

Fluids and Lubricants Specifications

MTU Fluids and Lubricants Specifications for Series 1600 PowerPack®

A001065/00E



Power. Passion. Partnership.

Printed in Germany

© 2014 Copyright MTU Friedrichshafen GmbH

This Publication is protected by copyright and may not be used in any way whether in whole or in part without the prior written permission of MTU Friedrichshafen GmbH. This restriction also applies to copyright, distribution, translation, microfilming and storage or processing on electronic systems including data bases and online services.

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

Subject to alterations and amendments.

Table of Contents

1	Preface			
1.1	General information	4		
2	Engine Oils			
2.1	Requirements and oil change intervals	6		
2.2	Viscosity grades	7		
3	Transmission oils			
3.1	Transmission oils for rail vehicles with ZF transmission	8		
3.2	Power transmission oils for Voith turbo transmission T211 + KB 190	10		
4	Hydraulic System			
4.1	Hydraulic system	11		
5	Coolants			
5.1	General information	12		
5.2	Fresh water requirements	14		
5.3	Operational monitoring	15		
5.4	Storage capability of coolant concentrates	16		
6	Liquid Fuels			
6.1	Diesel fuels	17		
6.2	NOx reducing agent AUS 32 for SCR after-treatment systems	19		
6.3	Microorganisms in fuel	20		
7	Approved Fluids and Lubricants			
7.1	Multi-grade oils - Category 3	21		
7.2	Multi-grade oils - Category 3.1 (low SAPS oils)	24		
7.3	Fluids and lubricants for ZF transmissions	26		
7.4	Fluids and lubricants for Voith transmissions T 211.re.4 + KB190	27		
7.5	Approved Coolants	28		
7.5.1	Corrosion-inhibiting antifreeze concentrates	28		
7.5.2	Corrosion-inhibiting antifreeze - Ready mixtures	30		
8	Preservation / Depreservation			
8.1	Preservation, re-preservation and de-preservation of PowerPacks®	32		
9	Flushing and Cleaning Specifications for Engine Coolant Circuits			
9.1	General information	33		
9.2	Approved cleaning agents	34		
9.3	Engine coolant circuits - Flushing	35		
9.4	Engine coolant circuits - Cleaning	36		
9.5	Cleaning assemblies	37		
9.6	Coolant circuits contaminated with bacteria, fungi or yeast	38		
10	Overview of Changes			
10.1	Revision history	39		
11	Appendix			
11.1	Index	40		

1 Preface

1.1 General information

Used symbols and means of representation

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



This symbol indicates instructions, tasks and operations that must be followed to avoid hazards to persons as well as damage to or destruction of 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. This publication specifies which fluids and lubricants are to be used.

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
DVGW	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-online.com/mtu/technical-info/fluids-and-lubricants-specifications/

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

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.



Fluids and lubricants for propulsion plants 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 responsibility 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 MTU Preservation and Re-preservation Specifications (publication number A001070/...). The latest version is also available at:

www.mtu-online.com/mtu/technical-info/preservation-specification/

2 Engine Oils

2.1 Requirements and oil change intervals

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

Requirements of the engine oils for MTU approval

The MTU conditions for engine oil approval are specified in the MTU Factory Standard MTL 5044, which can be ordered under this reference number.


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

Approved engine oils for Series 1600 engines are divided into the following MTU Quality Categories:


- Oil category 3: Highest quality / Multi-grade 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 500 mg/kg. When using diesel particle 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.

	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.
---	---

Oil change interval

	The oil change interval is 1,000 operating hours or max. 1 year under the condition that engine oils of oil category 3 (→ Page 21) and 3.1 (→ Page 24) and approved fuels (→ Page 17) are used. If fuels which have not been approved are used, shorter oil change intervals are to be expected. Prior to using unapproved fuels, contact MTU Friedrichshafen GmbH to determine the applicable oil change intervals.
---	--

	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.

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.

