:

## 5.8.2 Lubricating greases for diesel engine-generator set components

| Important  |                        |   |
|--|------------------------|---|
| Mixtures of different greases are not permitted! |                        |   |
| Manufacturer                                     | Brand name             | Notes   |
| Exxon Mobil Corporation                          | Mobil Polyrex EM       | High-temperature grease: Lubricity in the range from -30 to 250 °C (-22 to 482 °F)<br>For: <ul style="list-style-type: none"> <li>• Generator bearings of Marathon generators</li> <li>• Generator bearings of Leroy-Somer generators<sup>*)</sup></li> <li>• Fan wheel and belt pulley bearing on electrically driven coolant cooler, Series 4000</li> </ul> |
| Shell  | GADUS S3 V220C         | For generator bearings of Leroy-Somer generators <sup>*)</sup>  |
| SKF  | Mehrzweckfett LGMT2    | For generator bearings of HM generators   |
| ROCOL Limited                                    | Rocol RTD-Compound     | For belt tensioner on electrically driven coolant cooler, Series 4000   |
| ASCO Power Technologies                          | Lubrication Kit 75-100 | For automatic transfer switch (ATS) ASCO  |

<sup>\*)</sup> NOTE: For information about the applicable lubricating greases for Leroy-Somer generators, refer to the nameplate on the generator.

For information about lubricating greases for generators made by other manufacturers, please contact MTU service partners.

## 6 Approved Coolants

### 6.1 Coolants without antifreeze for cooling systems containing light metal

#### 6.1.1 Coolant without antifreeze – Concentrates for cooling systems containing light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Important information

For the marine engine Series 1163-03 and 1163-04, only coolants marked with an asterisk \* in the brand name can be used!

#### Coolants without antifreeze – concentrates

| Manufacturer                     | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|----------------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                                  |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| MTU Friedrichshafen GmbH         | Coolant CS100 Corrosion Inhibitor Concentrate*         |            | X       |         |              |           | 6000 / 2                      | X00057233 (20 l)<br>X00057232 (210 l)<br>X00070455 (1000 l)<br>Also available through MTU Asia     |
| MTU America Inc.                 | Power Cool® Plus 6000 Concentrate*                     |            | X       |         |              |           | 6000 / 2                      | colored green<br>23533526 (1 gallon)<br>23533527 (5 gallons)<br>Available through MTU America Inc. |
| Arteco NV                        | Freecor NBI  |            | X       |         |              |           | 6000 / 2                      |  |
| BASF SE                          | Glysacorr G93 green*                                   |            | X       |         |              |           | 6000 / 2                      | X00054105 (barrel)<br>X00058062 (canister)   |
| CCI Corporation                  | A 216  | X          |         |         |              | X         | 6000 / 2                      |  |
| CCI Manufacturing IL Corporation | A 216  | X          |         |         |              | X         | 6000 / 2                      | X00051509 (208 l)  |
| Chevron Corp.                    | Texcool A – 200  |            | X       |         |              |           | 6000 / 2                      |  |
| Detroit Diesel Corp.             | Power Cool Plus 6000                                   | X          |         |         |              | X         | 6000 / 2                      | colored red  |
| Drew Marine                      | Drewgard XTA*  |            | X       |         |              |           | 6000 / 2                      |  |
| ExxonMobil                       | Mobil Delvac Extended Life Corrosion Inhibitor         | X          |         |         |              | X         | 6000 / 2                      |  |
| Old World Industries Inc.        | Final Charge Extended Life Corrosion Inhibitor (A 216) | X          |         |         |              | X         | 6000 / 2                      |  |
| Valvoline                        | ZEREX G-93*  |            | X       |         |              |           | 6000 / 2                      |  |
| YORK SAS                         | York 719*  |            | X       |         |              |           | 6000 / 2                      |  |

Table 26:

## 6.1.2 Coolant without antifreeze – Ready mixtures for cooling systems containing light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

### Important information

For the marine engine Series 1163-03 and 1163-04, only coolants marked with an asterisk \* in the brand name can be used

### Coolant without antifreeze, ready mixtures

| Manufacturer             | Brand name                                  | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|--------------------------|---|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                          |   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| MTU Friedrichshafen GmbH | Coolant CS10/90 Corrosion Inhibitor Premix* |            | X       |         |              |           | 6000 / 2                      | X00069385 (20 l)<br>X00069386 (210 l)<br>X00069387 (1000 l)<br>(Sales region: Italy) |

Table 27:

## 6.2 Coolants without antifreeze for cooling systems free of light metal

### 6.2.1 Coolants without antifreeze – Concentrates for cooling systems free of light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Coolants without antifreeze – concentrates

| Manufacturer                     | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|----------------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                                  |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| MTU Friedrichshafen GmbH         | Coolant CS100 Corrosion Inhibitor Concentrate                    |            | X       |         |              |           | 6000 / 2                      | X00057233 (20 l)<br>X00057232 (210 l)<br>X00070455 (1000 l)<br>Also available through MTU Asia     |
| MTU America Inc.                 | Power Cool®Plus 6000 Concentrate                                 |            | X       |         |              |           | 6000 / 2                      | colored green<br>23533526 (1 gallon)<br>23533527 (5 gallons)<br>Available through MTU America Inc. |
| Arteco NV                        | Freecor NBI  |            | X       |         |              |           | 6000 / 2                      |  |
|                                  | Havoline Extended Life Corrosion Inhibitor [EU Code 32765] (XLI) | X          |         |         |              |           | 6000 / 2                      |  |
| BASF SE                          | Glysacorr G93 green  |            | X       |         |              |           | 6000 / 2                      | X00054105 (barrel)<br>X00058062 (canister)   |
| CCI Corporation                  | A 216  | X          |         |         |              | X         | 6000 / 2                      |  |
| CCI Manufacturing IL Corporation | A 216  | X          |         |         |              | X         | 6000 / 2                      | X00051509 (208 l)  |
| Chevron Corp.                    | Texcool A – 200  |            | X       |         |              |           | 6000 / 2                      |  |
| Chevron Lubricants               | Delo XLI Corrosion Inhibitor - Concentrate                       | X          |         |         |              |           | 6000 / 2                      |  |
| Detroit Diesel Corp.             | Power Cool Plus 2000   |            | X       | X       |              |           | 6000 / 2                      |  |
|                                  | Power Cool Plus 6000   | X          |         |         |              | X         | 6000 / 2                      | colored red  |
| Drew Marine                      | Drewgard XTA   |            | X       |         |              |           | 6000 / 2                      |  |
| ExxonMobil                       | Mobil Delvac Extended Life Corrosion Inhibitor                   | X          |         |         |              | X         | 6000 / 2                      |  |
| Fleetguard                       | DCA-4L   |            | X       | X       | X            |           | 2000 / 1                      |  |
| ImproChem                        | COOL-18  |            | X       | X       |              |           | 6000 / 2                      |  |

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| Manufacturer                | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|-----------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|                             |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Nalco                       | Alfloc (Maxitreat) 3477                                | X          |         |         |              |           | 6000 / 2                      |                               |
|                             | Alfloc 2000  |            | X       | X       |              |           | 6000 / 2                      |                               |
|                             | Nalco 2000   |            | X       | X       |              |           | 6000 / 2                      |                               |
|                             | Nalcool 2000   |            | X       | X       |              |           | 6000 / 2                      |                               |
|                             | Trac 102   |            | X       | X       |              |           | 6000 / 2                      |                               |
| Old World Industries Inc.   | Final Charge Extended Life Corrosion Inhibitor (A 216) | X          |         |         |              | X         | 6000 / 2                      |                               |
| Penray                      | Pencool 2000   |            | X       | X       |              |           | 6000 / 2                      |                               |
| PrixMax Australia Pty. Ltd. | PrixMax RCP  | X          |         |         |              |           | 6000 / 2                      |                               |
| Total Lubrifiants           | Total WT Supra   | X          |         |         |              |           | 6000 / 2                      |                               |
| Valvoline                   | Zerex G-93   |            | X       |         |              |           | 6000 / 2                      |                               |
| YORK SAS                    | York 719   |            | X       |         |              |           | 6000 / 2                      |                               |

