



Fluids and Lubricants Specifications

mtu Hybrid PropulsionPack

A001091/00E



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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 Rolls-Royce Solutions.



These Fluids and Lubricants Specifications contain specific information for Marine Hybrid Systems only. For all other information refer to the supplied Fluids and Lubricants Specifications (→ A001061/xx).

Symbols and presentation

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 material damage or destruction.

Note:

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

Fluids and lubricants

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

mtu ValueCare Portfolio

With mtu ValueCare, Rolls-Royce Solutions offers oils approved and tuned to the engine.

Test standards for fluids and lubricants

Test standard	Designation
DIN	Deutsches Institut für Normung (Federal German Standards Institute)
EN	Europäische Normung (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:

Monitoring of fluids and lubricants

The maintenance of fluids and lubricants includes regular monitoring. Relevant information on how samples should be taken and handled can be found in the Customer Information "Taking and handling samples for laboratory analyses" (→ A001080/xx). The most recent version can be retrieved from:

<http://www.mtu-solutions.com>

Your contact will be happy to help you with any inquiries.

Applicability of this publication

These Fluids and Lubricants Specifications will be amended or supplemented as necessary. Prior to operation, make sure that the latest version is used. The most recent version can be retrieved from:

<http://www.mtu-solutions.com>

Your contact will be happy to help you with any inquiries.

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 hazardous materials. Certain regulations must be observed when handling, storing, and disposing of these substances.

These regulations are contained in the manufacturers' instructions, such as product-specific safety data sheets, 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 applicable regulations. Rolls-Royce Solutions accepts no liability whatsoever for improper or illegal use of the fluids and lubricants which it has approved.

Preservation

All information on preservation, reprereservation, and depreservation including the approved preservatives is available in the Preservation and Reprereservation Specifications (→ A001070/xx). The most recent version can be retrieved from:

<http://www.mtu-solutions.com>

2 Approved Coolants

2.1 Series- and application-based usability of coolant additives

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

For details and special features, see "General" (→ Fluids and Lubricants Specifications A001061/xx) and "Unsuitable materials in the coolant circuit" (→ Fluids and Lubricants Specifications A001061/xx) in the chapter "Coolants".

Important

- In the case of an engine coolant circuit with no light metal elements but with add-on components containing light metal (e.g. external cooling system), the coolant approvals for cooling systems containing light metal shall apply. If you have any doubts about a coolant application, consult your contact at Rolls-Royce Solutions.
- The maximum admissible antifreeze content for Series 2000, model types 00 to 07 in marine applications is limited to 40% by volume.

Any deviant special agreements between the customer and Rolls-Royce Solutions GmbH remain valid.

Series	Application	Cooling system containing light metals	Coolant without anti-freeze	Antifreeze			Remarks
				See section (→ Page 8)	See section (→ Page 9)	See (→ Fluids and Lubricants Specifications A001061/xx)	
						Chapter 8.9.1	
2000 (incl. model type 07)	Marine	Yes	X	X ^{11, 12)}	X ^{11, 12)}	–	¹¹⁾ not permitted at seawater temperature > 25 °C if a heat exchanger is installed on the engine ¹²⁾ max. admissible antifreeze content limited to 40% by volume.
4000-03	Marine	No	–	X	X ¹⁷⁾	X ¹⁷⁾	X ¹⁷⁾ not permitted at seawater temperature > 25 °C if a heat exchanger is installed on the engine.
4000-04 4000-05	Marine	No	–	X	X ^{22, 23)}	X ²²⁾	²²⁾ not permitted at seawater temperature > 25 °C if a heat exchanger is installed on the engine. ²³⁾ for products, see information (→ Fluids and Lubricants Specifications A001061/xx) in chapter 8.6

Table 2: mtu four-stroke cycle engines

X = approved

– = not approved

2.2 Coolants without antifreeze for cooling systems containing light metal

2.2.1 Coolant without antifreeze – Concentrates for cooling systems containing light metal

For details and special features, see chapter “Coolants” (→ Fluids and Lubricants Specifications A001061/xx).