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

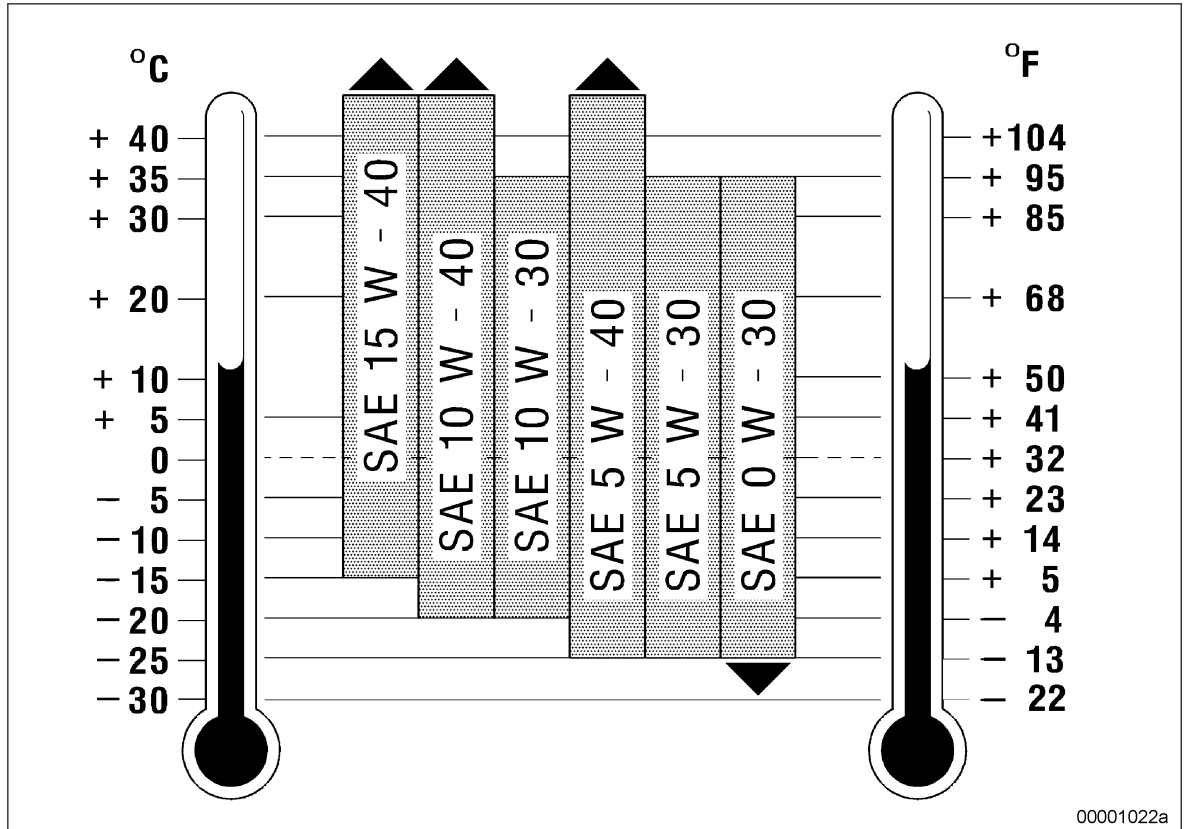


Figure 1: Viscosity grades

3 Transmission oils

3.1 Transmission oils for rail vehicles with ZF transmission

(Abstract from the ZF List of Lubricants TE-ML16, Edition 01.10.2008)

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

Product groups automatic transmissions for rail vehicles	Lubricant classes for service fills ⁽¹⁾ transmissions without/with ZF-Intarder
ASRail <ul style="list-style-type: none"> • 12 AS 2303. 12 AS 2703. 12 AS 3103. 16 AS2 603 	16K / 16P
EcoLife (up to 105 °C)	16Q

⁽¹⁾ = Approves commercial products (→ Page 26), oil change intervals and low temperature limits (listed below).

⁽²⁾ = Particularly recommended: The fully synthetic ATF ZF-Ecofluid A PLUS was developed specifically for use in Ecomat transmissions. This combination of a synthetic base oil with a specially balanced additive package delivers superlative oxidation stability and consistent friction characteristics. The viscosity level is ideally suited to this transmission and this factor, combined with resistance to scuffing and pitting, assures the unit of extremely valuable protection and a correspondingly long service life for its bearings and gears. Another positive feature of ZF-Ecofluid A PLUS is its flat viscosity characteristics curve which makes it particularly well suited to operation in cold as well as in hot climatic zones .

At greasing points pay attention to the manual!

	Additives of any kind added later to the oil change the oil in a manner that is unpredictable, and they are therefore not permitted. No liability of any kind will be accepted by ZF for any damage resulting from the use of such additives.
---	---

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

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

⁽¹⁾ = Pay attention to approved trade products and lubricant classes.

⁽²⁾ = Oil change required, depending on what occurs first.

⁽³⁾ = 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.