Table 28:

## 6.2.2 Coolant without antifreeze – Ready mixtures for cooling systems free of light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

### Coolant without antifreeze, ready mixtures

| Manufacturer              | Brand name                                  | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|---------------------------|---|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                           |   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| MTU Friedrichshafen GmbH  | Coolant CS 10/90 Corrosion Inhibitor Premix |            | X       |         |              |           | 6000 / 2                      | X00069385 (20 l)<br>X00069386 (210 l)<br>X00069387 (1000 l)<br>(Sales region: Italy) |
| Nalco                     | Alfloc (Maxitreat) 3443 (7 %)               | X          |         |         |              |           | 6000 / 2                      |  |
| PrixMax Australia Pty Ltd | PrixMax RCP Premix                          | X          |         |         |              |           | 6000 / 2                      |  |

Table 29:

## 6.3 Antifreezes for cooling systems containing light metal

### 6.3.1 Antifreezes – Concentrates for cooling systems containing light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Antifreeze concentrates

| Manufacturer                      | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|-----------------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                                   |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| MTU-Friedrichshafen GmbH          | Coolant AH100 Antifreeze Concentrate               | X          | X       |         |              |           | 9000 / 5                      | X00057231 (20 l)<br>X00057230 (210 l)<br>X00068202 (1000 l)<br>Also available through MTU Asia |
| Avia Mineralöl AG                 | Antifreeze APN                                     | X          | X       |         |              |           | 9000 / 5                      |  |
|                                   | Antifreeze APN - S                                 | X          |         |         |              |           | 9000 / 3                      |  |
| BASF SE                           | Glystantin G05                                     |            | X       | X       |              |           | 9000 / 5                      |  |
|                                   | Glystantin G48 blue green                          | X          | X       |         |              |           | 9000 / 5                      | X00058054 (25 l)<br>X00058053 (210 l)  |
|                                   | Glystantin G30 pink                                | X          |         |         |              |           | 9000 / 3                      | X00058072 (canister)<br>X00058071 (barrel)   |
| BayWa AG                          | Tectrol Coolprotect                                | X          | X       |         |              |           | 9000 / 5                      |  |
| BP Lubricants                     | Aral Antifreeze Extra                              | X          | X       |         |              |           | 9000 / 5                      |  |
| Bucher AG Langenthal              | Motorex Coolant G48                                | X          | X       |         |              |           | 9000 / 5                      |  |
| Castrol                           | Castrol Radicool NF                                | X          | X       |         |              |           | 9000 / 5                      |  |
| CCI Corporation                   | L 415  | X          |         |         |              | X         | 9000 / 3                      |  |
| Clariant                          | Genantin Super                                     |            | X       | X       |              |           | 9000 / 5                      |  |
| Classic Schmierstoff GmbH + Co KG | Classic Kolda UE G48                               | X          | X       |         |              |           | 9000 / 5                      |  |
| Comma Oil & Chemicals Ltd.        | Comma Xstream® G30® Antifreeze Coolant Concentrate | X          |         |         |              |           | 9000 / 3                      |  |
|                                   | Comma Xstream® G48® Antifreeze Coolant Concentrate | X          | X       |         |              |           | 9000 / 5                      |  |
| COPARTS Autoteile GmbH            | CAR 1 Premium Longlife Kühlerschutz C48            | X          | X       |         |              |           | 9000 / 5                      |  |
| Daimler Trucks North America      | Alliance OAT Extended Life Coolant                 | X          |         |         |              | X         | 9000 / 3                      |  |
| Detroit Diesel Corp.              | Power Cool Antifreeze                              |            | X       | X       |              |           | 9000 / 3                      |  |
|                                   | Power Cool Plus Coolant                            | X          |         |         |              | X         | 9000 / 3                      |  |
|                                   | Power Cool Diesel Engine Coolant                   |            | X       | X       |              |           | 9000 / 3                      |  |

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| Manufacturer                  | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number              |
|-------------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                               |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| ExxonMobil                    | Mobil Delvac Extended Life Coolant                   | X          |         |         |              | X         | 9000 / 3                      |  |
|                               | Mobil Antifreeze Advanced                            | X          |         |         |              |           | 9000 / 3                      |  |
|                               | Mobil Antifreeze Extra                               | X          | X       |         |              |           | 9000 / 5                      |  |
|                               | Mobil Antifreeze Special                             |            | X       | X       |              |           | 9000 / 5                      |  |
|                               | Mobil Heavy Duty Coolant                             |            | X       | X       |              |           | 9000 / 3                      |  |
|                               | Mobil Mining Coolant                                 |            | X       | X       |              |           | 9000 / 3                      |  |
|                               | Esso Antifreeze Advanced                             | X          |         |         |              |           | 9000 / 3                      |  |
|                               | Esso Antifreeze Extra                                | X          | X       |         |              |           | 9000 / 5                      |  |
| Finke Mineralölwerk GmbH      | AVIATICON Finkofreeze F30                            | X          |         |         |              |           | 9000 / 3                      |  |
|                               | AVIATICON Finkofreeze F48                            | X          | X       |         |              |           | 9000 / 5                      |  |
| Fuchs Petrolub SE             | Maintain Fricofin                                    | X          | X       |         |              |           | 9000 / 5                      |  |
|                               | Maintain Fricofin G12 Plus                           | X          |         |         |              |           | 9000 / 3                      | X00058074 (canister)<br>X00058073 (barrel) |
| Gazpromneft Lubricants Ltd.   | Belaz G-Profi Antifreeze Red                         | X          |         |         |              |           | 9000 / 3                      |  |
| INA Maziva Ltd.               | INA Antifriz AI Super                                | X          | X       |         |              |           | 9000 / 5                      |  |
| Krafft S.L.U.                 | Refrigerante ACU 2300                                |            | X       | X       |              |           | 9000 / 3                      | X00058075 (barrel)                         |
| Kuttenkeuler GmbH             | Kuttenkeuler Antifreeze ANF KK48                     | X          | X       |         |              |           | 9000 / 5                      |  |
|                               | Glycostar®ST48                                       | X          | X       |         |              |           | 9000 / 5                      |  |
| Lukoil Lubricants Europe GmbH | Lukoil Coolant Plus                                  | X          | X       |         |              |           | 9000 / 5                      |  |
|                               | Lukoil Coolant SF                                    | X          |         |         |              |           | 9000 / 3                      |  |
| Mitan Mineralöl GmbH          | Alpine C30   | X          |         |         |              |           | 9000 / 3                      |  |
|                               | Alpine C48   | X          | X       |         |              |           | 9000 / 5                      |  |
| Nalco                         | Nalcool 5990   | X          | X       |         |              |           | 9000 / 3                      |  |
| Nalco Australia               | Nalcool NF 48 C                                      | X          | X       |         |              |           | 9000 / 5                      |  |
| Navistar Inc.                 | Fleetrite Nitrite-Free Extended Life Coolant         | X          |         |         |              | X         | 9000 / 3                      |  |
| Old World Industries Inc.     | Blue Mountain Heavy Duty Extended Life Coolant       | X          |         |         |              | X         | 9000 / 3                      |  |
|                               | Fleet Charge SCA Pre-charged Coolant / Antifreeze    |            | X       | X       |              |           | 9000 / 3                      |  |
|                               | Final Charge Global Extended Life Coolant Antifreeze | X          |         |         |              | X         | 9000 / 3                      |  |
|                               | Peak Heavy Duty Coolant                              |            | X       | X       |              |           | 9000 / 3                      |  |
| Panolin AG                    | Panolin Anti-Frost MT-325                            | X          | X       |         |              |           | 9000 / 5                      |  |
| Penske Power Systems          | Power Cool - HB500 Coolant Concentrate               | X          | X       |         |              |           | 9000 / 3                      |  |