Nitrite-free coolants without antifreeze – concentrates

Manufacturer	Product/Brand name	Inhibitors						Runtime Hours/Years	Comments/ Material number	
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates			2-EHS
Rolls-Royce Solutions America Inc.	Power Cool® Plus 6000 Concentrate		X					X	6000 / 2	Colored green 23533526 (1 gallon) 23533527 (5 gallons) Available from Rolls-Royce Solutions America Inc.
BASF SE	Glysacorr G93 green		X					X	6000 / 2	X00054105 (barrel) X00058062 (canister)
CCI Corporation	A 216	X				X			6000 / 2	
CCI Manufacturing IL Corporation	A 216	X				X			6000 / 2	X00051509 (208 l)
Detroit Diesel Corp.	Power Cool Plus 6000	X				X			6000 / 2	Colored red
Drew Marine	Drewgard XTA		X					X	6000 / 2	
ExxonMobil	Mobil Delvac Extended Life Corrosion Inhibitor	X				X			6000 / 2	
Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	X				X			6000 / 2	
Valvoline	ZEREX G-93		X					X	6000 / 2	
	OEM Advanced 93		X					X	6000 / 2	
YORK SAS	York 719		X					X	6000 / 2	

Table 3: Nitrite-free coolants without antifreeze – concentrates

2.3 Antifreezes for cooling systems containing light metal

2.3.1 Antifreeze – Concentrates for cooling systems containing light metal

For details and special features, see chapter “Coolants” (→ Fluids and Lubricants Specifications A001061/xx)

Nitrite-free antifreeze – concentrates

Manufacturer	Product/Brand name	Inhibitors						Runtime Hours/ Years	Comments/material number
		Organic	Silicon	2-EHS	Borate	Phosphate	Molybdate		
Alliance Automotive Service GmbH	NAPA Premium Kühlerschutz N48	X	X	X	X			9000 / 5	
Avia AG	Antifreeze APN	X	X	X	X			9000 / 5	
	Antifreeze APN - S	X						9000 / 3	
BASF SE	Glysantin® G48 blue green	X	X	X	X			9000 / 5	X00058054 (25 l) X00058053 (210 l)
	Glysantin® G30 pink	X						9000 / 3	X00058072 (canister) X00058071 (barrel)
	Glysantin G30 ECO pink BMB 100	X						9000 / 3	
	Glysantin®G40 pink (concentrate)	X	X					9000 / 3	X00066724 (20 l) X00066725 (210 l)
	Glysantin G40 ECO pink BMB 100	X	X					9000 / 3	
BayWa AG	Tectrol Coolprotect	X	X	X	X			9000 / 5	
BP Lubricants	Aral Antifreeze Extra	X	X	X	X			9000 / 5	
Castrol	Castrol Radicool NF	X	X	X	X			9000 / 5	
CCI Corporation	L 415	X					X	9000 / 3	
COPARTS Autoteile GmbH	CAR 1 Premium Longlife Kühlerschutz C48	X	X	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	
Drew Marine	Drewgard ZX	X						9000 / 3	
ExxonMobil	Mobil Delvac Extended Life Coolant	X					X	9000 / 3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X						9000 / 3	
	AVIATICON Finkofreeze F40	X	X					9000 / 3	
	AVIATICON Finkofreeze F48	X	X	X	X			9000 / 5	
Fuchs Petrolub SE	Maintain Fricofin G12 Plus	X						9000 / 3	X00058074 (canister) X00058073 (barrel)

Manufacturer	Product/Brand name	Inhibitors						Runtime Hours/ Years	Comments/material number
		Organic	Silicon	2-EHS	Borate	Phosphate	Molybdate		
Kuttenkeuler GmbH	Kuttenkeuler Antifreeze ANF KK48	X	X	X	X			9000 / 5	
	Glycostar® ST48	X	X	X	X			9000 / 5	
LAEMMLE Chemicals AG	Roxor Anti-Frost MT-325	X	X	X	X			9000 / 5	
Mitán Mineralöl GmbH	Alpine C30	X						9000 / 3	
	Alpine C48	X	X	X	X			9000 / 5	
MJL Bangladesh Ltd.	Omera Premium Coolant	X						9000 / 3	
MOFIN Deutschland GmbH & Co KG	MOFIN Kühlerschutz M48 Premium Protect	X	X	X	X			9000 / 5	
	MOFIN Kühlerschutz M40 Extra	X	X					9000 / 3	
Motorex AG	Motorex Coolant G48	X	X	X	X			9000 / 5	
	Motorex Coolant M4.0 Extra	X	X					9000 / 3	
Nalco Water An Eco-lab Company	Nalcool NF 48 C	X	X	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 MT-325	X	X	X	X			9000 / 5	
Penske Power Systems	Power Cool - HB500 Coolant Concentrate	X	X		X			9000 / 3	
Puma Energy International S.A.	Puma HD Hybrid Coolant	X	X					9000 / 3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Concentrate	X	X	X	X			9000 / 5	
Recochem Inc.	HD Expert™ Endurance	X					X	9000 / 3	
	R542	X	X		X			9000 / 3	
Total Lubrificants	Glacelf MDX	X	X	X	X			9000 / 5	