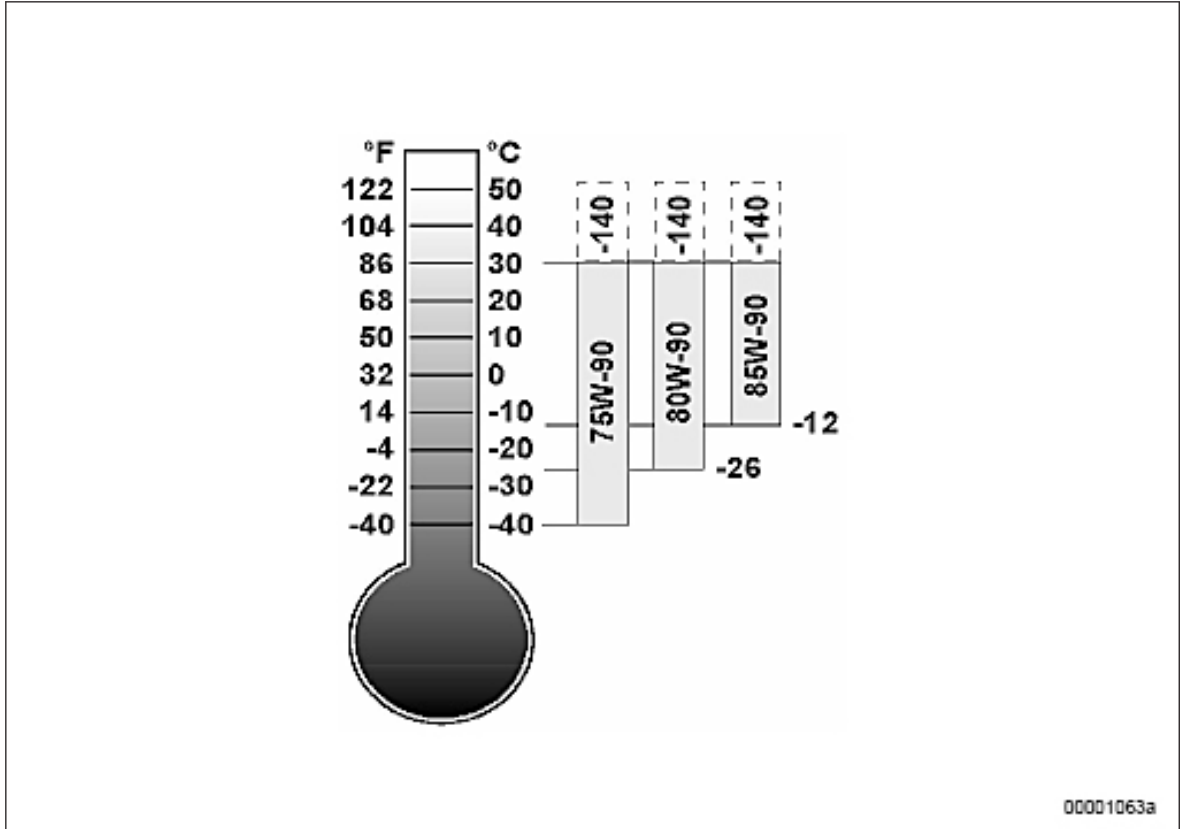


Figure 2: Range of use for hydraulic oil

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

3.2 Power transmission oils for Voith turbo transmission 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

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

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

⁽¹⁾ = 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 >4µm: 130 000 (purity class 17)
- Particles >6µm: 32 000 (purity class 15)
- Particles >14µm: 2 000 (purity class 11)

Approved power transmission oils (→ Page 27).

4 Hydraulic System

4.1 Hydraulic system

Hydraulic system



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

Approved engine oils for the hydraulic system (→ Page 21) and (→ Page 24).

5 Coolants

5.1 General information

Coolant definition


Coolant	= Coolant additive (concentrate) + freshwater in the specified mixing ratio ready for use in the engine.
---------	--

Requirements

Coolants must be prepared from suitable freshwater and a coolant additive which has been approved by MTU Friedrichshafen GmbH. Prepare the coolant outside the PowerPack®!

The corrosion-inhibiting effect of coolant is only ensured with the coolant circuit fully filled. This means that the engine must be preserved when coolant was drained off and refilling is not planned. For the preservation procedure, refer to the MTU Preservation and Re-preservation Specifications A001070/.. of the engine.

The entire cooling system must be free of zinc components. This also applies to coolant supply and return/drain lines as well as to storage bins.

	Mixing of different coolant additives and supplementary additives is prohibited!
--	--

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

To prevent cooling system damage:


- For initial filling, a corrosion-inhibiting antifreeze concentration of 50% by volume must be ensured.
- For topping up coolant (after a coolant loss) or when the corrosion-inhibiting antifreeze concentration falls below 40% by volume, a concentration of 50% by volume must be established in the cooling system.
- A corrosion-inhibiting antifreeze concentration lower than 40% by volume is inadmissible to avoid the reduction of corrosion protection.
- Never use coolant with a corrosion-inhibiting antifreeze concentration of more than 55% by volume. Concentrations in excess of this reduce antifreeze protection and heat dissipation.

Coolant mixtures

Antifreeze protection to °C	-27	-32	-37	-42
Water % by vol.	60	55	50	45
Corrosion-inhibiting antifreeze % by vol.	40	45	50	55

Limit values for coolants

Value	Minimum	Maximum
pH value for anti-corrosion/anti-freeze agent	7.0	9.0
Silicon (valid for coolants containing Si)	25 mg/l	

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

TIM-ID: 0000044666 - 002

Calculation of the corrosion-inhibiting antifreeze quantity for refill

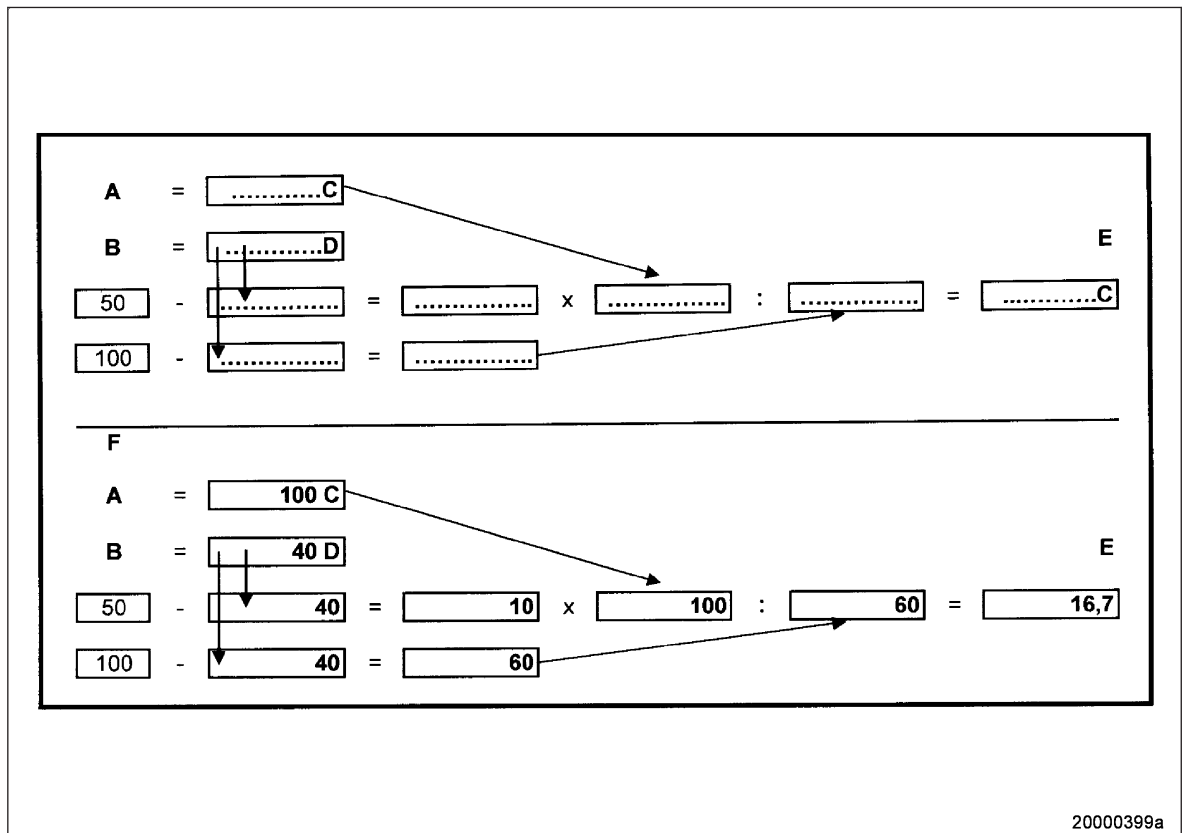


Figure 3: Typical calculation for coolant refill

A Coolant capacity (total)
 B Measured concentration

C Liter
 D Percent by volume

E Refill quantity of corrosion-inhibiting antifreeze (This quantity must be drained off if the coolant level is within the specifications!)