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| Manufacturer                | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|-----------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|                             |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Raloy Lubricantes           | Antifreeze Long Life NF-300 Concentrate            | X          | X       |         |              |           | 9000 / 5                      |                               |
| Recochem Inc.               | R542   | X          | X       |         |              |           | 9000 / 3                      |                               |
| SMB - Sotragal / Mont Blanc | Antigel Power Cooling Concentrate                  | X          | X       |         |              |           | 9000 / 5                      |                               |
| Total Lubrifiants           | Glacelf MDX  | X          | X       |         |              |           | 9000 / 5                      |                               |
| Valvoline                   | Zerex G-05   |            | X       | X       |              |           | 9000 / 5                      |                               |
|                             | Zerex G-48   | X          | X       |         |              |           | 9000 / 5                      |                               |
|                             | Zerex G-30   | X          |         |         |              |           | 9000 / 3                      |                               |
| Volvo Trucks                | Road Choice Nitrite-Free OAT Extended Life Coolant | X          |         |         |              | X         | 9000 / 3                      |                               |
| YORK SAS                    | York 716   | X          | X       |         |              |           | 9000 / 5                      |                               |
| ZAO Obninskorgsintez        | Lukoil Antifreeze HD G12 K                         | X          |         |         |              |           | 9000 / 3                      |                               |

Table 30:

### 6.3.2 Antifreeze – Concentrates for special applications

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Concentrates for special applications

| Manufacturer | Brand name | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number           |
|--------------|------------|------------|---------|---------|--------------|-----------|-------------------------------|---|
|              |            | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |   |
| BASF SE      | G206       | X          | X       |         |              |           | 9000 / 3                      | For use in arctic regions<br>(< -40 °C) |

Table 31:

### 6.3.3 Antifreeze – Ready mixtures for cooling systems containing light metals

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Ready mixtures for cooling systems containing light metals

| Manufacturer                    | Brand name  | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number   |
|---------------------------------|---|------------|---------|---------|--------------|-----------|-------------------------------|---|
|                                 |   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |   |
| MTU Friedrichshafen GmbH        | Coolant AH 35/65 Antifreeze Premix                  | X          | X       |         |              |           | 9000 / 5                      | X00069382 (20 l)<br>X00069383 (210 l)<br>X00069384 (1000 l)<br>(Sales region: Italy)          |
|                                 | Coolant AH 40/60 Antifreeze Premix                  | X          | X       |         |              |           | 9000 / 5                      | X00070533 (20 l)<br>X00070531 (210 l)<br>X00070532 (1000 l)<br>(Sales region: England, Spain) |
|                                 | Coolant AH 50/50 Antifreeze Premix                  | X          | X       |         |              |           | 9000 / 5                      | X00070528 (20 l)<br>X00070530 (210 l)<br>X00070527 (1000 l)<br>(Sales region: England)        |
|                                 | Coolant RM30 (40 %)                                 | X          |         |         |              |           | 9000 / 3                      | X00073922 (20 l)<br>X00073916 (205 l)<br>X00073923 (1000 l)                                   |
| MTU America Inc.                | Power Cool® Universal 35/65 mix                     | X          | X       |         |              |           | 9000 / 5                      | 800085 (5 gallons)<br>800086 (55 gallons)   |
|                                 | Power Cool® Universal 50/50 mix                     | X          | X       |         |              |           | 9000 / 5                      | 800071 (5 gallons)<br>800084 (55 gallons)   |
|                                 | Power Cool® Off-Highway Coolant 50/50 Premix        |            | X       | X       |              |           | 9000 / 5                      | 23533531 (5 gallons)<br>23533532 (55 gallons)   |
| Bantleon                        | Avilub Antifreeze Mix (50 %)                        | X          | X       |         |              |           | 9000 / 5                      | X00049213 (210 l)   |
| BayWa AG                        | Tectrol Coolprotect Mix 3000                        | X          |         |         |              |           | 9000 / 3                      | Antifreeze protection up to -24 °C  |
| Bucher AG Langenthal            | Motorex Coolant G48 ready to use (50/50)            | X          | X       |         |              |           | 9000 / 5                      |   |
| Castrol                         | Castrol Radicool NF Premix (45%)                    | X          | X       |         |              |           | 9000 / 5                      |   |
| CCI Corporation                 | L 415 (50%)   | X          |         |         |              | X         | 9000 / 3                      |   |
| Cepsa Comercial Petróleo S.A.U. | XTAR Super Coolant Hybrid NF 50%                    | X          | X       |         |              |           | 9000 / 5                      |   |
| Daimler Trucks North America    | Alliance 50/50 Prediluted OAT Extended Life Coolant | X          |         |         |              | X         | 9000 / 3                      |   |

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| Manufacturer                | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|-----------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|                             |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Detroit Diesel Corp.        | Power Cool Plus Prediluted Coolant (50/50)                               | X          |         |         |              | X         | 9000 / 3                      |                               |
|                             | Power Cool Prediluted 50/50 Diesel Engine Coolant                        |            | X       | X       |              |           | 9000 / 3                      |                               |
| Exxon Mobil                 | Mobil Delvac Extended Life Prediluted Coolant (50/50)                    | X          |         |         |              | X         | 9000 / 3                      |                               |
|                             | Mobile Heavy Duty 50/50 Prediluted Coolant                               |            | X       | X       |              |           | 9000 / 3                      |                               |
|                             | Mobile Mining 50/50 Prediluted Coolant                                   |            | X       | X       |              |           | 9000 / 3                      |                               |
| Finke Mineralölwerk GmbH    | AVIATICON Finkofreeze F48 RM 50/50                                       | X          | X       |         |              |           | 9000 / 5                      |                               |
|                             | AVIATICON Finkofreeze F30 RM 40:60 +                                     | X          |         |         |              |           | 9000 / 3                      |                               |
| Navistar Inc.               | Fleetrite 50/50 Prediluted Nitrite-Free Life Coolant                     | X          |         |         |              | X         | 9000 / 3                      |                               |
| Old World Industries Inc.   | Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)        | X          |         |         |              | X         | 9000 / 3                      |                               |
|                             | Final Charge Global Extended Life Prediluted Coolant/ Antifreeze (50/50) | X          |         |         |              | X         | 9000 / 3                      |                               |
|                             | Fleet Charge SCA Pre-charged 50/50 Prediluted Coolant                    |            | X       | X       |              |           | 9000 / 3                      |                               |
| Penske Power Systems        | Power Cool - HB500 Premix 50/50  | X          | X       |         |              |           | 9000 / 3                      |                               |
| Raloy Lubricantes           | Antifreez Long Life NF-300 Ready-to-Use (50:50)                          | X          | X       |         |              |           | 9000 / 5                      |                               |
| SMB - Sotragal / Mont Blanc | L.R.-30 Power Cooling (44%)  | X          | X       |         |              |           | 9000 / 5                      |                               |
|                             | L.R.-38 Power Cooling (52%)  | X          | X       |         |              |           | 9000 / 5                      |                               |
| Tosol-Sintez                | Glystantin Alu Protect G30 Ready Mix                                     | X          |         |         |              |           | 9000 / 3                      |                               |
|                             | Glystantin Alu Protect Plus G48 Ready Mix                                | X          | X       |         |              |           | 9000 / 5                      |                               |
| Total Lubrifiants           | Coolelf MDX (-26 °C)   | X          | X       |         |              |           | 9000 / 5                      |                               |
| Valentin Energie GmbH       | Valentin Coolant Plus -25 °C Ready                                       | X          |         |         |              |           | 9000 / 3                      |                               |
| Valvoline                   | Zerex G-05 50/50 Mix   |            | X       | X       |              |           | 9000 / 5                      |                               |
| Volvo Trucks                | Road Choice 50/50 Prediluted Nitrite-Free OAT Extended Life Coolant      | X          |         |         |              | X         | 9000 / 3                      |                               |

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| Manufacturer          | Brand name                        | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|-----------------------|-----------------------------------|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|                       |                                   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| YPF S.A. Argentina    | Kriox MTL50                       | X          |         |         |              | X         | 9000 / 3                      |                               |
| ZAO Obrninskorgsintez | Lukoil Antifreeze HD<br>G12 (50%) | X          |         |         |              |           | 9000 / 3                      |                               |

Table 32:

## 6.4 Antifreezes for cooling systems free of light metal

### 6.4.1 Antifreeze - Concentrates for cooling systems free of light metal

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Important information

For the Series 4000-04 and 4000-05, only coolants marked with an asterisk \* in the brand name can be used!