Manufacturer	Product/Brand name	Inhibitors						Runtime Hours/ Years	Comments/material number
		Organic	Silicon	2-EHS	Borate	Phosphate	Molybdate		
Valvoline	Zerex G-48	X	X	X	X			9000 / 5	
	Zerex G40	X	X					9000 / 3	Material number (USA): 800180 (Drum)
	Zerex G-30	X						9000 / 3	
	OEM Advanced 30	X						9000 / 3	
	OEM Advanced 40	X	X					9000 / 3	
	OEM Advanced 48	X	X	X	X			9000 / 5	
Volvo Trucks	Road Choice Nitrite-Free OAT Extended Life Coolant	X					X	9000 / 3	

Table 4: Nitrite-free antifreeze – concentrates

2.3.2 Antifreeze – Ready mixtures for cooling systems containing light metals

For details and special features, see chapter “Coolants” (→ Fluids and Lubricants Specifications A001061/xx)

Nitrite-free ready mixtures for cooling systems containing light metals

Manufacturer	Product/Brand name	Inhibitors						Runtime Hours/ Years	Comments/material number
		Organic	Silicon	2-EHS	Borate	Phosphate	Molybdate		
Rolls-Royce Solutions America Inc.	Power Cool®Universal 35/65 mix	X	X	X	X			9000 / 5	800085 (5 gallons) 800086 (55 gallons)
A. Roth GmbH & Co. KG	CRO Coolant Plus -26 °C Ready	X						9000 / 3	
BayWa AG	Tectrol Coolprotect Mix 3000	X						9000 / 3	Antifreeze protection down to -24 °C
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30 RM 40:60 +	X						9000 / 3	
Penske Power Systems	Power Cool – HB 500 Premix 35/65	X						9000 / 3	
Recochem	R542 35/65	X	X					9000 / 3	
Total Lubrifiants	Coolelf MDX -26 °C	X	X					9000 / 5	

Table 5: Nitrite-free ready mixtures for cooling systems containing light metals

3 Liquid Fuels

3.1 Diesel fuels – General information

Important

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

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.

Important

Diesel fuels are not available worldwide in the required quality according to the table (→ Page 14).
The fuel properties depend on many factors, in particular, region, time of year, and storage.

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

Operating companies must verify approval for use of these fuels in accordance with regional, national, or local regulations.

Fuel suppliers must always ensure that their fuels comply with the relevant requirements and are suitable for the intended purpose. They are also responsible for using additives that guarantee proper engine performance and function.

3.2 Fuel specifications to be complied with

Fuel specifications

		Test methods		Limit values
		ASTM		
Composition				The diesel fuel must be free of inorganic acids, visible water, solid foreign matter, and chlorine compounds.
Total contamination (= fuel-insoluble ingredients)	Max.	D6217	EN 12662	24 mg/kg
Spec. grav. at 15 °C	Min. Max.	D1298 D4052	EN ISO 3675 EN ISO 12185	0.820 g/ml 0.850 g/ml
Viscosity at 40 °C	Min. Max.	D445	EN ISO 3104	1.7 mm ² /s 4.5 mm ² /s
Flashpoint (closed crucible)	Greater	D93	DIN EN ISO 2719	60 °C for SOLAS ¹⁾
Boiling curve:		D86	EN 17306	
– Initial boiling point				160 to 220 °C
Recovery at 250 °C	Max.			65% by volume
– Volume share 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
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:	Max.	D482	EN ISO 6245	10 mg/kg
Sulfur content:	Max.	D5453 D2622	EN ISO 20846 EN ISO 20884	15 mg/kg
Cetane number	Min.	D613	EN ISO 5165 EN ISO 15195	45
Cetane index	Min.	D976	EN ISO 4264	42
Corrosion effect on copper. 3 hrs. at 50 °C	Max. degree of corrosion	D130	EN ISO 2160	1a
Oxidation stability (Rancimat) ²⁾	Min.		EN 15751	20 hours
Oxidation stability ³⁾	Max.	D2274	EN ISO 12205	25 g/m ³

		Test methods		Limit values
		ASTM		
Lubricity at 60 °C (HFRR value)	Max.	D6079	EN ISO 12156-1	450 µm
Neutralization number	Max.	D974		0.2 mgKOH/g
Polycyclic aromatic hydrocarbons	Max.		EN 12916	10% by weight
Particle distribution for fuel between last tank before engine and prefilter	Max.	D7619 D7647	Coding of number of particles as per ISO 4406	ISO code 18/17/14 for 4/6/14 µm particle size

Table 6: Fuel specifications

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

2) = Relevant for diesel fuel with a FAME content of ≥ 2% by volume.