F Calculation example

5.2 Fresh water requirements

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, hardness or mineral content can be decreased by adding de-mineralized water.

Item	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	6.5	8.0
Chloride ions		100 mg/l
Sulfate ions		100 mg/l
Anions total		200 mg/l
Bacteria, fungi, yeasts	are not permitted!	

*) Common designations for water hardness in various countries:

1 mmol/l = 5.6°d = 100 mg/kg CaCO₃

- 1°d = 17.9 mg/kg CaCO₃, USA hardness
- 1°d = 1.79° French hardness
- 1°d = 1.25° English hardness

5.3 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
- Antifreeze (corrosion-inhibiting) concentration


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

5.4 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
Corrosion-inhibiting antifreeze	Approx. 3 years	Observe manufacturer's specifications

Table 2: Storage capability

	<p>For reasons of corrosion protection, do not store in galvanized bins. 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 anti-freeze protection during the cold season.</p> <p>For further information, refer to the product specifications and the Material Safety Data Sheets of the individual coolants.</p>
---	--

6 Liquid Fuels

6.1 Diesel fuels

Selecting 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.

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) and particle size distribution must be complied with in the vehicle tank for all approved fuel qualities.

Limit values for water and total contamination

Parameter	Test method		Limit values
	ASTM	EN, ISO	
Water content, max.	ASTM D6304	EN ISO 12937	200 mg/kg
Total contamination (undissolved solids), max.	ASTM D6217	EN 12662	24 mg/kg
Lubricity at 60 °C	ASTM D6079	EN ISO 12156-1	520 µm
Particle size distribution for fuels in tank, max.	-	ISO 4406	ISO classes 18/17/14

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



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. Consult MTU Friedrichshafen GmbH before using unapproved fuels!



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



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

Specifications for distillate fuels

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

- DIN EN 590:2013-05 (summer and winter quality)
- ASTM D975-13 Grade 1-D (S15, S500, S5000); Restriction: Sulfur content max. 3000 mg/kg
- ASTM D975-13 Grade 2-D (S15, S500, S5000); Restriction: Sulfur content max. 3000 mg/kg

Low-sulfur diesel fuels

Sulfur is contained in chemically bound form in crude oil and is therefore present in fuel at varying concentrations.

A sulfur content of max. 50 mg/kg or 10 mg/kg (depending on category) has been a European Union requirement since 01.01.2005.

Since 01.2009, the term “sulfur-free” is used designate diesel fuels with a sulfur content of max. 10 mg/kg.

Low-sulfur diesel fuels (max. 50 mg/kg) are recommended for environmental reasons.

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.

Flow improvers

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

The effectiveness of the flow improvers is not guaranteed for every fuel. Certainty is only assured after laboratory testing of the filtering capability. Required quantities and mixing procedures must be carried out according to the manufacturer's instructions.

6.2 NO_x reducing agent AUS 32 for SCR after-treatment systems

General information

SCR (Selective Catalytic Reduction) catalysts can be used for NO_x emission reduction. The reducing agent (urea solution with an urea concentration of 32.5 %) in such catalysts reduces the nitrogen oxide emissions.

To ensure efficient operation of the exhaust gas after-treatment 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.

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.

6.3 Microorganisms in fuel

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

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

Approved biocides

Manufacturer	Brand name	Concentration for use
ISP Biochema Schwaben GmbH Ashland Specialty Ingredients Luitpoldstrasse 32 D-87700 Memmingen Tel. +49 (0)8331 9580 0 Fax. +49 (0)8331 9580 51	Bakzid	100 ml / 100 l
Maintenance Technologies Adrian Fourie Member and CEO Paddy's Pad 1056 CC t/a Maintenance Technologies Tel. +27 21 786 4980 Cell +27 82 598 6830	Dieselcure Fuel Decontainment	1 : 1200 (833mg/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
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-Albrtandswaard Tel. +31 10 487 7777 Fax. +31 10 487 7888 Nederland	Biocontrol MAR 71	333 ml / ton

Table 3: Approved biocides

7 Approved Fluids and Lubricants

7.1 Multi-grade oils – Category 3

For details and special information, see chapter on “Engine oils”(→ Page 6).

The approved multi-grade oils of category 3 correspond with SAE grades 5W-30, 5W-40, and 10W-40 for diesel engines.