#### Antifreeze concentrates

| Manufacturer             | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|--------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                          |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| MTU Friedrichshafen GmbH | Coolant AH100* Antifreeze Concentrate                      | X          | X       |         |              |           | 9000 / 5                      | X00057231 (20 l)<br>X00057230 (210 l)<br>X00068202 (1000 l)<br>Also available through MTU Asia |
| Arteco NV                | Havoline Extended Life Coolant XLC [EU Code 30379]         | X          |         |         |              |           | 9000 / 3                      |  |
| Avia Mineralöl AG        | Antifreeze APN*  | X          | X       |         |              |           | 9000 / 5                      |  |
|                          | Antifreeze APN - S*  | X          |         |         |              |           | 9000 / 3                      |  |
|                          | AVIA Coolant APN-S   | X          |         |         |              |           | 9000 / 3                      |  |
| BASF SE                  | Glysantin G05  |            | X       | X       |              |           | 9000 / 5                      |  |
|                          | Glysantin G48 blue green*                                  | X          | X       |         |              |           | 9000 / 5                      | X00058054 (25 l)<br>X00058053 (210 l)  |
|                          | Glysantin G30 pink*  | X          |         |         |              |           | 9000 / 3                      | X00058072 (canister)<br>X00058071 (barrel)   |
| BayWa AG                 | Tectrol Coolprotect*                                       | X          | X       |         |              |           | 9000 / 5                      |  |
| BP Lubricants            | ARAL Antifreeze Extra*                                     | X          | X       |         |              |           | 9000 / 5                      |  |
| Bucher AG Langenthal     | Motorex Coolant G48*                                       | X          | X       |         |              |           | 9000 / 5                      |  |
| Caltex                   | Caltex Extended Life Coolant [AP Code 510614] (XLC)        | X          |         |         |              |           | 9000 / 3                      |  |
| Castrol                  | Castrol Radicool NF*                                       | X          | X       |         |              |           | 9000 / 5                      |  |
| CCI Corporation          | L415*  | X          |         |         |              | X         | 9000 / 3                      |  |
| Chevron Corp.            | Havoline Dexcool Extended Life Antifreeze [US Code 227994] | X          |         |         |              |           | 9000 / 3                      |  |
| Chevron Lubricants       | Delo XLC Antifreeze/Coolant-Concentrate                    | X          |         |         |              |           | 9000 / 3                      |  |
| Clariant                 | Genantin Super   |            | X       | X       |              |           | 9000 / 3                      |  |

| Manufacturer                       | Brand name  | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number              |
|------------------------------------|---|------------|---------|---------|--------------|-----------|-------------------------------|--|
|                                    |   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| Classic Schmierstoff GmbH + Co. KG | Classic Kolda UE G48*                               | X          | X       |         |              |           | 9000 / 5                      |  |
| Comma Oil & Chemicals Ltd.         | Comma Xstream® G30®* Antifreeze Coolant Concentrate | X          |         |         |              |           | 9000 / 3                      |  |
|                                    | Comma Xstream® G48®* Antifreeze Coolant Concentrate | X          | X       |         |              |           | 9000 / 5                      |  |
| COPARTS Autoteile GmbH             | CAR1 Premium Longlife Kühlerschutz C48*             | X          | X       |         |              |           | 9000 / 5                      |  |
| Daimler Trucks North America       | Alliance OAT Extended Life Coolant*                 | X          |         |         |              | X         | 9000 / 3                      |  |
| Detroit Diesel Corp.               | Power Cool Antifreeze                               |            | X       | X       |              |           | 9000 / 3                      |  |
|                                    | Power Cool Plus Coolant*                            | X          |         |         |              | X         | 9000 / 3                      |  |
|                                    | Power Cool Diesel Engine Coolant                    |            | X       | X       |              |           | 9000 / 3                      |  |
| ExxonMobil                         | Mobil Delvac Extended Life Coolant*                 | X          |         |         |              | X         | 9000 / 3                      |  |
|                                    | Mobil Antifreeze Advanced*                          | X          |         |         |              |           | 9000 / 3                      |  |
|                                    | Mobil Antifreeze Extra*                             | X          | X       |         |              |           | 9000 / 5                      |  |
|                                    | Mobil Antifreeze Special                            |            | X       | X       |              |           | 9000 / 5                      |  |
|                                    | Mobil Heavy Duty Coolant                            |            | X       | X       |              |           | 9000 / 3                      |  |
|                                    | Mobil Mining Coolant                                |            | X       | X       |              |           | 9000 / 3                      |  |
|                                    | Esso Antifreeze Advanced*                           | X          |         |         |              |           | 9000 / 3                      |  |
| Finke Mineralölwerk GmbH           | AVIATICON Finkofreeze F30*                          | X          |         |         |              |           | 9000 / 3                      |  |
|                                    | AVIATICON Finkofreeze F48*                          | X          | X       |         |              |           | 9000 / 5                      |  |
| Fuchs Petrolub SE                  | Maintain Fricofin*                                  | X          | X       |         |              |           | 9000 / 5                      |  |
|                                    | Maintain Fricofin G12 Plus*                         | X          |         |         |              |           | 9000 / 3                      | X00058074 (canister)<br>X00058073 (barrel) |
|                                    | Maintain Fricofin HDD [Oil-code T-AF3-1]            |            | X       | X       |              | X         | 9000 / 3                      |  |
|                                    | Maintain Fricifin LL                                | X          |         |         |              |           | 9000 / 3                      |  |
| Gazpromneft Lubricants Ltd.        | Belaz G-Profi Antifreeze Red*                       | X          |         |         |              |           | 9000 / 3                      |  |
|                                    | G - Energy Antifreeze SNF                           | X          |         |         |              |           | 9000 / 3                      |  |
| INA Maziva Ltd.                    | INA Antifriz AI Super*                              | X          | X       |         |              |           | 9000 / 5                      |  |
| Krafft S.L.U                       | Refrigerante ACU 2300                               |            | X       | X       |              |           | 9000 / 3                      | X00058075 (barrel)                         |



| Manufacturer                              | Brand name  | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|---|---|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|   |   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Kuttenkeuler GmbH                         | Kuttenkeuler Antifreeze ANF KK48*                     | X          | X       |         |              |           | 9000 / 5                      |                               |
|   | Glycostar® ST48*                                      | X          | X       |         |              |           | 9000 / 5                      |                               |
| Kuwait Petroleum Research & Technology BV | Q8 Antifreeze Long Life                               | X          |         |         |              |           | 9000 / 3                      |                               |
|   | Q8 Mahler Cool  | X          |         |         |              |           | 9000 / 3                      |                               |
|   | Roloil Rol-ICE SNF                                    | X          |         |         |              |           | 9000 / 3                      |                               |
| Lukoil Lubricants Europe GmbH             | Lukoil Coolant Plus*                                  | X          | X       |         |              |           | 9000 / 5                      |                               |
|   | Lukoil Coolant SF*                                    | X          |         |         |              |           | 9000 / 3                      |                               |
| Mitan Mineralöl GmbH                      | Alpine C30*   | X          |         |         |              |           | 9000 / 3                      |                               |
|   | Alpine C48*   | X          | X       |         |              |           | 9000 / 5                      |                               |
| MOL-Lub Kft.                              | EVOX Premium concentrate                              | X          |         |         |              |           | 9000 / 3                      |                               |
| Nalco                                     | Nalcool 4070  | X          | X       | X       |              |           | 9000 / 3                      |                               |
|   | Nalcool 5990  | X          | X       |         |              |           | 9000 / 3                      |                               |
| Nalco Australia                           | Nalcool NF 48 C*                                      | X          | X       |         |              |           | 9000 / 5                      |                               |
| Navistar Inc.                             | Fleetrite Nitrite-Free Extended Life Coolant*         | X          |         |         |              | X         | 9000 / 3                      |                               |
| OAo Technoform                            | Cool Stream Premium C                                 | X          |         |         |              |           | 9000 / 3                      |                               |
| Old World Industries Inc.                 | Blue Mountain Heavy Duty Extended Life Coolant*       | X          |         |         |              | X         | 9000 / 3                      |                               |
|   | Fleetcharge SCA Pre-charged Coolant / Antifreeze      |            | X       | X       |              |           | 9000 / 3                      |                               |
|   | Final Charge Global Extended Life Coolant Antifreeze* | X          |         |         |              | X         | 9000 / 3                      |                               |
|   | Peak Heavy Duty Coolant                               |            | X       | X       |              |           | 9000 / 3                      |                               |
| Panolin AG                                | Panolin Anti-Frost MT-325*                            | X          | X       |         |              |           | 9000 / 5                      |                               |
| Penske Power Systems                      | Power Cool - HB500                                    | X          | X       |         |              |           | 9000 / 3                      |                               |
|   | Power Cool - HB800                                    | X          | X       | X       |              |           | 9000 / 3                      |                               |
| Raloy Lubricantes                         | Antifreeze Long Life NF-300 Concentrate*              | X          | X       |         |              |           | 9000 / 5                      |                               |
| Recochem Inc.                             | R542  | X          | X       |         |              |           | 9000 / 3                      |                               |
|   | R824M   | X          | X       | X       |              |           | 9000 / 3                      |                               |
| Shell                                     | Shell HD Premium N                                    |            | X       | X       |              |           | 9000 / 3                      |                               |
| SMB - Sotragal / Mont Blanc               | Antigel Power Cooling Concentrate*                    | X          | X       |         |              |           | 9000 / 5                      |                               |
| Total Lubrificants                        | Glacelf Auto Supra                                    | X          |         |         |              |           | 9000 / 3                      |                               |
|   | Glacelf MDX*  | X          | X       |         |              |           | 9000 / 5                      |                               |
|   | Glacelf Supra   | X          |         |         |              |           | 9000 / 3                      |                               |

