



# Fluids and Lubricants Specifications

Fluids and Lubricants Specifications for Series 1600 PowerPack®

A001065/02E



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# 1 Preface

## 1.1 General information

These Fluids and Lubricants Specifications contain general instructions for the proper and safe operation of your product from the manufacturer MTU.

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

Test standard	Designation
DIN	Deutsches Institut für Normung (Federal German Standards Institute)
EN	Europäische Normung (European Standards)
ISO	International standard
ASTM	American Society for Testing and Materials
IP	Institute of Petroleum
DVGW	Deutscher Verein des Gas- und Wasserfaches e.V. (German Gas and Water Industry Association)

Table 1: Test standards for fluids and lubricants

### Applicability of this publication

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Before using them, make sure you have the latest version. The latest version is also available at:

[www.mtu-solutions.com](http://www.mtu-solutions.com)

If you have any questions, your MTU contact person will be happy to help you.

### 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 drive units may be considered hazardous substances. Certain regulations must be obeyed when handling, storing and disposing of these substances.

These regulations are contained in the manufacturers' instructions, statutory regulations 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 liability whatsoever for improper or illegal use of the fluids and lubricants which it has approved.

### Preservation

All information on preservation, re-preservation and de-preservation including the approved preservatives is available in the Preservation and Re-preservation Specifications (publication number A001070/...). The latest version is also available at:

[www.mtu-solutions.com](http://www.mtu-solutions.com)

## 2 Engine Oils

### 2.1 Requirements and oil change intervals

#### Important

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

#### Requirements for the approval of engine oils by MTU

The conditions of for the approval of engine oils are specified in the delivery standard MTL 5044, which can be ordered under this reference number.

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

Diesel engine oils approved for Series 1600 PowerPack engines are divided into the following MTU quality categories:

- Oil category 2.1: Multi-grade oils with a low ash-forming additive content (low SAPS oils)
- Oil category 3.1: Multi-grade 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. The use of low-ash oils is prescribed depending on the exhaust gas aftertreatment used (→ Page 32).

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.

#### Special features - MTU diesel engine oils

The following multigrade oils are available depending on the relevant region.

Manufacturer & sales region	Product name	SAE grade	Oil category	Material no.
MTU America Inc. Americas	Power Guard® SAE 15W-40 Off Highway Heavy Duty	15W-40	2.1	5 gallons: 800133 55 gallons: 800134 IBC: 800135
MTU EMEA	Diesel Engine Oil DEO SAE 10W-40 (increased corrosion protection)	10W-40	3.1	20 l container: X00078578 210 l container X00078577 IBC: X00078576

Table 2: Multigrade oils from MTU

#### Oil change interval

#### Important

The oil change interval is 1,000 operating hours or max. 1 year under the condition that engine oils of oil category 3.1 (→ Page 35) and approved fuels (→ Page 22) are used.

The oil change interval is 500 operating hours or max. 1 year under the condition that engine oils of oil category 2.1 (→ Page 32) and approved fuels are used (→ Page 22)

If fuels which have not been approved are used, shorter oil change intervals are to be expected.

Prior to using non-approved fuels, contact MTU to determine the applicable oil change intervals.

### Important

When changing to an engine oil in oil category 3.1, 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).

### 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 3) 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 filters or separators, especially in comparison with the previous analysis.
- Abnormal discoloration of components.

### Analytical limit values for used diesel engine oils

	Test method	Limit values	
Viscosity at 100 °C max. mm <sup>2</sup> /s	ASTM D445 DIN 51562 DIN 51569-1	SAE 5W-30 SAE 10W-30	15.0
		SAE 5W-40 SAE 10W-40 SAE 15W-40 SAE 20W-40	19.0
min. mm <sup>2</sup> /s		SAE 5W-30 SAE 10W-30	9.0
		SAE 5W-40 SAE 10W-40 SAE 15W-40 SAE 20W-40	10.5
Flashpoint °C (COC)	ASTM D92 DIN EN ISO 2592	Min. 190	
Flashpoint °C (PM)	ASTM D93 DIN EN ISO 2719	min. 140	
Soot content (by weight %)	DIN 51452 CEC-L-82-97	Max. 3.5	
Total base number (mg KOH/g)	ASTM D2896 ISO 3771 DIN 51639	Min. 50% of new-oil value	

	Test method	Limit values
Water content (vol%)	ASTM D6304 EN 12937 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 DIN 51399-2 ASTM D5158	To confirm that the new oil is identical with the oil grade of the used oils

Table 3:

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

### Spectrometric oil analysis

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

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



## 2.2 Viscosity grades

Selection of the viscosity grade is based primarily on the ambient temperature at which the engine is to be started and operated. Figure (→ Figure 1) contains guideline values for the temperature limits of the individual viscosity grades.

The temperature specifications of the SAE grade are always based on fresh oils. During operation, engine oil ages due to soot and fuel residue. This results in significant deterioration of the properties of the engine oil particularly at low outside temperatures. At outside temperatures below  $-20\text{ }^{\circ}\text{C}$ , MTU strongly recommends the use of engine oil of SAE grade 5W-30 or - if approved - 0W-30.