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8-10 mgKOH/g	10-12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Ultra Truck MD 0538	5W-30			X	
	Addinol Super Truck MD 1049	10W-40			X	
Aral AG	Aral Super Turboral	5W-30			X	
	Aral Mega Turboral	10W-40			X	
Avia Mineralöl AG	Avia Turbosynth HT-U	5W-30			X	
BayWa AG	Tectrol Super Truck 530	5W-30			X	
	Tectrol Super Truck 1040	10W-40	X			
Bucher AG Langenthal	Motorex MC Power Plus	10W-40			X	
BP p.l.c.	BP Vanellus Max	5W-30			X	
	BP Energol IC-MT	10W-40			X	
Castrol Ltd.	Castrol Enduron MT	10W-40			X	
	Castrol Enduron Plus	5W-30			X	
	Castrol Elixion HD	5W-30			X	
	Castrol Vecton Long Drain	10W-40			X	
Cepsa	Cepsa Eurotrans SHPD	5W-30			X	
	Cepsa Eurotrans SHPD	10W-40	X			
Chevron Lubricants	Caltex Delo XLD Multigrade	10W-40			X	
	Chevron Delo XLD Multigrade	10W-40			X	
	Texaco Ursa Super	10W-40	X			
	Texaco Ursa Premium FE	5W-30			X	
	Ursa TDX	10W-40			X	
	Texaco Ursa Super TDX	10W-40				
	Texaco Ursa HD	10W-40			X	
Elinoil	Elin Diesel Tec Synthetic	10W-40	X			
ENI S.p.A.	Agip Sigma Trucksint TFE	5W-40			X	
	Agip Sigma Super TFE	10W-40			X	
Enoc	Enoc Vulcan 770 SLD	10W-40	X			
Exxon Mobil Corporation	Mobil Delvac XHP Extra	10W-40			X	
	Mobil Delvac XHP Ultra 5W-30	5W-30			X	

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8-10 mgKOH/g	10-12 mgKOH/g	>12 mgKOH/g	
	Mobil Delvac 1 SHC 5W-40	5W-40			X	
Exol Lubricants Ltd.	Taurus Extreme M3	10W-40			X	
Fuchs Europe Schmierstoffe GmbH	Titan Cargo SL	5W-30			X	
	Titan Cargo MC	10W-40			X	
Ginouves	York 847 10W40	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	
Huiles Berliet S.A.	RTO Extensia RXD ECO	5W-30			X	
Igol, France	Trans Turbo 8X	5W-30			X	
INA	INA Super 2000	10W-40			X	
Iranol Oil Co.	Iranol D - 40000	10W-40		X		
Kuwait Petroleum	Q8 T 860	10W-40		X		
	Q8 T 905	10W-40	X			
LLK Finland Oy	Teboil Super XLD-2	5W-30			X	
Lotos Oil	Turdus Powertec Synthetic	5W-30			X	
	Turdus Powertec 3000	10W-40			X	
Meguin	Megol Motorenöl Super LL Dimo Premium	10W-40			X	
MOL-LUB Ltd.	MOL Synt Diesel	10W-40		X		
	MOL Dynamic Synt Diesel E4	10W-40			X	
OMV Refining & Marketing GmbH	OMV super truck	5W-30			X	
	OMV super truck	10W-40			X	
Orlen Oil Sp.o.o.	Platinum Ultor Max	5W-30			X	
OOO LLK International	Lukoil Avantgarde Professional M5	10W-40			X	
Panolin	Panolin Diesel HTE	10W-40			X	
Petroleos de Portugal, Petrogal S.A.	Galp Galaxia Extreme	5W-30		X		
	Galp Galaxia Ultra XHP	10W-40			X	
Petronas Lubricants International	Petronas Urania Maximo	5W-30			X	
	Urania Maximo	10W-40			X	
	Urania Optimo	10W-40			X	
	Urania 100 K	10W-40			X	
	Urania FE	5W-30			X	
PHI OIL GmbH	Motordor Silver 10W-40	10W-40			X	
Raj Petro Specialites P Ltd.	Zoomol Rforce 8200 RF1	10W-40			X	
Ravensberger Schmierstoff Vertrieb GmbH	RAVENOL Super Performance Truck	5W-30			X	

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8-10 mgKOH/g	10-12 mgKOH/g	>12 mgKOH/g	
	RAVENOL Performance Truck	10W-40			X	
Repsol YPF	Repsol Turbo UHPD	10W-40			X	
	Repsol Diesel Turbo VHPD	5W-30			X	
Shell	Shell Normina Extra	10W-40			X	
	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	
SMV GmbH JB German Oil	JB German Oil Hightech Truck	10W-40			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	
Statoil Lubricants	MaxWay Ultra 5W-30	5W-30			X	
	MaxWay Ultra E4 10W-40	10W-40			X	
Total	Antar Maxolia	10W-40		X		
	Fina Kappa Syn FE	5W-30			X	
	Gulf Gulfleet Highway 10W-40	10W-40			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	LCM 800	10W-40			X	
Valvoline	Profleet	10W-40			X	
	All Fleet Superior	10W-40			X	
Wolf Oil Corporation	Champion Turbofleet UHPD	10W-40				
Yacco SAS	Yacco Transpro 45	10W-40			X	

7.2 Multi-grade oils – Category 3.1 (low SAPS oils)

For details and special information, see chapter on “Engine oils”(→ Page 6).

The approved multi-grade oils of category 3.1 (low SAPS) correspond with SAE grades 5W-30 and 10W-40 for diesel engines.