3) = Relevant for diesel fuel with a FAME content of < 2% by volume.

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 in the table (→ Table 6) at the interface marked in Fig. 1 item 6 (→ Figure 1) at the latest.

Important

The limit values named in the (→ Fluids and Lubricants Specifications A001091/xx) must already be observed in the feed between the last tank before the engine and the prefilter (if necessary, with water separator).

For plants without a prefilter, this refers to the feed between the last tank and the scope of supply of Rolls-Royce Solutions. 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 Rolls-Royce Solutions is permissible.

General fuel system diagram for diesel engines

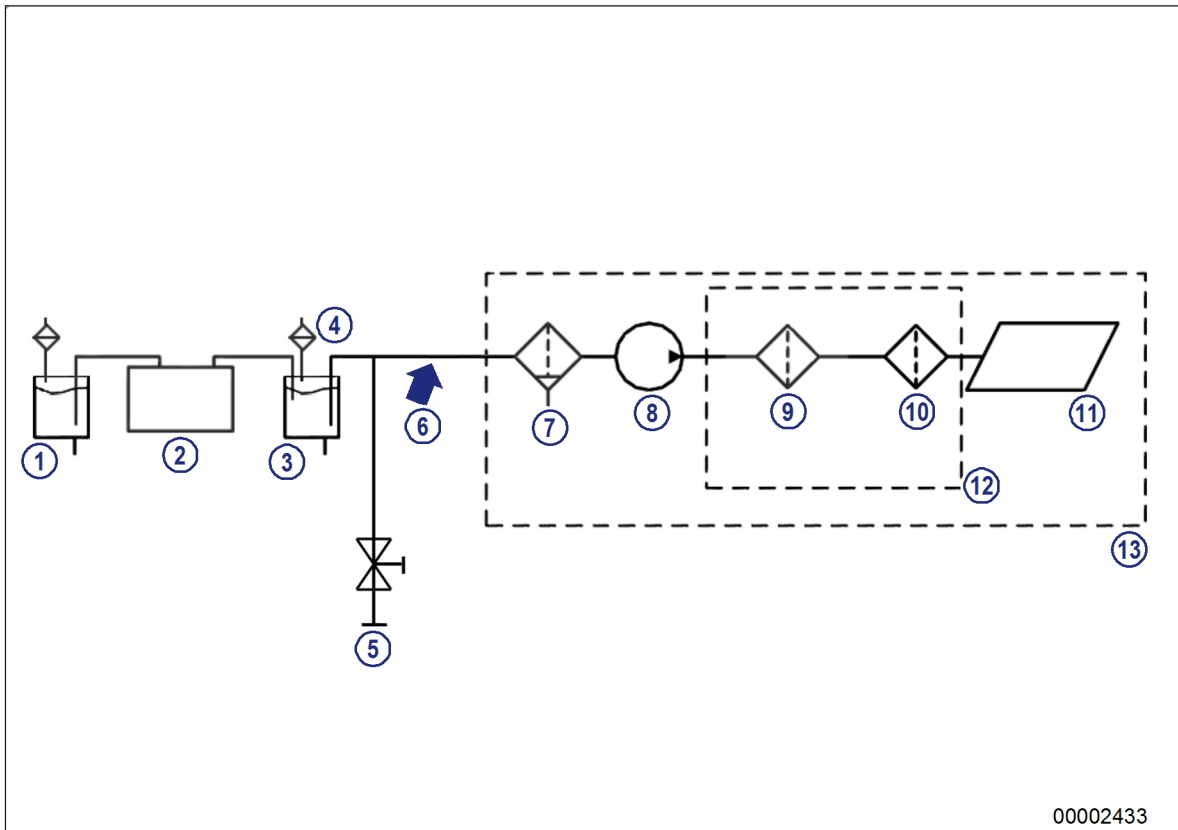


Figure 1: Fuel system diagram for diesel engines

- | | | |
|---------------------------|--|---------------------------|
| 1 Fuel tank | 6 Interface for fuel specification | 11 Injection system |
| 2 Fuel treatment (option) | 7 Fuel prefilter with water separator (option) | 12 Engine filter |
| 3 Last tank before engine | 8 LP fuel pump | 13 Engine scope of supply |
| 4 Tank breather filter | 9 Intermediate filter (option) | |
| 5 Sampling point | 10 Primary filter | |

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.

It has been validated that prefilters approved by Rolls-Royce Solutions provide sufficient filtration for the limit values named for this interface.