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

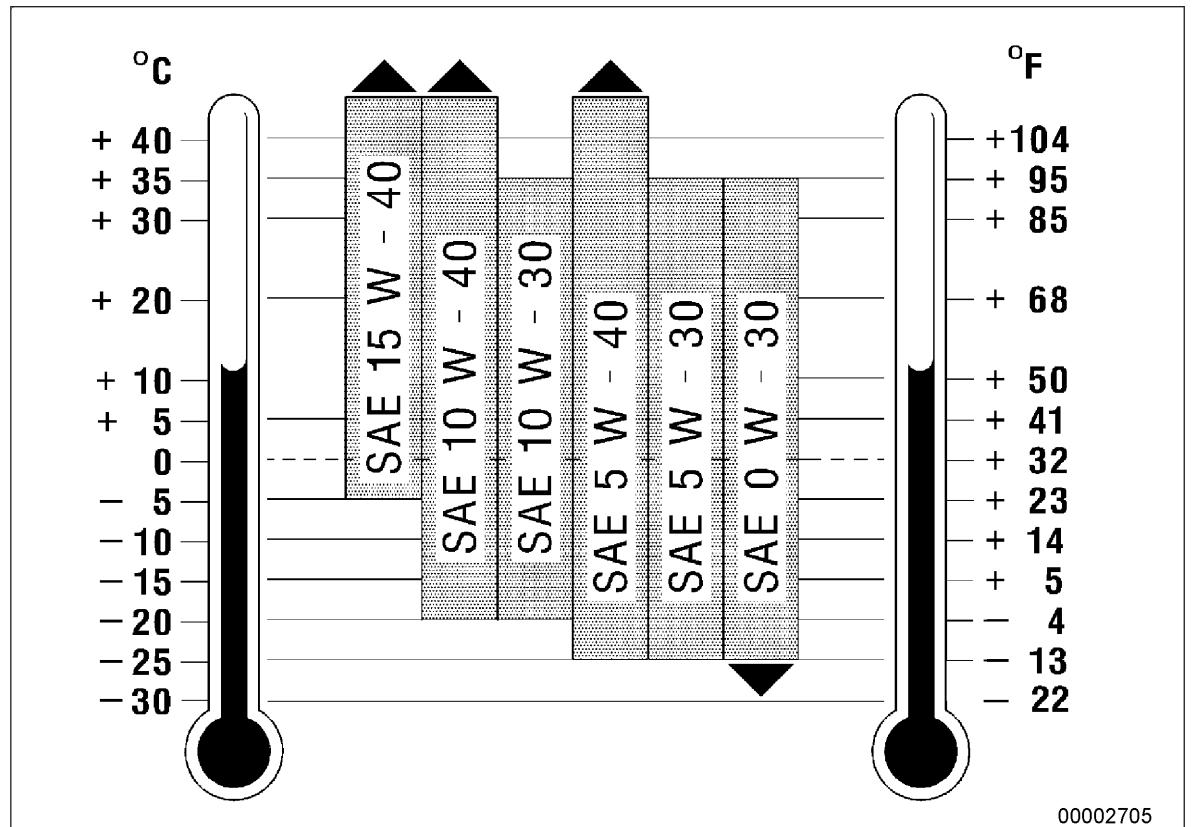


Figure 1: Viscosity grades

# 3 Transmission Oils

## 3.1 Transmission oils for rail vehicles with ZF transmissions

### (Excerpt from the ZF List of Lubricants TE-ML16, Edition 01.10.2018)

The ZF Lists of Lubricants are updated every three months on 01.01., 01.04., 01.07. and 01.10.. Before using them, make sure you have the latest version. The latest version is also available at:

[www.zf.com/corporate/de/products/spare\\_parts/technical\\_information/lubricants/lists\\_of\\_lubricants.html/TE-ML16](http://www.zf.com/corporate/de/products/spare_parts/technical_information/lubricants/lists_of_lubricants.html/TE-ML16)

Product groups automatic transmissions for rail vehicles	Lubricant classes for service fills <sup>(1)</sup> transmissions with-out/with ZF-Intarder
ASRail <ul style="list-style-type: none"> <li>12 AS 2303, 12 AS 2703, 12 AS 3103, 16 AS2603</li> </ul>	16K / 16P
EcoLife (up to 105 °C)	16Q

Table 4:

<sup>(1)</sup> = Approves commercial products (→ Page 40), oil change intervals and low temperature limits (listed below).

Important
Follow the instructions for greasing points in the manual.
Important
Additives of any kind added later to the oil change the oil in a manner that is unpredictable, and they are therefore not permitted. ZF accepts no liability whatsoever for any damage resulting from the use of such additives.

### Oil and filter change intervals for EcoLife transmissions for rail vehicles:

Lubricant classes <sup>(1)</sup>	Oil and filter change interval [km / years] <sup>(2,3)</sup>
16Q	180,000 km / every 3 years

Table 5:

<sup>(1)</sup> = Pay attention to approved trade products and lubricant classes.

<sup>(2)</sup> = Oil change required, depending on what occurs first.

<sup>(3)</sup> = After consultation with the product support department of ZF Friedrichshafen AG, Special Drive Technology, and after an oil analysis has been made (after agreed mileages), longer oil change intervals can be applied to some reference transmissions. The procedure for taking oil samples is described in the respective Service Information.

### Application areas of lubricants

The following illustration (→ Figure 2) shows application areas of the various SAE classes in relation to the ambient temperatures to be expected.

The oils have a bottom limit of max. dynamic viscosity (Brookfield) of 150,000 mPas, which roughly corresponds to the viscosity limit at low temperatures.

The upper limit is determined by the load in the transmission and the appearing temperature level during operation. It can be assumed that high ambient temperatures will also result in higher oil sump temperatures. For detailed information on the low temperature behavior of the specific product see at the safety data sheet of the supplier.

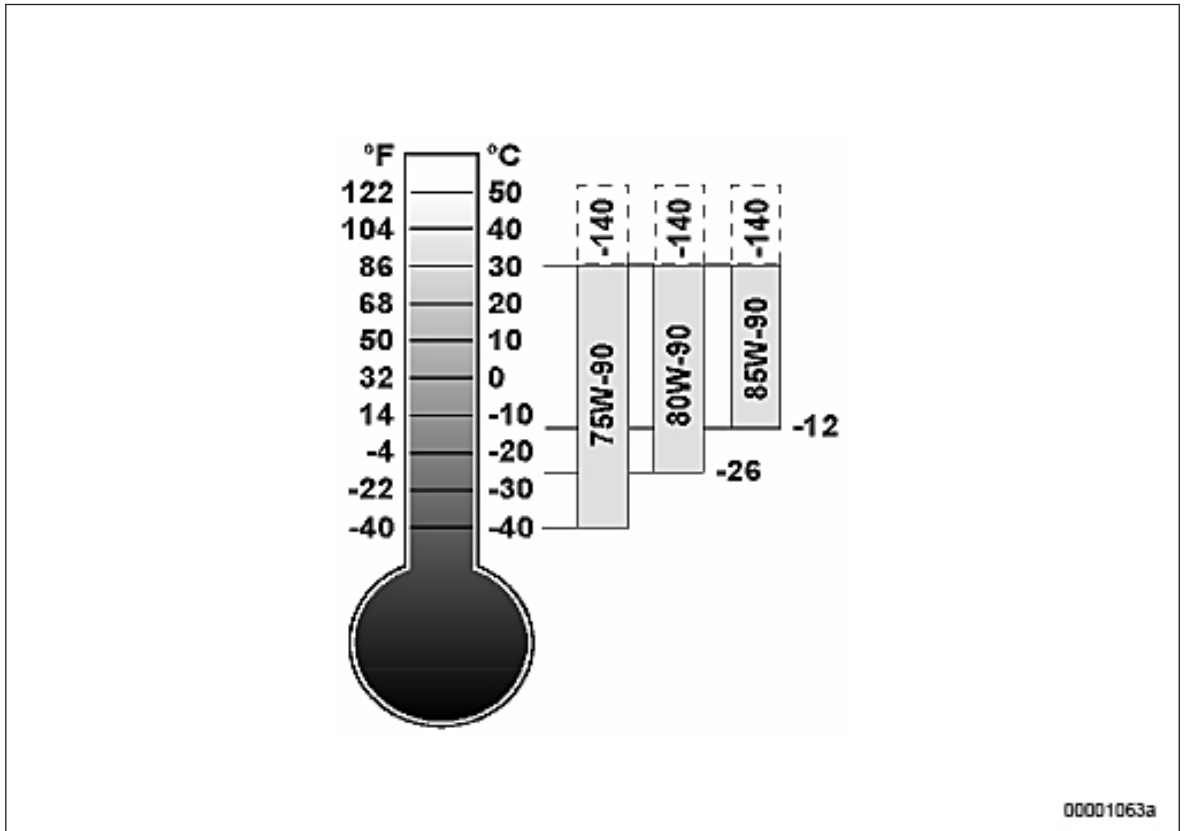


Figure 2: Range of use for hydraulic oil

**The user must observe the low temperature limits!**

Lubricant classes	Viscosity grades	Use at oil sump temperature as over
16K / 16L / 16M / 16N / 16P / 16Q	75W-80 / 75W-85 / 75W-90 / 75W-110 / 75W-140 / ATF	- 40 °C

Table 6:

## 3.2 Power transmission oils for Voith turbo transmissions T211 + KB 190

### Excerpt from Voith documentation of power transmission oils for Voith turbo transmissions

Voith publications are continuously updated. Before using them, make sure you have the latest version. The latest version is also available at:

[www.voith.com/brochures/2255](http://www.voith.com/brochures/2255)

### Oil and filter change intervals for Voith turbo transmissions T 211 re4 + KB190

Oil and filter change interval based on running hours <sup>(1)</sup>	Oil and filter change intervals based on mileage (km)
5,000	300,000

Table 7:

<sup>(1)</sup> = Running hours are accumulated operating hours at speeds of more than 1 km/h.