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| Manufacturer         | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|----------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|                      |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Valvoline            | Zerex G-05   |            | X       | X       |              |           | 9000 / 5                      |                               |
|                      | Zerex G-48*  | X          | X       |         |              |           | 9000 / 3                      |                               |
|                      | Zerex G-30*  | X          |         |         |              |           | 9000 / 5                      |                               |
| Volvo Trucks         | Road Choice Nitrite-Free<br>OAT Extended Life Coolant* | X          |         |         |              | X         | 9000 / 3                      |                               |
| YORK SAS             | York 716*  | X          | X       |         |              |           | 9000 / 5                      |                               |
| ZAO Obninskorgsintez | Lukoil Antifreeze<br>HD G12 K*                         | X          |         |         |              |           | 9000 / 3                      |                               |

Table 33:

## 6.4.2 Antifreeze – Concentrates for special applications

For details and special features, see chapter on “Coolants” (→ Page 17)

### Concentrates for special applications

| Manufacturer | Brand name | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number  |
|--------------|------------|------------|---------|---------|--------------|-----------|-------------------------------|--|
|              |            | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |  |
| BASF SE      | G206       | X          | X       |         |              |           | 9000 / 3                      | For use in arctic regions<br>(< -40 °C)<br>No approval for Ser-<br>ies 4000-04 |

Table 34:

### 6.4.3 Antifreeze – Ready mixtures for cooling systems free of light metals

For details and special features, see chapter on “Coolants” (→ Page 17)

#### Important information

For the Series 4000-04 and 4000-05, only coolants marked with an asterisk \* in the brand name can be used!

#### Antifreeze, ready mixtures

| Manufacturer             | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number   |
|--------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|---|
|                          |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |   |
| MTU Friedrichshafen GmbH | Coolant AH 35/65 Antifreeze Premix*                                  | X          | X       |         |              |           | 9000 / 5                      | X00069382 (20 l)<br>X00069383 (210 l)<br>X00069384 (1000 l)<br>(Sales region: Italy)          |
|                          | Coolant AH 40/60 Antifreeze Premix*                                  | X          | X       |         |              |           | 9000 / 5                      | X00070533 (20 l)<br>X00070531 (210 l)<br>X00070532 (1000 l)<br>(Sales region: England, Spain) |
|                          | Coolant AH 50/50 Antifreeze Premix*                                  | X          | X       |         |              |           | 9000 / 5                      | X00070528 (20 l)<br>X00070530 (210 l)<br>X00070527 (1000 l)<br>(Sales region: England)        |
|                          | Coolant RM 30 (40%)*   | X          |         |         |              |           | 9000 / 3                      | X00073922 (20 l)<br>X00073916 (205 l)<br>X00073923 (1000 l)                                   |
| MTU America Inc.         | Power Cool® Universal 35/65 mix*                                     | X          | X       |         |              |           | 9000 / 5                      | 800085 (5 gallons)<br>800086 (55 gallons)   |
|                          | Power Cool® Universal 50/50 mix*                                     | X          | X       |         |              |           | 9000 / 5                      | 800071 (5 gallons)<br>800084 (55 gallons)   |
|                          | Power Cool® Off-Highway Coolant 50/50 Premix                         |            | X       | X       |              |           | 9000 / 5                      | 23533531 (5 gallons)<br>23533532 (55 gallons)   |
| Arteco NV                | Havoline Extended Life Coolant + B2 50/50 OF01 [EU Code 33073] (50%) | X          |         |         |              |           | 9000 / 3<br>9000 / 3          |   |
|                          | Havoline Extended Life Coolant + B2 40/60 OF01 [EU Code 33069] (40%) | X          |         |         |              |           | 9000 / 3                      |   |
|                          | Havoline Extended Life Coolant + B2 35/65 OF01 [EU Code 33074] (35%) | X          |         |         |              |           | 9000 / 3                      |   |
| Bantleon                 | Avilub Antifreeze Mix (50%)*   | X          | X       |         |              |           | 9000 / 5                      | X00049213 (210 l)   |
| BayWa AG                 | Tectrol Coolprotect Mix 3000*  | X          |         |         |              |           | 9000 / 3                      | Antifreeze protection up to -24 °C  |

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| Manufacturer                              | Brand name  | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|---|---|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|   |   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Bucher AG Langenthal                      | Motorex Coolant G48 ready to use (50/50)*   | X          | X       |         |              |           | 9000 / 5                      |                               |
| Caltex                                    | Caltex Extended Life Coolant Pre-Mixed 50/50 [AP Code 510609] (50 %)                | X          |         |         |              |           | 9000 / 3                      |                               |
| Castrol                                   | Castrol Radicool NF Premix (45 %)*  | X          | X       |         |              |           | 9000 / 5                      |                               |
| CCI Corporation                           | L 415 (50 %)*   | X          |         |         |              | X         | 9000 / 3                      |                               |
| Cepsa Comercial Petróleo S.A.U.           | Xtar Super Coolant Hybrid NF 50%*   | X          | X       |         |              |           | 9000 / 5                      |                               |
| Chevron Corp.                             | Havoline Dexcool Extended Life Prediluted 50/50 Antifreeze Coolant [US Code 227995] | X          |         |         |              |           | 9000 / 3                      |                               |
| Daimler Trucks North America              | Alliance 50/50 Prediluted OAT Extended Life Coolant*                                | X          |         |         |              | X         | 9000 / 3                      |                               |
| Detroit Diesel Corp.                      | Power Cool Plus Prediluted Coolant (50/50)*   | X          |         |         |              | X         | 9000 / 3                      |                               |
|   | Power Cool Prediluted 50/50 Diesel Engine Coolant                                   |            | X       | X       |              |           | 9000 / 3                      |                               |
| ExxonMobil                                | Mobil Delvac Extended Life Prediluted Coolant (50/50)*                              | X          |         |         |              | X         | 9000 / 3                      |                               |
|   | Mobile Heavy Duty 50/50 Prediluted Coolant  |            | X       | X       |              |           | 9000 / 3                      |                               |
|   | Mobile Mining 50/50 Prediluted Coolant  |            |         |         |              |           |                               |                               |
| Finke Mineralölwerk GmbH                  | AVIATICON Finkofreeze F48 RM 50/50*   | X          | X       |         |              |           | 9000 / 5                      |                               |
|   | AVIATICON Finkofreeze F30 RM 40:60 +  | X          |         |         |              |           | 9000 / 3                      |                               |
| Fuchs Petrolub SE                         | Maintain Fricofin HDD Premix 50/50 [Oilcode T-AF3-2]                                |            | X       | X       |              | X         | 9000 / 3                      |                               |
| Kuwait Petroleum Research & Technology BV | Q8 Antifreeze Longlife 40/60  | X          |         |         |              |           | 9000 / 3                      |                               |
|   | Q8 Mahler Cool premixed 4060  | X          |         |         |              |           | 9000 / 3                      |                               |
|   | Roloil Ro-ICE SNF 4060  | X          |         |         |              |           | 9000 / 3                      |                               |
| Nalco                                     | Nalcool 4100 (50 %)   | X          | X       | X       |              |           | 9000 / 3                      |                               |
| Navistar Inc.                             | Fleetrite 50/50 Prediluted Nitrite-Free Extended Life Coolant                       | X          |         |         |              | X         | 9000 / 3                      |                               |