Warranty provided by Rolls-Royce Solutions shall not cover damage and harm to engines due to the use of fuel grades not approved by Rolls-Royce Solutions according to the table listed in this chapter as well as chapter "Series-dependent approval of fuel grades for mtu engines" in the (→ Fluids and Lubricants Specifications A001061/xx).

Diesel fuels in winter operation

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

In order to prevent operational problems (e.g. clogged filters) during the winter months, diesel fuel with suitable cold-flow characteristics is available on the market. Deviations are possible during transitional periods and in individual countries.

The following parameters define the cold-flow characteristics:

	Test methods		Limit values
	ASTM		
Cold filter plugging point (CFPP)	D6371	DIN EN 116	See Note ¹⁾
Cloud point	D2500	DIN EN 3015	See Note ²⁾

Table 7: Parameters to define the cold-flow characteristics

¹⁾ Filter plugging point or Cold Filter Plugging Point (CFPP) denotes the temperature at which a test filter is blocked under defined conditions by precipitated paraffins. This characteristic is used for diesel fuels as per DIN EN 590 to describe the climatic requirements (e.g. summer and winter diesel). As a rule, however, the fuel filters installed on the engine have a significantly higher filtration efficiency than the test filters.

²⁾ 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.

Rolls-Royce Solutions GmbH recommends the use of the cloud point for the evaluation of the cold-flow characteristics.

Diesel fuels for engines with exhaust gas aftertreatment (EGAT)

Engines with exhaust gas aftertreatment place special demands on the fuels used to guarantee the operational reliability and service life of the exhaust system and the engine.

If the specifications in the table (→ Table 6) are not observed, the specified TBO cannot be guaranteed. Warranty cases that result from the use of an impermissible fuel quality shall be rejected. Any possible restrictions related to engine requirements must also be observed.

Important

Commercially available diesel fuels normally contain considerably less ash-forming agents than those certified by the relevant standards (typical ash content max. 0.001% = 10 mg/kg). The particulate filters are designed for these low loads accordingly because the exhaust system would otherwise be completely overdimensioned. The maximum ash content in fuel specified by Rolls-Royce Solutions has been defined to ensure that the particulate filter reaches the assured service life without the back pressure of the filter becoming too high for the engine.

Important

The use of fuel additives for minimizing wear is not permitted on plants with exhaust gas aftertreatment.

Supplementary fuel additives

The engines are designed such that satisfactory operation with normal, commercially available diesel 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.

Microorganisms in fuel

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

The biocides approved by Rolls-Royce Solutions can be found in the chapter on supplementary fuel additives in the (→ Fluids and Lubricants Specifications A001061/xx).

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 and the exhaust gas aftertreatment system. The use of halogenated biocides is prohibited due to their effects on the engine system and the environment.

Biocides that contain neither inorganic nor halogenated substances may be used for engine systems with exhaust gas aftertreatment.

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

3.3 Approval of fuel grades

The approvals are valid for the engine series listed below, including SCR (selected catalytic reduction):

- Rolls-Royce Solutions: 2000Mx7, 4000Mx3, 4000Mx5
- Volvo Penta: all Volvo Penta Marine commercial diesel engines
- John Deere: Power Tech E Models with 6.8 l or 9.0 l

Approvals include distillate fuels according to:

- EN 590 Summer and Winter grade and
- fossil diesel of ASTM D975 grade 1 and grade 2, each S15, S500.

Provided they meet the fuel specifications to be complied with from table (→ Page 14).

4 Approved Engine Oils and Lubricating Greases

4.1 Series- and application-based usability of engine oils

Note: Coupling mtu engines with Zenoro/John Deere

1. Select an oil approved for the mtu engine from the Fluids and Lubricants Specifications A001061/xx.
 2. Refer to the product data sheet to check that the oil bears one of the following claims:
 - API Service Category: CI-4, CI-4 PLUS, CJ-4, CK-4
 - ACEA: E9, E7, E6, E4
 3. After checking the two specifications, the oil can be used for both the mtu and John Deere/Zenoro engine.
- > Multigrade oils are preferred.

Note: Coupling mtu engines with Volvo Penta/Mase genset

1. Select a category 2.1 or 3.1 oil approved for the mtu engine from the Fluids and Lubricants Specifications A001061/xx.
 2. Refer to the product data sheet to check that the oil also bears the Volvo claim VDS-4.5.
 3. After checking the two specifications, the oil can be used for both the mtu and Volvo Penta/Mase genset engine.
- > When combining Volvo Penta/Mase genset engines with mtu engines, the lubricant Vecton 15W-40 CK-4/E9 from Castrol Ltd. is permitted.

5 Appendix A

5.1 Index

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