### Use at low temperatures

The approved transmission oils allow cold starts at temperatures down to -20 °C.

Special measures must be taken if temperatures are lower.

### Oil filtration

Ensure oil filtration to purity class 15/11 as per ISO 4406 when filling the transmission with oil. For appropriate filter units please contact Voith Turbo.

The maximum quantity of foreign particles in 100 ml oil for this purity class is:

- Particles >4 µm: 130,000 (purity class 17)
- Particles >6 µm: 32,000 (purity class 15)
- Particles >14 µm: 2,000 (purity class 11)

Approved power transmission oils (→ Page 41).

# 4 Hydraulic Oils

## 4.1 Hydraulic system

### Hydraulic system

**Important**

The oil change interval for the hydraulic system is 4000 operating hours / max. 2 years!

Approved engine oils for the hydraulic system (→ Page 40) and (→ Page 41).

**Important**

Purity class 19/17/14 as per ISO 4406 is required when filling the hydraulic system.

# 5 Coolants

## 5.1 General information

### Definition of coolant

Coolant = coolant additive (concentrate) + freshwater to predefined mixing ratio ready for use in engine.

Ready mixtures are coolants ready for direct use in the engine. They must not be diluted with freshwater.

Coolants must be prepared from suitable fresh water and a coolant additive approved by MTU.

All approved coolants for the Series 1600 PowerPack® may be used in locomotive and underfloor applications.

**Important**  
Prepare the coolant outside the PowerPack®!  
Mixing of different coolant additives and supplementary additives is prohibited!

**Important**  
Flush with freshwater before changing from an antifreeze product containing silicate (ready mixture or concentrate) to a silicate-free product! The same applies when changing from a silicate-free product to a product containing silicate.

The quantity of coolant remaining in the PowerPack® coolant circuit during a coolant change is not critical.

The approval conditions for coolant additives are defined in the delivery standard MTL 5048 / corrosion-inhibiting antifreezes.

Coolant manufacturers are informed in writing if their product has been approved.

### Permissible working concentrations of engine coolants

Working concentration	Coolant additive	Fresh water	Antifreeze <sup>1)</sup> down to approx.
Minimum	40% by volume	60% by volume	-25 °C
	45% by volume	55% by volume	-31 °C
	50% by volume	50% by volume	-37 °C
Maximum	55% by volume	45% by volume	-45 °C

Table 8:

<sup>1)</sup> = Antifreeze specifications determined as per ASTM D 1177

The working concentration of a coolant shall be specified by stating the percentage of coolant additive (concentrate) first.

Example:

Coolant concentration 40 % by volume = 40 % coolant additive by volume + 60 % freshwater by volume

The coolant concentration for any given application depends primarily on the degree of antifreeze protection required.

## Calculating antifreeze quantities when refilling

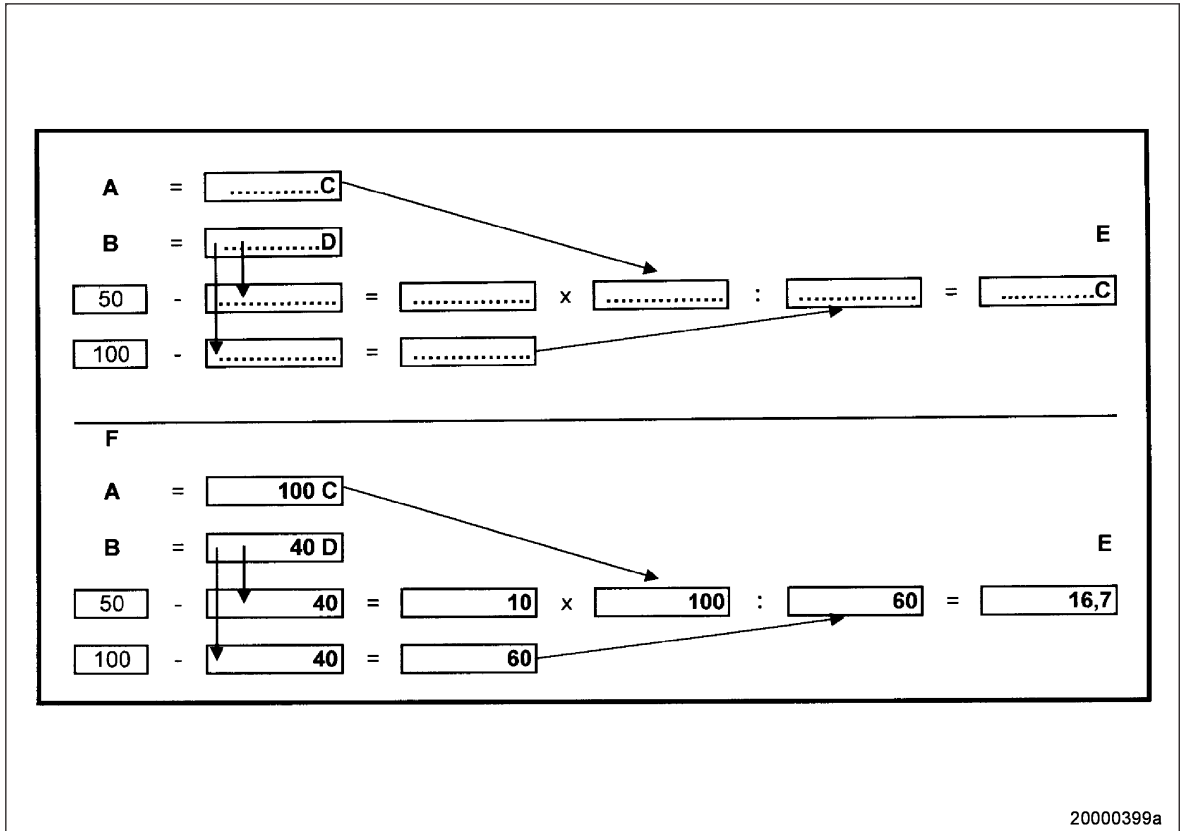


Figure 3: Typical calculation for coolant refill

A Coolant capacity (total)

B Measured concentration

C Liters

D Percent by volume

E Antifreeze refill quantity (this quantity must be drained off if the coolant level is within the specifications!)