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| Manufacturer                | Brand name   | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|-----------------------------|--|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|                             |  | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Old World Industries Inc.   | Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)*         | X          |         |         |              | X         | 9000 / 3                      |                               |
|                             | Final Charge Global Extended Life Prediluted Coolant / Antifreeze (50/50)* | X          |         |         |              | X         | 9000 / 3                      |                               |
|                             | Fleet Charge SCA Pre-charged 50/50 Prediluted Coolant                      |            | X       | X       |              |           | 9000 / 3                      |                               |
| Penske Power Systems        | Power Cool - HB500 Premix 50/50  | X          | X       |         |              |           | 9000 / 3                      |                               |
|                             | Power Cool - HB800 Premix 50/50  | X          | X       | X       |              |           | 9000 / 3                      |                               |
| Raloy Lubricantes           | Antifreeze Long Life NF-300 Ready-to-Use (50:50)*                          | X          | X       |         |              |           | 9000 / 5                      |                               |
| SMB - Sotragal / Mont Blanc | L.R.-30 Power Cooling (44 %)*  | X          | X       |         |              |           | 9000 / 5                      |                               |
|                             | L.R.-38 Power Cooling (52%)*   | X          | X       |         |              |           | 9000 / 5                      |                               |
| Total Lubrifiants           | Coolelf MDX (-26 °C)*  | X          | X       |         |              |           | 9000 / 5                      |                               |
|                             | Coolelf Supra (40%)  | X          |         |         |              |           | 9000 / 3                      |                               |
|                             | Coolelf Supra GF NP (50 %)   | X          |         |         |              |           | 9000 / 3                      |                               |
| Tosol-Sinzez                | Glystantin Alu Protect/G30 Ready Mix*                                      | X          |         |         |              |           | 9000 / 3                      |                               |
|                             | Glystantin Protect Plus/G48 Ready Mix*                                     | X          | X       |         |              |           | 9000 / 5                      |                               |
| Valentin Energie GmbH       | Valentin Coolant Plus -25 °C Ready*  | X          |         |         |              |           | 9000 / 3                      |                               |
| Valvoline                   | Zerex G-05 50/50 Mix   |            | X       | X       |              |           | 9000 / 5                      |                               |
| Volvo Trucks                | Road Choice 50/50 Prediluted Nitrite-Free OAT Extended Life Coolant*       | X          |         |         |              | X         | 9000 / 3                      |                               |
| YPF S.A. Argentina          | Kriox MTL50*   | X          |         |         |              | X         | 9000 / 3                      |                               |
| ZAO Obninskorgsintez        | Lukoil Antifreeze HD G12 (50%)*  | X          |         |         |              |           | 9000 / 3                      |                               |

Table 35:

## 6.5 Coolant Additives with Limited Series Approval

### 6.5.1 Antifreeze - Concentrates and ready mixtures on ethylene-glycol basis for series with and without light metal

#### Antifreeze, concentrates

| Manufacturer                  | Brand name                        | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number   |
|-------------------------------|-----------------------------------|------------|---------|---------|--------------|-----------|-------------------------------|---|
|                               |                                   | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |   |
| BASF SE                       | Glysantin®G40 pink (concentrate)  | X          | X       |         |              |           | 9000 / 3                      | X00066724 (20 l)<br>X00066725 (210 l)<br>Concentration for use: 40 to 50% by volume |
| Bucher AG Langenthal          | Motorex Coolant M 4,0 Concentrate | X          | X       |         |              |           | 9000 / 3                      | Concentration for use: 40 to 50% by volume  |
| Finke Mineralölwerk GmbH      | AVIATICON Finkofreeze F40         | X          | X       |         |              |           | 9000 / 3                      | Concentration for use: 40 to 50% by volume  |
| Lukoil Lubricants Europe GmbH | Lukoil Coolant SOT                | X          | X       |         |              |           | 9000 / 3                      | Concentration for use: 40 to 50% by volume  |
| Valvoline                     | ZEREX G40 (concentrate)           | X          | X       |         |              |           | 9000 / 3                      | Concentration for use: 40 to 50% by volume<br>Material number (USA): 800180 (Drum)  |

Table 36:

#### Antifreeze, ready mixtures

| Manufacturer         | Brand name                         | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number      |
|----------------------|------------------------------------|------------|---------|---------|--------------|-----------|-------------------------------|------------------------------------|
|                      |                                    | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                                    |
| Bucher AG Langenthal | Motorex Coolant M 4,0 Ready to use | X          | X       |         |              |           | 9000 / 3                      | Antifreeze protection up to -38 °C |

Table 37:

6.5.2 Antifreeze – Ready mixtures based on propylene glycol for series free of light metal

**Antifreeze, ready mixture**

| Manufacturer | Brand name                | Inhibitors |         |         |              |           | Operating time<br>Hour / Year | Comments /<br>Material number |
|--------------|---------------------------|------------|---------|---------|--------------|-----------|-------------------------------|-------------------------------|
|              |                           | Organic    | Silicon | Nitrite | Phosphatized | Molybdate |                               |                               |
| Fleetguard   | PG XL (40%) ready mixture |            | X       | X       | X            |           | 9000 / 3                      |                               |

Table 38:



# 7 Flushing and Cleaning Specifications for Engine Coolant Circuits

## 7.1 General information

In the course of time, sludge deposits from aging coolant additives can accumulate in the coolant circuits. 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 circuit 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 coolant circuit and all affected parts must be cleaned.

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

Only products approved by MTU or corresponding products at the specified concentrations may be used for cleaning, see (→ Page 123). The specified cleaning procedure is to be complied with.

Immediately after flushing or cleaning, fill the coolant circuits with prepared engine coolant as stipulated in the current Fluids and Lubricants Specifications. Otherwise there is a danger of corrosion!

### Important

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. Considerable 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 liability whatsoever for improper or illegal use of the fluids and lubricants / cleaning agents which it has approved.

### Important

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

Required auxiliary materials:

- Compressed air
- Superheated steam

Required fluids and lubricants:

- Fresh water
- Prepared engine coolant

## 7.2 Fresh water requirements for cleaning solutions and flushing water

| Important  |                    |   |
|--|--------------------|---|
| Only clean, clear water with values in accordance with those in the following table must be used for preparing cleaning solutions. If the limit values for the water are exceeded, hardness or mineral content can be decreased by adding demineralized water. |                    |   |
| Item   | Minimum            | Maximum                                       |
| Total earth alkalines <sup>1)</sup> (water hardness)   | 0 mmol/l<br>0°d    | 2.7 mmol/l<br>15°d                            |
| pH-value at 20 °C  | 5.5                | 8.0   |
| Chloride ions  |                    | 100 mg/l                                      |
| Sulfate ions   |                    | 100 mg/l                                      |
| Total chloride + sulfate ions  |                    | 200 mg/l                                      |
| Bacteria   |                    | 10 <sup>3</sup> CFU (colony forming unit )/ml |
| Fungi, yeasts  | are not permitted! |   |

Table 39:

<sup>1)</sup> = Common designations for water hardness in various countries: 1 mmol/l = 5.6°d = 100 mg/kg CaCO<sub>3</sub>