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8-10mgKOH/g	10-12 mgKOH/g	>12 mgKOH/g	
Addinol Lube Oil	Addinol Extra Truck MD 1049 LE	10W-40	X			
BVG Vertriebsgesellschaft AG	Alpha Advanced Eco-Efficiency low SAPS	10W-40	X			
Aral AG	Aral Mega Turboral LA	10W-40			X	
BayWa AG	Tectrol Super Truck Plus 1040	10W-40			X	
Bucher AG Langenthal	Motorex Focus QTM	10W-40	X			
BP p.l.c.	BP Vanellus Max Drain Eco	10W-40			X	
	BP Vanellus Max Eco	10W-40			X	
Cepsa	Cepsa Eurotech LS	10W-40			X	
Chevron Lubricants	Caltex Delo XLE Multigrade	10W-40	X			
	Delo 400 LE Synthetic	5W-30	X			
	Texaco Ursa Premium TDX (E4)	10W-40			X	
	Texaco Ursa Ultra	10W-40	X			
	Texaco Ursa Ultra X	10W-30	X			
	Texaco Ursa Ultra X	10W-40	X			
	Ursa Ultra XLE	5W-30	X			
De Oliebron B.V.	Tor turbosynth LSP Plus 10W-40	10W-40			X	
ENOC International Sales L.L.C.	Vulkan green	10W-40	X			
Exxon Mobil Corporation	Mobil Delvac 1 LE	5W-30	X			
	Mobil Delvac XHP LE	10W-40			X	
	Mobil Delvac XHP Ultra LE 5W-30	5W-30	X			
Fuchs	Titan Cargo Maxx	5W-30		X		
	Titan Cargo Maxx	10W-40	X			
Gulf Oil International	Gulf Superfleet XLE	10W-40	X			
	Gulf Superfleet Synth XLE	10W-30		X		
	Gulf Superfleet Synth XLE	10W-40		X		
Huiles Berliet S.A.	RTO Extensia FP	10W-40	X			
Igol	Protruck 200 X	10W-40	X			
INA Rfinerija nafte Rjeka	INA Super 9000	10W-40			X	
Kuwait Petroleum R&T	Q T 900	10W-40	X			
	Q8 905	10W-40	X			
	Q8 T 904	10W-40		X		

Manufacturer	Brand name	SAE viscosity class	TBN			Remarks
			8-10mgKOH/g	10-12 mgKOH/g	>12 mgKOH/g	
	Q8 T 905	10W-40	X			
	Q8 T 910	5W-30	X			
LLK Finland Oy	Teboil Super XLD-2	5W-30			X	
Meguin	megol Motorenöl UHPD Low Saps	5W-30			X	
Morris Lubricants	Ring Free Ultra	10W-40		X		
Oel Brack AG	Midland maxtra	10W-40		X		
OMV Refining & Marketing GmbH	OMV truck blue ET	5W-30	X			
	OMV truck blue ET	10W-40	X			
OOO LLK International	Lukoil Avantgarde Professional LS	10W-40			X	
Orlen Oil	Platinum Ultor Progress	10W-40		X		
Panolin	Panolin Diesel Synth EU-4	10W-40	X			
Petróleos de Portugal	Galp Galaxia Ultra LS	10W-40	X			
Petronas Lubricants International	Duron UHP 10W-40	10W-40	X			
	Petronas Urania Ecotech	10W-40			X	
	Petronas Urania FE LS	5W-30			X	
PHI OIL GmbH	Motodor LSP Gold 5W30	5W-30			X	
Prista Oil AD	Prista UHPD	10W-40	X			
Repsol YPF y Especialidades S.A.	Repsol Diesel Turbo UHPD Mid Saps	10W-40	X			
	Repsol Diesel Turbo VHPD Mid Saps	5W-30				
Shell	Shell Rimula R6 LM	10W-40	X			
SK energy	ZIC XQ 5000	10W-40	X			
SRS Schmierstoff Vertrieb GmbH	SRS Cargolub Leichtlauf Motorenöl LA	10W-40		X		
	SRS Cargolub TLA	10W-40		X		
	SRS Cargolub TLS	5W-30			X	
	SRS Cargolub TLS plus	5W-30				
	SRS Turbo Diesel LA	10W-40	X			
Statoil Lubricants	MaxWay Ultra E6 10W-40	10W-40			X	
Total	Total Rubia TIR 8900	10W-40	X			
	Total Rubia Works 2500	10W-40	X			
Transnational Blender B.V.	Engine Oil Synthetic UHPD E6	10W-30		X		
	Engine Oil Synthetic UHPD E6	10W-40		X		
	Motor Oil SCR	10W-40	X			
Valvoline	Valvoline ProFleet LS	5W-30			X	
	Valvoline ProFleet LS	10W-40			X	
Wibo Schmierstoffe GmbH	Wibokraft Ultra AF 10W40	10W-40		X		
Yacco SAS	Yacco Transpo 65	10W-40			X	

7.3 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

Lubricant class 16Q

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

7.4 Fluids and lubricants for Voith transmissions T 211.re.4 + KB190

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

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

Manufacturer	Product name	Index	Suitable for low temperatures ⁴⁾ down to
Addinol	SGL 18	1	-25 °C
ARAL	ARAL Degol BG 32		-20 °C
BP	BP Energol HL-XP 32	2	-25 °C
Caltex	Torque Fluid 32	2	-25 °C
Castrol	Castrol Hyspin HL-XP 32	2	-25 °C
Chevron Texaco	Textran V 32	2	-25 °C
Exxon Mobil	Mobilfluid 125	2	-20 °C
Fuchs-Europe	Renofluid TF 1500	1	-20 °C
Maziva Zagreb	INA Fluid V 32	2	-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	SRS Wiolan HF 32 synth	3	-40 °C
Total	Total Azolla VTR 32	1	-20 °C

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. Minimum oil sump temperature as of which the turbo transmission can be started and operated.
Any other constraints applicable to specific applications are specified in the Operating Instructions.
Special measures must be taken if temperatures are lower. Contact Voith for details.

7.5 Approved Coolants

7.5.1 Corrosion-inhibiting antifreeze concentrates

For details and special information, see chapter on “Coolants”(→ Page 12).