F Calculation example

## MTU engine coolant or coolant additives

The following engine coolants/coolant additives are available in the framework of MTU ValueCare.

Manufacturer & sales region	Product name	Type
MTU Friedrichshafen GmbH, MTU Asia	Coolant AH 100 Antifreeze Concentrate	Antifreeze concentrate
Europe	Coolant AH 50/50 Antifreeze Pre-mix	Antifreeze, ready mixture
Middle East	Coolant AH 40/60 Antifreeze Pre-mix	Antifreeze, ready mixture
Africa	Coolant AH 40/60 Antifreeze Pre-mix	Antifreeze, ready mixture
Asia	Coolant AH 40/60 Antifreeze Pre-mix	Antifreeze, ready mixture
MTU America Inc. Americas	Power Cool® Universal 50/50 mix	Antifreeze, ready mixture

Table 9:

## Avoiding damage in the coolant system

- For initial filling, an antifreeze concentration of 50% by volume must be ensured.
- For topping up coolant (after a coolant loss) or when the antifreeze concentration falls below 40% by volume, a concentration of 50% by volume must be established in the cooling system.
- An antifreeze concentration lower than 40% by volume is inadmissible to avoid compromising corrosion protection.
- Never exceed an antifreeze concentration of 55% by volume. Concentrations in excess of this reduce antifreeze protection and heat dissipation.
- The coolant must not contain any oil or copper residue (in solid or dissolved form).
- The corrosion-inhibiting effect of coolant is only ensured with the coolant circuit fully filled. Otherwise, only the antifreeze approved for internal preservation of the coolant circuit provides 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. For the preservation procedure, refer to the MTU Preservation and Represervation Specifications A001070/.. of the engine.
- A coolant circuit can not usually be drained completely, i.e. residual quantities of used coolant or freshwater 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

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



## 5.2 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.

## 5.3 Requirements imposed on freshwater

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 of the water are exceeded, demineralized water can be added to reduce the hardness or mineral content.

	Minimum	Maximum
Sum of alkaline earth metals *) (Water hardness)	0 mmol/l 0°d	2.7 mmol/l 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 10: Freshwater requirements for coolant treatment

\*) 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

## 5.4 Operational monitoring

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

The following tests can be conducted with the MTU test kit:

- Determination of total hardness (°d)
- pH value
- Chloride content of freshwater
- Determination of antifreeze content

An order can be placed for analysis of the freshwater and coolant with MTU. Samples of min. 0.25 l must be supplied.

The coolant must fulfill the following requirements:

Value	Minimum	Maximum
pH value with antifreeze	7.5	9.0
Silicon (valid for coolants containing Si)	25 mg/l	

*Table 11: Coolant requirements*

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.

## 5.5 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.

Coolant concentrate	Limit value	Brand name / Remarks
Antifreeze	Approx. 3 years	Observe manufacturer's specifications

Table 12: Storage capability

Important
<p>For reasons of corrosion protection, do not store in galvanized containers. Take this requirement into account when coolant must be transferred.</p> <p>Store containers in hermetically sealed condition in a cool and dry place. Ensure proper antifreeze protection during the cold season.</p> <p>Further information can be obtained from the product and safety data sheets for the individual coolants.</p>

## 5.6 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. Chromatech Europe B.V.	D11014 Chromatint Uranine Conc	X00066947	20 kg	2 years

Table 13: 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.

# 6 Liquid Fuels

## 6.1 Diesel fuels – General information

### Important

Dispose of used fluids and lubricants in accordance with local regulations.

### Selecting a suitable diesel fuel

The quality of the fuel has an influence on the engine power, engine lifetime and exhaust gas emissions.

### Important

Diesel fuels are not available worldwide in the quality required.  
The fuel properties depend on many factors, in particular, region, time of year and storage.

Unsuitable fuel usually leads to a reduced operational life of engine components and can also cause engine damage. Furthermore, there is a risk that the statutory exhaust gas emissions are no longer observed.

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/..).

In order to achieve optimum engine performance and satisfactory service life for the entire fuel and injection system, the limit values for water, total contamination (undissolved solids content) and particle size distribution must be complied with in the vehicle tank for all approved fuel qualities.

### Fuel specifications to be complied with

		Test method		Limit values
		ASTM		
Composition				The diesel fuel must be free of inorganic acids, visible water, solid foreign matter and chlorous compounds
Total contamination (= fuel-insoluble ingredients)	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)	min.	D93	EN ISO 2719	55 °C (60 °C for SOLAS) <sup>1)</sup>
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 Internal MTU procedure	7.0% by volume

TIM-ID: 0000010759 - 011

		Test method		Limit values
		ASTM		
Water content: (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: <sup>2)</sup> – Engines without exhaust gas aftertreatment or recirculation – Engines with exhaust gas aftertreatment or recirculation	max. max.	D482	EN ISO 6245	0.01% by weight (100 mg/kg) 0.001 % by weight (10 mg/kg)
Sulfur content: <sup>2)</sup> – Engines without exhaust gas aftertreatment or recirculation – Engines with exhaust gas aftertreatment or recirculation	max. max.	D5453, D2622	EN ISO 20846 EN ISO 20884	0.05% by weight (500 mg/kg) <sup>2)</sup> 0.0015% by weight (15 mg/kg)
Cetane number	min.	D613	EN ISO 5165, EN ISO 15195	45
Cetane index	min.	D976	EN ISO 4264	42
Copper corrosion 3 hrs. at 50 °C	Max. degree of corrosion	D130	EN ISO 2160	1a
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 (HFRR value)	max.	D6079	EN ISO 12156-1	520 µm
Cold filter plugging point (CFPP)		D6371	DIN EN 116	See Note <sup>3)</sup>
Particle distribution for fuel between last tank before engine and prefilter (see Fig. 3 item 6)		D7619	Coding of number of particles as per ISO 4406	Common rail: max. ISO Code 18/17/14 for 4/6/14 µm particle size
Cloud Point		D2500	DIN EN 23015	See Note <sup>4)</sup>
Neutralization number	max.	D974		0.2 mgKOH/g

Table 14:

<sup>1)</sup> For marine applications, a min. flashpoint of 60 °C (SOLAS = Safety of life at sea) applies.

<sup>2)</sup> Note: 1 by weight % = 10000 mg/kg = 10000 ppm

<sup>3)</sup> 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>4)</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.

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

The operating company must ensure that there is always sufficient fuel to meet the corresponding climatic requirements.

**Note:**

For safe and efficient engine operation, the specified limit values, in particular for water, total contamination, must be observed for all permissible fuel grades at the interface marked in Fig. 2 item 6, at the latest.

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.