- 1°d = 17.9 mg/kg CaCO<sub>3</sub>, USA hardness
- 1°d = 1.79° French hardness
- 1°d = 1.25° English hardness

| Important   |
|---|
| The cleaning agent concentrates used for the preparation of the cleaning solution, may not contain more than 100 mg/l chloride and/or 100 mg/l sulfate. |

## 7.3 Approved cleaning agents

| Manufacturer   | Product name                       | Working concentration |        | Order no.            |
|--|------------------------------------|-----------------------|--------|----------------------|
| <b>For coolant systems:</b>  |                                    |                       |        |                      |
| Kluthe   | Hakutex 111 <sup>1, 5)</sup>       | 2% by volume          | Liquid | X00065751            |
|  | Decorrdal 20-1 <sup>8)</sup>       | 10% by volume         | Liquid | <sup>7)</sup>        |
|  | Hakupur 50-706-3 <sup>4)</sup>     | 2% by volume          | Liquid | X00055629            |
| <b>For assemblies:</b>   |                                    |                       |        |                      |
| Henkel   | Bonderite C-AK FD <sup>2)</sup>    | 1 to 10% by weight    | Powder | <sup>7)</sup>        |
|  | Bonderite C-MC 11120 <sup>3)</sup> | 2 to 10% by weight    | Powder | <sup>7)</sup>        |
| Kluthe   | Hakutex 60 MTU                     | 100% by volume        | Liquid | X00070585<br>(25 kg) |
| <b>For coolant systems contaminated with bacteria, fungi or yeast (so-called system cleaners):</b> |                                    |                       |        |                      |
| Schülke & Mayr GmbH  | Grotan WS Plus <sup>5)</sup>       | 0.15% by volume       | Liquid | X00065326<br>(10 kg) |
|  | Grotanol SR2 <sup>6)</sup>         | 0.5% by volume        | Liquid | X00069827<br>(10 kg) |

Table 40:

<sup>1)</sup> For light lime deposits, light corrosion

<sup>2)</sup> For greasy lime deposits

<sup>3)</sup> Preferred for heavy lime deposits

<sup>4)</sup> Not suitable for galvanized surfaces

<sup>5)</sup> Bacteria contamination up to  $10^4$

<sup>6)</sup> Bacteria contamination up to  $> 10^4$ , contamination with fungi and yeast

<sup>7)</sup> Not stocked by MTU

<sup>8)</sup> With serious corrosion; not permitted for aluminum materials

### Important information

The technical data sheets and safety data sheets of the product must be observed!

The cleaning agents are available world-wide through the branches of the manufacturers or their trading partners.

## 7.4 Engine coolant circuits - Flushing

1. Drain engine coolant.
2. Measure pH-value of the fresh water using the MTU test kit or electric pH-value measuring device.
3. Fill coolant circuit with fresh water.

### Important information

Never pour cold water into a hot engine!

4. Preheat, start and run engine until warm.
5. Run engine for approx. 30 minutes at increased speed.
6. Take flush-water sample at engine-coolant-sample extraction cock.
7. Shut down engine.
8. Drain flush water.
9. Measure pH value of flush-water sample using the MTU test kit or electric pH value measuring device and compare with the pH value of the fresh water.
  - a) pH value difference  $< 1$ : Fill system with treated coolant and start engine.
  - b) pH value difference  $> 1$ : Fill system with fresh flush water and repeat flushing process.
  - c) If the pH value difference is still  $> 1$  after 4 to 5 flushing operations: The coolant circuit must be cleaned, see (→ Page 125). The assemblies may also have to be cleaned, see (→ Page 127).

### Important information

Refer to the engine operating instructions for additional information.

## 7.5 Engine coolant circuits - Cleaning

1. Mix cleaner to the specified concentration with freshwater. Use warm freshwater (45 °C) if the engine is warm.
2. Cleaning agents for coolant circuits are prepared in warm freshwater as a concentrated solution, see (→ Page 123).
3. In the case of powdered products, stir until the cleaning agent is completely dissolved and without sediment.
4. Pour solution together with freshwater into coolant circuit.
5. Start engine and run until warm.
6. Select temperature and duration of residence time according to the specifications of the technical data sheets of the manufacturer.
7. Shut down engine.
8. Drain off cleaning agents and flush the engine coolant circuit with fresh water.
9. Take flush-water sample at engine-coolant-sample extraction cock.
10. Measure pH value of flush-water sample using the MTU test kit or electric pH value measuring device and compare with the pH value of the freshwater.
  - a) pH value difference < 1: Fill system with treated coolant and start engine.
  - b) pH value difference > 1: Clean assemblies, see (→ Page 127).

### Important

Refer to the engine operating instructions for additional information.

## 7.6 Removal of heavy corrosion in coolant circuits using Decorrdal 20-1

1. Drain all coolant from engine coolant circuit.
2. Fill engine coolant circuit with fresh water and flush the cooling system.
3. Drain flush water completely.
4. Fill coolant circuit completely with a water solution containing 10% Decorrdal 20-1.
5. Start engine and run to operating temperature, 20 minutes.
6. Perform cleaning cycle with the engine running, with circulating Decorrdal 20-1, duration: 4 hours.
7. Vent the coolant circuit several times while running the cleaning cycle to ensure complete filling.
8. Allow the engine to cool down to approx. 45 °C.
9. When the temperature reaches 45 °C, drain Decorrdal 20-1.
10. First flushing cycle: Fill the coolant circuit with 10% Glysacorr P113 solution in water immediately after draining the cleaning solution.
11. Operate the engine for 30 minutes, vent the coolant circuit several times.
12. Allow the engine to cool down to 45 °C.
13. Drain the Glysacorr P113 flushing solution completely.
14. Second flushing cycle: Fill coolant circuit again with a fresh water solution containing 10% Glysacorr P113.
15. Operate the engine for 30 minutes, vent the coolant circuit several times.
16. Allow the engine to cool down to 35 °C.
17. Drain the Glysacorr P113 flushing solution completely.
18. Fill engine with coolant.
19. Rust removal is complete.
20. Put engine into operation.

### Important

The engine coolant circuit must always be vented properly to ensure complete filling. This applies when filling the engine with water, cleaning agent, corrosion inhibitor and coolant as well as in engine operation with one of the mentioned media.

In zones where air is present, neither rust removal nor preservation take place, and corrosion occurs again. All crankcase openings, hose connection openings, etc. must be closed immediately if no longer required. There is a risk of corrosion in the area of the openings.

## 7.7 Assemblies – Cleaning

1. Remove, disassemble and clean assemblies that are exposed to heavy sludge deposits e.g. expansion tanks, preheating units, heat exchangers (coolant cooler, oil heat-exchanger, charge-air cooler, charge-air preheater, fuel preheater etc.) and lower sections of pipework.
2. Before cleaning, examine degree of contamination on water sides.
3. If greasy lime deposits are found, first degrease the water side.
4. Deposits in charge-air coolers caused by oil mist can be removed using Kluthe Hakutex 60.
5. Remove hard lime deposits with a decalcifying product. In the event of stubborn lime deposits, if necessary a 10% inhibited hydrochloric acid solution may have to be used.
6. Dissolve deposits on and in heat-exchanger elements in a heated cleaning bath. Observe the manufacturer's specifications and use only approved detergents in the permissible concentration, see (→ Page 123)

### Important information

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

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

### Important information

In order to avoid damage:  
Do not use hard or sharp-edged tools (steel brushes, scrapers, etc.) (oxide protective layer).  
Do not set the pressure of the water jet too high (may damage cooler fins, for example).

8. 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.
9. Check that all components are in perfect condition, repair or replace as necessary.
10. 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.
11. After installing all assemblies, flush engine coolant circuit once, see (→ Page 124).
12. Check coolant system for leaks during initial operation of engine.

### Important information

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

## 7.8 Coolant circuits contaminated with bacteria, fungi or yeast

### **System cleaning**

The system cleaner must flow a sufficiently long time through the complete cooling system to ensure effective cleaning and disinfection.

Therefore, the predefined amount of the approved system cleaner must be added to the contaminated coolant in the system, see (→ Page 123). Use a circulating pump to provide continuous mixture flow through the coolant system for at least 24 hours or max. 48 hours.