Silicated concentrates

Manufacturer	Brand name	OAT			Runtime Hours / Years	Comments / Material no.
		Containing nitrite	Containing silicon	Containing phosphate		
MTU Friedrichshafen	Coolant AH100		X		9000 / 5	X00057231 (20 liters) X00057230 (210 liters)
MTU America	Power Cool Universal		X		9000 / 5	800070 (5 gallons)
Avia Mineralöl-AG	Antifreeze APN		X		9000 / 5	
BASF AG	Glysantin G 40	X	X		9000 / 3	X00066724 (20 liters) X00066725 (210 liters)
	Glysantin G 48		X		9000 / 5	X00058054 (25 liters) X00058053 (210 liters)
Bucher AG Langenthal	Motorex Coolant G48 concentrate		X		9000 / 5	
BP	Aral Antifreeze Extra		X		9000 / 5	
Castrol Ltd.	Castrol Antifreeze NF		X		9000 / 5	
	Castrol Radicool NF		X		9000 / 5	
Clariant mbH	Genantin Super	X	X		9000 / 3	
Classic Schmierstoff GmbH	Classic Kolda UE G48		X		9000 / 5	
Comma Oils & Chemicals	Comma Xstream G48		X		9000 / 5	
ExxonMobil	Mobil Antifreeze Extra		X		9000 / 5	
	Esso Antifreeze Extra		X		9000 / 5	
Fuchs Petrolub SE	Maintain Fricofin		X		9000 / 5	
Ginouves Georges S.A.	York 716		X		9000 / 5	
Kemetyl	Carix Premium G48		X		9000 / 5	
Krafft S.A.	Krafft Refrigerante ACU 2300	X	X		9000 / 3	X00058075 (barrel)
INA Maziva Ltd.	INA Antifiz AI Super		X		9000 / 5	
MOL-LUB Ltd.	EVOX Extra G48 Antifreeze concentrate		X		9000 / 5	
Nalco Australia	Nalcool NF 48		X		9000 / 5	
OMV	OMV Coolant Plus		X			

Manufacturer	Brand name	OAT	Containing nitrite	Containing silicon	Containing phosphate	Runtime Hours / Years	Comments / Material no.
Sotragal - Mont Blanc	Antigel Power Cooling Concentrate			X		9000 / 5	
Valvoline	Zerex G 40	X		X		9000 / 3	
Valvoline	Zerex G 48			X		9000 / 5	
Total	Glacelf MDX			X		9000 / 5	

Unsilicated concentrates

Manufacturer	Brand name	OAT	Containing nitrite	Containing molybdate	Containing phosphate	Runtime Hours / Years	Comments / Material no.
BASF	Glysantin G 30	X				9000 / 3	X00058072 (canister) X00058071 (barrel)
BP Lubricants	Castrol Heavy Duty Extended Life Coolant	X		X		9000 / 3	
CCI Corporation	L 415	X		X		9000 / 3	
CCI Manufacturing IL Corporation	C 521	X		X		9000 / 3	
Comma Oil & Chemicals	Comma Xstream G 30	X				9000 / 3	
Detroit Diesel Corp.	Power Cool Plus Coolant	X		X		9000 / 3	
ExxonMobil	Esso Antifreeze Advanced	X				9000 / 3	
	Mobil Antifreeze Advanced	X				9000 / 3	
	Mobil Delvac Extended Life Coolant	X		X		9000 / 3	
Fuchs Petrolub SE	Maintain Fricofin G 12 Plus	X				9000 / 3	X00058074 (canister) X00058073 (barrel)
Old World Industries	Blue Mountain Heavy Duty Extended Life Coolant	X		X		9000 / 3	
	Final Charge Global Extended Life Coolant	X		X		9000 / 3	
OMV	OMV Coolant SF	X				9000 / 3	
Ravensberger Schmierstoffvertrieb GmbH	RAVENOL Kühlerfrostschutz silikatfrei	X				9000 / 3	
Valvoline	Zerex G-30	X				9000 / 3	

7.5.2 Corrosion-inhibiting antifreeze – Ready mixtures

For details and special information, see chapter on “Coolants”(→ Page 12).

Silicated ready mixtures

Manufacturer	Brand name	OAT			Runtime Hours / Years	Comments / Material no..
		Containing nitrite	Containing silicon	Containing phosphate		
MTU America	Power Cool Universal (50/50)		X		9000 / 5	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)
Bucher AG Langenthal	Motorex Coolant G 48 ready to use (50/50)		X		9000 / 5	
Castrol Ltd.	Castrol Antifreeze NF Premix (45%)		X		9000 / 5	
	Castrol Radicool NF Premix (50/50)		X		9000 / 5	
Hermann Bantleon GmbH	Avilub Antifreeze Mix (50%)		X		9000 / 5	X00049213 (210 liters)
Sotragal – Mont Blanc	L.R. Power Cooling (44%)		X		9000 / 5	
	L.R. Power Cooling (52%)		X		9000 / 5	
Tosol-Sintez	Glystantin Protect Plus/ G48 ready Mix		X		9000 / 5	
Total	Coolelf MDX		X		9000 / 5	

Unsilicated ready mixtures

Manufacturer	Brand name	OAT			Runtime Hours / Years	Comments / Material no.
		Containing nitrite	Containing molybdate	Containing phosphate		
BP Lubricants	Castrol Heavy Duty Extended Life Prediluted Coolant (50/50)	X	X		9000 / 3	
Detroit Diesel Corp.	Power Cool Plus Prediluted Coolant (50/50)	X	X		9000 / 3	
CCI Corporation	L 415 (50%)	X	X		9000 / 3	
CCI Manufacturing IL Corporation	C 521 (50%)	X	X		9000 / 3	
ExxonMobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X	X		9000 / 3	

Manufacturer	Brand name	OAT	Containing nitrite	Containing molybdate	Containing phosphate	Runtime Hours / Years	Comments / Material no.
Old World Industries	Final Charge Global 50/50 Prediluted Extended Life Coolant	X	X	X	X	9000 / 3	
Old World Industries	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X	X	X	X	9000 / 3	
Tosol-Sintez	Glysantin Alu Protect G30 Ready Mix	X				9000 / 3	

8 Preservation / Depreservation

8.1 Preservation, re-preservation and de-preservation of PowerPacks®

Note

For information on preservation, re-preservation and de-preservation of PowerPacks® refer to the Preservation and Re-preservation Specifications, MTU publication No. A001070/.. .