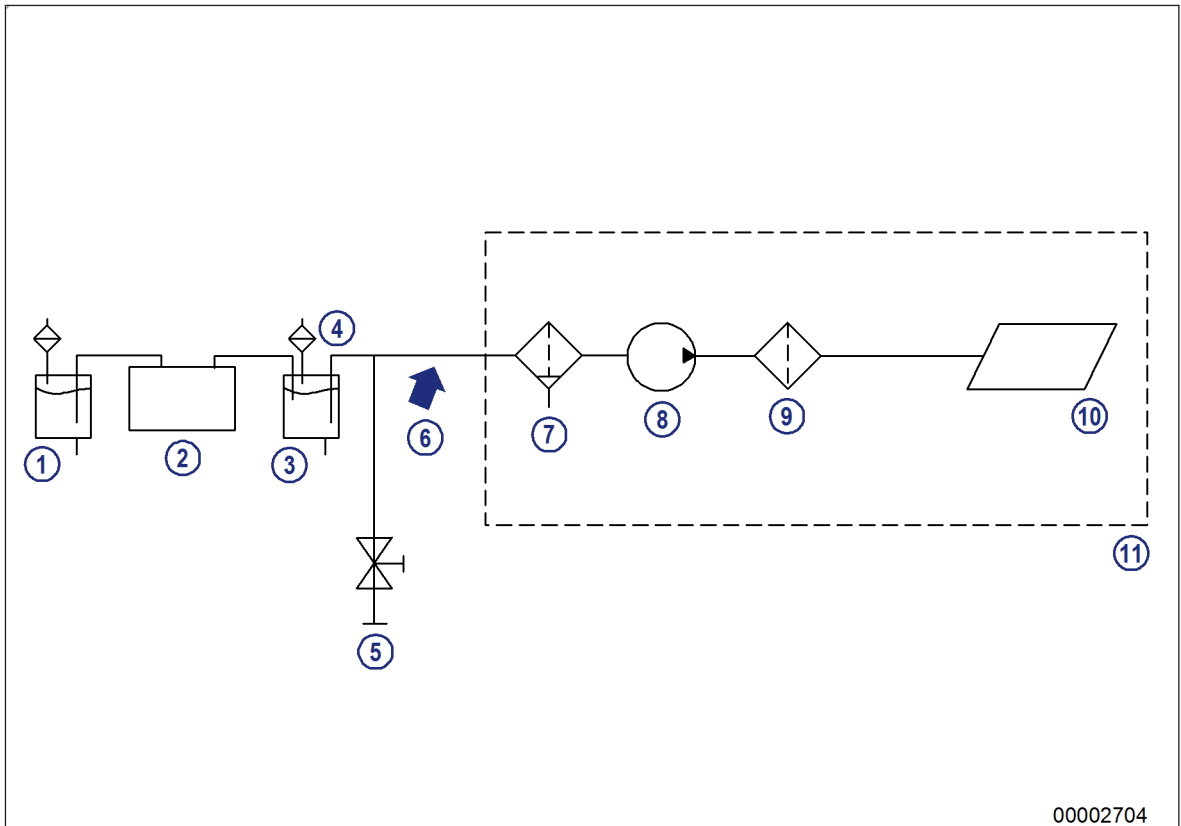


Figure 4: Fuel system diagram

- |                              |                                       |                           |
|------------------------------|---------------------------------------|---------------------------|
| 1 Fuel tank                  | 5 Sample extraction<br>18/17/14       | 9 Main filter             |
| 2 Fuel conditioning (option) | 6 Interface for fuel specification    | 10 Injection system       |
| 3 Last tank before engine    | 7 Fuel prefilter with water separator | 11 Engine scope of supply |
| 4 Tank ventilation filter    | 8 LP fuel pump                        |                           |

**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.

Warranty provided by MTU shall not cover damage and harm to engines due to the use of fuel qualities not approved by MTU.

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## Series-based injection / and exhaust aftertreatment systems

Series	Diesel accumulator injection system (Common rail)	Exhaust aftertreatment system	Exhaust gas recirculation
1600 R70, R70L, R80, R80L	Yes	SCR	No

Table 15: Overview of Series 1600 injection / and exhaust aftertreatment systems

### Laboratory analysis

An order for fuel analysis can be placed with MTU.

The following data is required:

- Fuel specifications
- Sampling point
- Sampling date
- Serial number of engine from which fuel sample was taken
- Laboratory examinations to be carried out
- Customer/contact person

Submit the following:

- 0.5 liters of fuel
- 1.5 liters of fuel (with additional determination of cetane number)

It is strongly recommended to integrate an additional filtering system in the fuel system.

#### Important

The use of fuels which have not been approved may lead to considerable deviations from the specified engine power and to severe damage to the engine. Furthermore, there is a risk that the statutory exhaust gas emissions are no longer observed.

Consult MTU before using non-approved fuels!

#### Important

If fuels which have not been approved are used, shorter oil change intervals are to be expected. Prior to using non-approved fuels, contact MTU to determine the applicable oil change intervals!

#### Important

Dispose of used fluids and lubricants in accordance with local regulations.

### 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 should be used.

## 6.2 Model type-based diesel fuel approvals for Series 1600

### Diesel fuel: DIN EN 590, ASTM D975 and other low-sulfur diesel fuel qualities

Fuel specifications	DIN EN 590: 2017-10 Summer and winter quality	ASTM D975-18a Grade 1-D S 15, S 500, S 5000 <sup>1)</sup>	ASTM D975-18a Grade 2-D S 15, S 500, S 5000 <sup>1)</sup>	Low-sulfur diesel fuels (Smax. 50 mg/kg) whose properties correspond to fuels in acc. with DIN EN 590 2014-04
Restrictions	- SOLAS: Flashpoint min. 60 °C - particle distribution for fuel between tank and filter system: max. ISO Code 18/17/14	- SOLAS: Flashpoint min. 60 °C - proportion of water: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - particle distribution for fuel between tank and filter system: max. ISO Code 18/17/14	- SOLAS: Flashpoint min. 60 °C - proportion of water: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - particle distribution for fuel between tank and filter system: max. ISO Code 18/17/14	- SOLAS: Flashpoint min. 60 °C - particle distribution for fuel between tank and filter system: max. ISO Code 18/17/14
Series	12V 1600: Underfloor: R70, R70L, R80, R80L	Approval issued	Approval issued for: - S 15 <sup>1)</sup>	Approval issued for: - S 15 <sup>1)</sup>

Table 16: Fuel specifications for diesel fuel: DIN EN 590, ASTM D975 and other low-sulfur diesel fuel qualities

<sup>1)</sup> = In the US, diesel fuels are categorized by the ASTM D975 standard into 2 main groups (Grade No 1 and Grade No 2), each of which are subdivided into 3 subgroups of varying sulfur content (S15, S500, S5000 - the number indicates the maximum sulfur content in ppm).

## 6.3 NO<sub>x</sub> reducing agent AUS 32 for SCR aftertreatment systems on Series 1600 engines

### General information

SCR (Selective Catalytic Reduction) catalysts can be used for NO<sub>x</sub> emission reduction. The reducing agent (Aqueous Urea Solution, (urea solution with 32.5% urea share)) in such catalysts reduces the nitrogen oxide emissions.