### **Flushing**

When the coolant and system cleaner have been drained, the cooling circuit must be flushed with fresh water. Flushing must be carried out until no more contaminants are visible and the flushing liquid has the same pH-value as the fresh water used (max. pH-value difference < 1).

### **Refill**

Before refilling the circuit, make sure the system is free of contaminants.

Refill must be performed directly after flushing to avoid the risk of corrosion!



# 8 Cleaning the Product Externally

## 8.1 General information

If, in the course of time, contaminants such as oil deposits and leaves have accumulated on the engine, it might be necessary to clean it. This should be done with due care and only on the surface.

Wash-cleaning the engine can - at the worst - have the opposite effect if it is carried out incorrectly.

Before getting started and using cleaning products, electric components (battery-charging generator, plug connections, ignition cables etc.) and the air intake should be protected with covers to avoid water ingress into the plug connections or combustion chambers, which could cause damage.

Only clean fresh water (no river or sea water) must be used for spray-washing.

All plug connections should be checked and, if necessary, blown out with compressed air after cleaning to avoid misfiring and other electrical problems.

Only products approved by MTU Friedrichshafen or corresponding products at the specified concentrations may be used for cleaning. The specified cleaning procedure must be complied with.

### Important information

Cleaning must be carried out with pressure washers at an operating pressure of  $\leq 60$  bar to avoid damage to the cooler and the engine. High-pressure cleaners with an operating pressure  $> 60$  bar are not permitted.

After the clean-washing procedure, the equipment must be thoroughly rinsed with fresh water. The specifications in the chapter "Fresh water requirements for cleaning solutions and flushing water" are applicable. The technical data sheets and safety data sheets of the product must be observed!

### Important information

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, statutory requirements and technical guidelines valid in the individual countries. Considerable 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 Friedrichshafen accepts no responsibility whatsoever for improper or illegal use of the fluids and lubricants / cleaning agents which it has approved.

## Test equipment, auxiliary materials and fluids and lubricants

MTU test kit or electric pH value measuring instrument

- Fresh water
- Superheated steam
- Compressed air

## 8.2 Approved cleaning agents

| Manufacturer   | Product name               | Working concentration            |        | Order no.               |
|--|----------------------------|----------------------------------|--------|-------------------------|
| <b>For remote cooler on air side:</b>                          |                            |                                  |        |                         |
| Kluthe GmbH  | Hakupur 50 K <sup>1)</sup> | 0.5% by volume -<br>5% by volume | Liquid | X00070940 <sup>2)</sup> |
| <b>For cleaning painted, contaminated surfaces externally:</b> |                            |                                  |        |                         |
| Kluthe GmbH  | Hakupur 449 <sup>1)</sup>  | 1% by volume                     | Liquid | X00071179 <sup>2)</sup> |

Table 41:

<sup>1)</sup> Cleaning agent for cleaning with high-pressure cleaning device (parameter: Pressure: ≤ 60 bar, gentle spray jet, distance from nozzle to object at least 25 cm, cleaning agent temperature: 80 °C)

<sup>2)</sup> Not stocked by MTU

### Important information

The technical data sheets and safety data sheets of the product must be observed!

The cleaning agents are available world-wide through the branches of the manufacturers or their trading partners.

## 9 Revision Overview

### 9.1 Revision overview from version A001064/09 to version A001064/10

| Seq. No. | Section | Subject  | Page         | Action  |
|----------|---------|--|--------------|---------|
| 1        | 1.1     | Preface  | (→ Page 5)   | Revised |
| 2        | 2.1     | Engine oils – General information  | (→ Page 7)   | Revised |
| 3        | 3.1     | Coolants – General information   | (→ Page 17)  | Revised |
| 4        | 3.2     | Operational monitoring   | (→ Page 20)  | Revised |
| 5        | 3.3     | Series-based usability of coolant additives  | (→ Page 24)  | Revised |
| 6        | 3.10    | Coolant concentrates – Storage capability  | (→ Page 31)  | Revised |
| 7        | 4.1     | Diesel fuels – General information   | (→ Page 35)  | Revised |
| 8        | 4.2.1   | Distillate fuels according to DIN EN 590 and ASTM D975   | (→ Page 40)  | Revised |
| 9        | 4.2.2   | British Standard 2869  | (→ Page 42)  | Revised |
| 10       | 4.2.3   | Chinese distillate fuels according to GB 19147-2013 and GB 252-2015                                  | (→ Page 43)  | Revised |
| 11       | 4.2.4   | Heating oil  | (→ Page 45)  | Revised |
| 12       | 4.2.5   | Marine distillate fuels according to ISO 8217:2018-10  | (→ Page 46)  | Revised |
| 13       | 4.2.6   | Aviation turbine fuel  | (→ Page 48)  | Revised |
| 14       | 4.2.7   | NATO diesel fuels  | (→ Page 49)  | Revised |
| 15       | 4.2.9   | B20 diesel fuel  | (→ Page 53)  | Revised |
| 16       | 4.3     | Biodiesel – Biodiesel admixture  | (→ Page 58)  | Revised |
| 17       | 4.5     | Supplementary fuel additives   | (→ Page 62)  | Revised |
| 18       | 5.1     | Single-grade oils – Category 1, SAE grades 30 and 40 for diesel engines                              | (→ Page 67)  | Revised |
| 19       | 5.2     | Multigrade oils – Category 1, SAE grades 15W-40 for diesel engines                                   | (→ Page 69)  | Revised |
| 20       | 5.3     | Single-grade oils – Category 2, SAE-grades 30 and 40 for diesel engines                              | (→ Page 70)  | Revised |
| 21       | 5.4     | Multigrade oils – Category 2 of SAE grades 10W-40, 15W-40 and 20W-40 for diesel engines              | (→ Page 73)  | Revised |
| 22       | 5.5     | Multigrade oils – Category 2.1 (Low SAPS oils) of SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 | (→ Page 83)  | Revised |
| 23       | 5.6     | Multigrade oils – Category 3 of SAE grades 5W-30, 5W-40 and 10W-40 for diesel engines                | (→ Page 87)  | Revised |
| 24       | 5.7     | Multigrade oils – Category 3.1 (Low SAPS oils) of SAE grades 5W-30, 10W-30 and 10W-40                | (→ Page 92)  | Revised |
| 25       | 6.1.1   | Coolant without antifreeze – Concentrates for cooling systems containing light metal                 | (→ Page 99)  | Revised |
| 26       | 6.2.1   | Coolants without antifreeze – Concentrates for cooling systems free of light metal                   | (→ Page 101) | Revised |

| Seq. No. | Section | Subject   | Page         | Action        |
|----------|---------|---|--------------|---------------|
| 27       | 6.2.2   | Coolant without antifreeze – Ready mixtures for cooling systems free of light metal                           | (→ Page 103) | Revised       |
| 28       | 6.3.1   | Antifreeze – Concentrates for cooling systems containing light metal  | (→ Page 104) | Revised       |
| 29       | 6.3.3   | Antifreeze – Ready mixtures for cooling systems containing light metals                                       | (→ Page 108) | Revised       |
| 30       | 6.4.1   | Antifreeze – Concentrates for cooling systems free of light metal   | (→ Page 111) | Revised       |
| 31       | 6.4.3   | Antifreeze – Ready mixtures for cooling systems free of light metals  | (→ Page 116) | Revised       |
| 32       | 6.5.1   | Antifreeze – Concentrates and ready mixtures on ethylene-glycol basis for series with and without light metal | (→ Page 119) | Revised       |
| 33       | 7.2     | Fresh water requirements for cleaning solutions and flushing water  | (→ Page 122) | Chapter added |
| 34       | 7.5     | Engine coolant circuits – Cleaning  | (→ Page 125) | Revised       |
| 35       | 7.6     | Removal of heavy corrosion in coolant circuits using Decorrda 20-1  | (→ Page 126) | Chapter added |
| 36       | 8.1     | General information   | (→ Page 129) | Chapter added |
| 37       | 8.2     | Approved cleaning agents  | (→ Page 130) | Chapter added |

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