9 Flushing and Cleaning Specifications for Engine Coolant Circuits

9.1 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-Friedrichshafen GmbH or corresponding products (→ Page 34) 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 the current MTU Fluids and Lubricants Specifications (→ Page 12). Otherwise there is a danger of corrosion!



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.



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

Test equipment, auxiliary materials and fluids and lubricants

MTU test kit or electric pH value measuring instrument

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

9.2 Approved cleaning agents

Manufacturer	Product name	Concentration for use		Order no.
For coolant systems:				
Kluthe	Hakutex 111 ^{1, 8)}	2% by volume	Liquid	X00065751
	Hakupur 50-706-3 ⁸⁾	2% by volume	Liquid	X00055629
Nalco	Maxi Clean 2 ^{1, 8)}	2% by volume	Liquid	⁷⁾
For assemblies:				
Henkel	P3-FD ²⁾	3 to 5% by weight	Powder	⁷⁾
	Porodox ³⁾	5 to 10% by weight	Powder	⁷⁾
Kluthe	Hakutex 60	100% by volume	Liquid	X00056750 (25kg)
For coolant systems contaminated with bacteria, fungi or yeast (so-called system cleaners):				
Schülke & Mayr GmbH	Grotan WS Plus ⁵⁾	0.15% by volume	Liquid	X00065326 (10kg)
	Grotanol SR1 ⁶⁾	1% by volume	Liquid	X00057297 (10kg) X00057298 (200kg)
Troy Chemical Company	Troyshield SC1 ⁶⁾	1% by volume	Liquid	⁷⁾

¹⁾ For light lime deposits, light corrosion

²⁾ For greasy lime deposits

³⁾ Preferred for heavy lime deposits

⁴⁾ For heavy lime deposits

⁵⁾ Bacteria contamination up to 10^4

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

⁷⁾ Not stocked by MTU

⁸⁾ Not suitable for galvanized surfaces

9.3 Engine coolant circuits - Flushing

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



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 (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 36). The assemblies may also have to be cleaned, see (→ Page 37).



Refer to the engine Operating Instructions for additional information.

9.4 Engine coolant circuits – Cleaning

1. Detergent for coolant circuits is prepared in warm, fresh water as a concentrated solution, see (→ Page 34).
2. In the case of powdered products, stir until the detergent is completely dissolved and without sediment.
3. Pour solution together with fresh water into coolant circuit.
4. Start engine and run until warm.
5. Run engine for approx. 2 hours at increased speed.
6. Shut down engine.
7. Drain off cleaning agents and flush the engine coolant circuit with fresh water.
8. Take flush-water sample (engine-coolant-sample extraction cock).
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: Clean assemblies, see (→ Page 37).



Refer to the engine Operating Instructions for additional information.

9.5 Cleaning assemblies

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, intercooler, 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 intercoolers 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, 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 34)



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.



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 35).
12. Check coolant system for leaks during initial operation of engine.



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

9.6 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 34). Use a circulating pump to provide continuous mixture flow through the coolant system for at least 24 hours.

Flushing

After draining the coolant/system cleaner mixture, the coolant circuit must be flushed with fresh water as long as visible contamination can be detected and until the flush water has the pH-value of the fresh water (maximum deviation of the pH-values: < 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!

10 Overview of Changes

10.1 Revision history



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

Revisions

NONE, first issue.

11 Appendix

11.1 Index

A

- Applicability of the publication 4
- Approved cleaning agents 34
- Approved fluids and lubricants
 - Category 3 engine oils 21
 - Category 3.1 engine oils (low SAPS) 24
 - Corrosion-inhibiting antifreeze 28, 30

B

- Biocides 20

C

- Cleaning assemblies 37
- Coolant 12
 - Concentrates 16
 - Fresh water requirements 14
 - Operational monitoring 15
 - Treatment 14
- Corrosion-inhibiting antifreeze
 - Concentrates, silicated 28
 - Concentrates, unsilicated 28
 - Ready mixtures, silicated 30
 - Ready mixtures, unsilicated 30

D

- Diesel fuel see fuel 17
- Distillate fuel 17

E

- Engine oils
 - Category 3 21
 - Category 3.1 (low SAPS) 24
 - Change intervals 6
 - Requirements 6
 - Viscosity grades 7
- Engine preservation 4

F

- Flow improvers 17
- Fluids and lubricants for Voith transmissions 27
- Fluids and lubricants for ZF transmissions 26
- Flushing and cleaning specifications for engine coolant circuits
 - Approved cleaning agents 34
 - Cleaning assemblies 37
 - Coolant circuits contaminated with bacteria, fungi or yeast 38
 - Engine coolant circuits
 - Cleaning 36
 - Flushing 35
 - General information 33

Fuel

- Limit values 17
- Microorganisms 20
- NOx reducing agent 19

H

- Hydraulic system 11

I

- Information on use 4

L

- Low SAPS oils
 - Category 3.1 24

M

- Microorganisms in fuel 20

N

- NOx reducing agent AUS 32 for SCR after-treatment systems 19

O

- Oil change intervals 6
- Operational monitoring 15

P

- Power transmission oils for Voith turbo transmission T211 + KB 190 10
- Preservation, re-preservation and de-preservation of PowerPacks® 32

R

- Revision history 39

S

- SCR after-treatment systems 19
- Storage capability of coolant concentrates 16

T

- Transmission oils for rail vehicles with ZF transmission 8

V

- Viscosity grades 7