To ensure efficient operation of the exhaust gas aftertreatment system, compliance of the reducing agent with the quality requirements stipulated in DIN 70070 / ISO 222 41-1 is mandatory.

In Europe, this reducing agent is often offered under the brand name “AdBlue”.

The test methods to determine the quality and characteristics of the reducing agent are specified in the standards DIN 70071 / ISO 222 41-2.

#### Important

SCR systems from MTU are designed for a concentration of 32.5% urea. The use of NO<sub>x</sub> reducing agents with other concentrations of urea (AUS 40, AUS 48) is not approved!

#### Important

The use of antifreeze additives for AUS 32, or winter urea, is generally not approved.

### Storage of reducing agent

For instructions on storage, packing and transport, refer to the ISO 222 41-3 standard . The instructions of the manufacturer must be observed.

The reducing agent crystallizes at -11 °C.

Avoid direct sunlight because it promotes the occurrence of microorganisms and the decomposition of the reducing agent.

## 6.4 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 party responsible for product quality.

Biocides are 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.

### 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 Ashland Specialty Ingredients Luitpoldstrasse 32 87700 Memmingen Tel. +49 (0)8331 9580 0 Fax. +49 (0)8331 9580 51	Bakzid	100 ml / 100 l
Maintenance Technologies Paddy's Pad 1056 CC t/a Maintenance Technologies Tel. +27 21 786 4980 Cell +27 82 598 6830	Diesecure Fuel Decontainment	1 : 1200 (833 mg/kg)
Adolf Würth GmbH & Co. KG Reinhold Würth-Straße 12-17 74653 Künzelsau Tel. +49 (0) 7940 15-2248	Diesecure Fuel Decontainment	1 : 1200 (833 mg/kg)
Schülke und Mayr 22840 Norderstedt Tel. +49 (0) 40 52100-00 Fax. +49 (0) 40 52100-244	grotamar 71 grotamar 82 StabiCor 71	0.5 l / ton 1.0 l / 1000 l 0.5 l / ton
DOW® <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

Manufacturer	Brand name	Concentration for use
Supafuel Marketing CC PO Box 1167 Allens Nek 1737 Johannesburg South Africa Tel. +27 83 6010 846 Fax. +27 86 6357 577	Dieselfix / Supafuel	1:1200 (833 mg/kg)
Wilhelmsen Ships Service AS Willem Barentszstraat 50 3165 AB Rotterdam-Albrtand- swaard Tel. +31 10 487 7777 Fax. +31 10 487 7888 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.

## 6.5 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.

## 6.6 Measures prior to engine out-of-service periods >1 month

### General information

Diesel fuel according to EN 590 is currently permitted biodiesel shares of the 1st generation (FAME) of up to 7%. In case of long engine standstill, these biodiesel shares result in deposits. These deposits can cause problems when the engine is put back into operation; damage to components in the fuel circuit is possible.

To prevent deposits and resultant damage to the fuel system due to the 7% biodiesel share in the diesel fuel, the following measures are therefore required if the engine is to be taken out of service for a period of up to 6 months:

- The engine must be operated once a month for approx. 15 mins, at approx. 900 rpm with cut-in auxiliary consumers to reliably flush the fuel system.
- Prior to this, it is essential to check the perfect operation of the engine, in particular, with regard to the coolant and oil level. If the fuel systems have water separators, they must be drained prior to engine start. During engine start and engine operation, the operating parameters must be monitored carefully.
- Before putting engines that were placed in storage with B7 fuel back into operation, testing of the fuel is necessary to check its usability and quality (as per EN 590). If fuels do not comply with EN 590, they must be replaced.

### Note:

Systems on the vehicle side with fuel supply can also be damaged due to deposits from the biodiesel shares. Adequate flushing is also required for these systems.

The monthly engine start can be omitted if the engine was flushed for at least 30 mins. prior to shutdown with FAME-free fuel (B0 fuel). For this purpose, the commercially available EN 590 fuel with 7% FAME share is removed from the tank and then B0 fuel without a FAME share is filled. Ensure that all fuel-carrying parts of the engine system take part in the flushing procedure.

Fuels that currently meet the requirements of the die B0 specifications are, for example, ARAL Ultimate Diesel and BP Ultimate Diesel.

### Note:

The bio share in the fuel is highly hygroscopic, which means that the bio share dehydrates the surrounding area and binds the water. This also results in an increased proportion of water in the tank during long out-of-service periods and the associated problems such as a coating formation, bacterial attack or corrosion which can cause damage to the vehicle/engine and fuel filtration system when the engine is put back into operation.

# 7 Approved Fluids and Lubricants

## 7.1 Approved Engine Oils

### 7.1.1 Multi-grade 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 6)

#### Multi-grade 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 55 gallons: 800134 IBC: 800135 Available through MTU America Inc.
Bucher AG Langenthal	Motorex Focus CF	15W-40	X			
BP p.l.c.	BP Vanellus Eco	15W-40	X			
Canroyal Oil Lubricants / Dist.	Canroyal Synthetic Diesel Engine Oil	15W-40	X			
Castrol Ltd.	Castrol CRB Mining 15W-40	15W-40	X			
	Castrol CRB Mining 15W-40 CK-4		X			
	Castrol CRB Turbo G4 15W-40	15W-40	X			
	Castrol Hypuron	10W-30		X		
	Castrol RX Super 15W-40 CJ-4/E9	15W-40	X			
Champion Chemicals N.V.	Champion OEM Specific 15W40 MS	15W-40	X			
Chevron Lubricants (Chevron)	Delo 400 LE	15W-40	X			
	Delo 400 MGX	15W-40	X			
	Delo 400 SDE	15W-40	X			
	Delo 400 XLE	10W-30		X		
	Delo 400 XLE	15W-40		X		
Chevron Lubricants (Texaco)	Ursa Ultra LE	15W-40	X			
ExxonMobil Corporation	Mobil Delvac 1 ESP	0W-40	X			
	Mobil Delvac 1 ESP	5W-40		X		
	Mobil Delvac 1300 Super F2	15W-40	X			
	Mobil Fleet	15W-40	X			
eni S.P.A.	eni i-Sigma top MS	15W-40	X			
Fuchs Europe	Fuchs Titan Cargo	15W-40	X			
Fuchs Petrolub SE	Fuchs Titan Cargo	10W-30	X			



Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8 to 10 mgKOH/g	10 to 12 mgKOH/g	>12 mgKOH/g	
	Fuchs Titan Cargo	15W-40	X			
Gulf Oil International	Gulf Supreme Duty XLE	15W-40	X			
	Gulf Supreme Duty XLE	10W-30	X			
Hitachi	Hitachi Genuine Engine Oil 10W-40 DH-2	10W-40	X			
Kuwait Petroleum	Q8 T 760	10W-30	X			
Lotos Oil	Turdus Powertec 1100	15W-40	X			
Morris Lubricants	Versimax HD6	15W-40	X			
MPM International Oil Company B.V.	Motor Oil 15W-40 Extra High Performance	15W-40	X			
OOO "LLK-International"	Lukoil Avantgarde Professional LA	10W-30	X			
	Lukoil Avantgarde Professional LA	10W-40	X			
	Lukoil Avantgarde Professional LA	15W-40	X			
Panolin AG	Panolin Universal LA-X	15W-40	X			
Pennzoil Products	Pennzoil Long-Life Gold	15W-40		X		
Petro-Canada	Duron -E	15W-40	X			
Phillips 66 Lubricants	Fleet Supreme EC	15W-40	X			
	Guardol ECT	15W-40	X			
	Kenndall Super-D XA	15W-40	X			
Prolube Lubricants	Prolube Ultraplus	15W-40	X			
Repsol Lubricantes Y Especialidades, S.A.	Repsol Diesel Turbo THPD Mid Saps	15W-40	X			
Shell International Petroleum Company	Shell Rimula Super	15W-40		X		
	Shell Rimula RT4L	15W-40		X		
	Shell Rotella T	15W-40		X		
	Shell Rotella T3	15W-40		X		
	Shell Rotella T3 Fleet	15W-40	X			
	Shell Rotella T5	10W-30	X			
	Shell Rotella T5	10W-40	X			
	Shell Rotella T6	5W-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 Rimula R4 MV	15W-40	X			
	Shell Rimula R4 L	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	
SRS Schmierstoff Vertrieb GmbH	SRS Turbo Rekord plus	15W-40	X			
	SRS Turbo Rekord plus FE	10W-40	X			
Total Lubrifiants	Hitachi Genuine Engine Oil 10W-40 DH-2	10W-40	X			
	Total Rubia TIR 7900	15W-40	X			
	Total Rubia Works 2000	10W-40	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			
Valvoline EMEA	Valvoline All Fleet Extra LE SAE 15W-40	15W-40	X			
	All-Fleet Extra LE NTI	15W-40	X			
	Premium Blue 8100 15W-40	15W-40	X			
Valvoline USA	All Fleet Plus	15W-40	X			
Verco International	April Superpro RXL 1 Gold Plus	15W-40	X			

Table 18:

## 7.1.2 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 6)

### 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: X00078578 210 l container X00078577 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	

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	
Meguín 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			
Petrogal, 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		

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 Lubrificants	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 19:

## 7.2 Approved Transmission Oils

### 7.2.1 Fluids and lubricants for ZF transmissions

Mechanical manual-shift transmissions from ZF Co. Friedrichshafen:

The current, permissible fluids and lubricants for ZF transmissions can be downloaded free-of-charge from the following Internet address:

[http://www.zf.com/corporate/de/products/spare\\_parts/technical\\_information/lubricants/lists\\_of\\_lubricants.html/TE-ML16](http://www.zf.com/corporate/de/products/spare_parts/technical_information/lubricants/lists_of_lubricants.html/TE-ML16)

#### **Lubricant class 16Q**

Manufacturer	Product name
ZF Friedrichshafen AG, Friedrichshafen/D	ZF-Ecofluid Life Plus

*Table 20:*



## 7.2.2 Fluids and lubricants for Voith transmissions T 211.re.4 + KB190 (General List of Lubricants 120-00059010\_EN, Edition 14 dated 2019-04-10)

Voith hydrodynamic transmissions:

Before using them, make sure the fluids and lubricants listed below are still approved. The latest version is available at: [www.voith.com/brochures/2255](http://www.voith.com/brochures/2255)

### Important

Use Voith approved transmission oils only when filling the turbo transmission. The use of other oil grades and blends or contaminated oils is prohibited.

No liability whatsoever will be accepted if oils for which Voith has not granted approval are used in the turbo transmission.

### Approved power transmission oils for Voith turbo transmissions T 211 re.4 + KB190

Manufacturer	Product name	Index	Suitable for low temperatures <sup>4)</sup> down to
Addinol	SGL 18	1	-25 °C
ARAL	ARAL Degol BG 32		-20 °C
BASF	Emgard HF EAL 801-32	1, 4, 5	-40 °C
Caltex	Torque Fluid 32	2	-25 °C
Castrol	Castrol Alpha VT 32	1	-25 °C
	Castrol Hyspin HL-XP 32	2	-25 °C
Chevron Texaco	Textran V 32	2	-25 °C
Exxon Mobil	Mobilfluid 125	2	-20 °C
Finke	Aviaticon ML 32 SG	1	-25 °C
Fuchs-Europe	Renofluid TF 1500	1	-25 °C
INA Maziva	INA Fluid V 32	2	-25 °C
	INA Fluid VT 32	1	-25 °C
Q8	Q8 Auto R 26	2	-25 °C
Shell	Shell Tegula V 32	1	-25 °C
SRS	SRS Wiolan HF 32 DB	1	-25 °C
	SRS Wiolan HF 32 synth	3	-40 °C
Total	Total Azolla VTR 32		-20 °C
Voith Turbo s,r,l.	Turbo Transmission Fluid	1	-25 °C
	Turbo Transmission Fluid Synth	3	-40 °C

Table 21:

Explanation of the Index column:

1. Increased thermal-oxidation resistance
2. Oil is not suitable for all electronically-controlled turbo transmissions except for T 211...
3. Especially increased thermal-oxidation resistance (synthetic oil)
4. Rapidly biodegradable, comprises renewable raw materials, granted EU Ecolabel
5. Only for use with electrostatically optimized fine filter element (order no. H90.934913) not suitable for S 211 re.2

## 7.3 Approved Coolants

### 7.3.1 Antifreeze – Concentrates on ethylene glycol basis

For details and special information, see chapter on “Coolants” (→ Page 14).

#### Antifreeze concentrates on ethylene glycol basis

Manufacturer	Brand name	Inhibitors					Runtime Hours / Years	Comments / Material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
MTU Friedrichshafen GmbH	Coolant AH100 Antifreeze Concentrate	X	X				9000 / 5	X00057231 (20l) X00057230 (210l) X00068202 (1000l) Also available through MTU Asia
Avia Mineralöl AG	Antifreeze APN	X	X				9000 / 5	
	Antifreeze APN - S	X					9000 / 3	
BASF SE	Glysantin® G30 pink	X					9000 / 3	X00058072 (canister) X00058071 (barrel)
	Glysantin® G40 pink	X	X				9000 / 3	X00066724 (20 l) X00066725 (210 l)
	Glysantin® G48 blue green	X	X				9000 / 5	X00058054 (25l) X00058053 (210l)
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	
	Motorex Coolant M4.0 Concentrate	X	X				9000 / 3	
Castrol	Castrol Radicool NF	X	X				9000 / 5	
Clariant	Genantin Super		X	X			9000 / 5	
Classic Schmierstoff GmbH + Co KG	Classic Kolda UE G48	X	X				9000 / 5	
CCI Corporation	L 415	X				X	9000 / 3	
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 Plus Coolant	X				X	9000 / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours / Years	Comments / Material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
ExxonMobil	Mobil Delvac Extended Life Coolant	X				X	9000 / 3	
	Mobil Antifreeze Advanced	X					9000 / 3	
	Mobil Antifreeze Extra	X	X				9000 / 5	
	Esso Antifreeze Advanced	X					9000 / 3	
	Esso Antifreeze Extra	X	X				9000 / 5	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X					9000 / 3	
	AVIATICON Finkofreeze F40	X	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) 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 SOT	X	X				9000 / 3	
	Lukoil Coolant SF	X					9000 / 3	
Mitan Mineralöl GmbH	Alpine C30	X					9000 / 3	
	Alpine C48	X	X				9000 / 5	
MJL Bangladesh Ltd.	Omera Premium Coolant	X					9000 / 3	
Nalco Australia	Nalcool NF 48C	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	
	Final Charge Global Extended Life Coolant Antifreeze	X				X	9000 / 3	
Panolin AG	Panolin Anti-Frost MT325	X	X				9000 / 5	
Penske Power Systems	Power Cool - HB500 Coolant Concentrate	X	X				9000 / 3	

Manufacturer	Brand name	Inhibitors					Runtime Hours / Years	Comments / Material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
Raloy Lubricantes	Antifreeze Long Life NF-300 Concentrate	X	X				9000 / 5	
Recochem Inc.	R542	X	X				9000 / 3	
SMB - Sotagal / Mont Blanc	Antigel Power Cooling Concentrate	X	X				9000 / 5	
Total Lubrifiants	Glacelf MDX	X	X				9000 / 5	
Valvoline	Zerex G-30	X					9000 / 3	
	Zerex G-40	X	X				9000 / 3	
	Zerex G-48	X	X				9000 / 5	
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 G 12 K	X					9000 / 3	

Table 22: Antifreeze concentrates on ethylene glycol basis

### 7.3.2 Antifreeze – Ready mixtures on ethylene glycol basis

For details and special information, see chapter on “Coolants” (→ Page 14).

Manufacturer	Brand name	Inhibitors					Runtime Hours / Years	Comments / Material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate		
MTU Friedrichshafen GmbH	Coolant AH 50/50 Antifreeze Premix	X	X				9000 / 5	X00070528 (20 l) X00070530 (210l) X00070527 (1000l) (Sales region: England)
	Coolant AH 40/60 Antifreeze Premix	X	X				9000 / 5	X00070533 (20 l) X00070531 (210l) X00070532 (1000l) (Sales region: England, Spain)
	Coolant RM30 (40%)	X					9000 / 3	X00073922 (20l) X00073916 (210l) X00073923 (1000l)
MTU America Inc.	Power Cool® Universal 50/50 mix	X	X				9000 / 5	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)
Bantleon GmbH	Avilub Antifreeze Mix (50%)	X	X				9000 / 5	X00049213 (210l)
BayWa AG	Tectrol Coolprotect Mix-3000	X					9000 / 3	Antifreeze protection down to -24 °C
Bucher AG Langenthal	Motorex Coolant G48 ready to use (50/50)	X	X				9000 / 5	
	Motorex Coolant M 4.0 Ready to use	X	X				9000 / 3	Antifreeze protection down to -38 °C
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 Suoer Coolant Hybrid NF 50%	X	X				9000 / 5	
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	
Exxon Mobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	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 Extended Life Coolant	X				X	9000 / 3	

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Manufacturer	Brand name	Inhibitors					Runtime Hours / Years	Comments / Material no.
		Organic	Silicon	Nitrite	Phosphate	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	
Penske Power Systems	Power Cool - HB500 Premix 50/50	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	
Tosol-Sintez	Glystantin Alu Protect G30 Ready Mix	X					9000 / 3	
	Glystantin Alu Protect Plus G48 Ready Mix	X	X				9000 / 5	
Valentin Energie GmbH	Valentin Coolant Plus -25 °C Ready	X					9000 / 3	
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 G 12 (50%)	X					9000 / 3	

Table 23: Antifreeze – Ready mixtures on ethylene glycol basis

# 8 Flushing and Cleaning Specifications for Engine Coolant Circuits

## 8.1 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 assemblies 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 (→ Page 48) at the specified concentrations may be used for cleaning. The specified cleaning procedure is to be complied with.

Immediately after flushing or cleaning, fill the coolant circuits with treated engine coolant as stipulated in these Fluids and Lubricants Specifications (→ Page 14). 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, 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 accepts no responsibility 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

- Freshwater
- Prepared engine coolant
- Superheated steam
- Compressed air

## 8.2 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 (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 (10 kg)
	Grotanol SR2 <sup>6)</sup>	0.5% by volume	Liquid	X00069827 (10 kg)

Table 24:

<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.



## 8.3 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 50). The assemblies may also have to be cleaned, see (→ Page 51).

### Important information

Refer to the engine operating instructions for additional information.

## 8.4 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 48).
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 51).

### Important

Refer to the engine operating instructions for additional information.

## 8.5 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 48)

### 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 49).
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.

## 8.6 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 48). 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!

## 8.7 Cleaning

### 8.7.1 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

## 8.7.2 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 - 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 25:

<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

### Important information

This publication is applicable to Series 1600 PowerPack® engines.  
All information on other MTU and MTU-DD series engines is provided in the Fluids and Lubricants Specifications publication no. A001061/..., for Series 1800 PowerPack® in A001062/..., and for Series 1600 in A001063/....

### Revision overview

Revision overview from version A001065/00 to A001065/01.

Seq. No.	Page	Subject	Action	Action
0	(→ Page 0)	Copyright	Updated	New Corporate Design
1	(→ Page 4)	Preface	Revised	New Corporate Design
2	(→ Page 6)	Requirements and oil change intervals	Revised	New Corporate Design
3	(→ Page 9)	Viscosity grades	Revised	New Corporate Design
4	(→ Page 14)	General information	Revised	New Corporate Design
5	(→ Page 17)	Unsuitable materials in the coolant circuit	Revised	New Corporate Design
6	(→ Page 19)	Operational checks	Revised	New Corporate Design
7	(→ Page 22)	Diesel fuels – General information	Revised	New Corporate Design
8	(→ Page 28)	Supplementary fuel additives	Revised	New Corporate Design
9	(→ Page 30)	Unsuitable materials in the diesel fuel circuit	Revised	New Corporate Design
10	(→ Page 32)	Multi-grade oils – Category 2.1 (Low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40	Revised	New Corporate Design
11	(→ Page 35)	Multi-grade oils – Category 3.1 (Low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40	Revised	Content changed
12	(→ Page 42)	Antifreeze – Concentrates on ethylene glycol basis	Revised	New Corporate Design
13	(→ Page 45)	Antifreeze – Ready mixtures on ethylene glycol basis	Revised	New Corporate Design
14	(→ Page 47)	General information	Revised	New Corporate Design
15	(→ Page 48)	Approved cleaning agents	Revised	New Corporate Design
16	(→ Page 53)	General information	Revised	Cross reference adjusted
17	(→ Page 54)	Approved cleaning agents	Revised	New Corporate Design
18	(→ Page 55)	Revision – Overview	Revised	Revisions from Version 01 to 02

Table 26: Revision overview from version A001065/00 to A001065/01

# 10 Appendix

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